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LIVESTOCK MANAGEMENT AND DAIRYING

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Intermediate Vocational Course

Paper I : Livestock Health Management

Paper II : Dairy Economics, Extension and Quality control of milk

Paper III : Milk Processing & Milk Products

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LIVESTOCK MANAGEMENT AND DAIRYING

Paper – I

Livestock Health Management

INDEX

Unit-1	**Signs of Health**	**1**
Unit-2	**Bacterial diseases**	**8**
Unit-3	**Viral diseases**	**34**
Unit-4	**Protozoan diseases**	**57**
Unit -5	**Helminthic and External Parasitic diseases**	**66**
Unit-6	**Mycotic diseases**	**79**
Unit -7	**Production and Systemic diseases**	**82**
Unit -8	**Diseases of New born**	**97**
Unit -9	**Reproductive disorders**	**101**
Unit -10	**Principles of disease control and prevention**	**120**
Unit -11	**First Aid**	**130**

UNIT 1

Signs of Health

Structure

1.1 Definitions of health and disease

1.2 Signs of health and ill health

1.3 Recording Body Temperature, Pulse and Respiration Rates

1.4 Normal values of body temperature, pulse and respiration rates

1.1 Definition of health and disease

Health

According to World Health Organization (WHO), Health may be defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". These components are interrelated. Social health also applies to animals.

Disease

Any deviation from normal, physical, physiological conditions is considered as disease or inability to perform the normal physiological functions though nutrition and other environmental factors are maintained at optimum level.

1.2 Signs of health and ill health

1.2.1 Signs of health

- Healthy animal looks alert and powerful.
- Eyes appear bright, wide, clear and with no excessive Discharges
- Normal eating (appetite) and drinking habits

- Coat is shiny and skin is glossy, thin and pliable.
- Muzzle is wet and moist.
- Gait of the animal is normal.
- Nostrils are clear with no nasal discharges.
- Physiological parameters like body temperature, pulse rate and respiratory rate are normal. Body temperature of the animal may be a good indicator of illness.
- Healthy bowel movement and consistency of dung is semi solid and dark green in colour.
- Colour of the urine is pale yellow.
- Animals stay in a group with normal behaviour and actively curious.

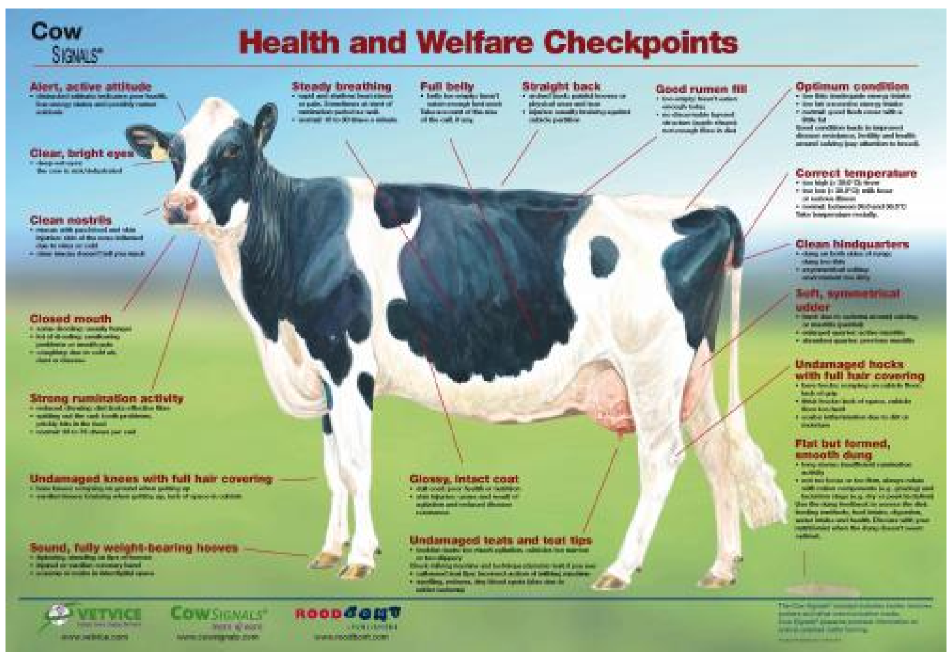

Fig.1.1 Signs of healthy animal

1.2.2 Signs of ill health

- Sunken eyes, dull or hopeless look in the eyes, lacrimation.
- Muzzle appears dry.
- Animal is dull and not looking around, disinterested in surroundings and disinterest in other animals.

- One of the most important signals of illness is lack of appetite that is manifested as off feed, not eating normally. Animal refuses to eat, chew cud and remains idle.

- Soiled tail, large amount of manure not just on the part of the tail that brushes over the anus and dribbled down the length of the tail.

- Skin stretched tight over bones. Dull and life less coat

Fig. 1.2 Ill health of Dairy Animal

- Very thin ribs and pelvis stand out.
- Refuses to suckle calf and reduced milk yield

- Consistency of dung and urine gets altered i.e loose and watery dung with mucous and blood.
- Depression is noted as drooping head and ears excessively slow movement, lagging behind the rest of the herds and reluctance to get up when approached.

- More discharges from nostrils, eyes and mouth are noticed in diseased animals.

- High body temperature, pulse rate and respiratory rate.

- Cough and difficulty breathing.

Differentiation between healthy and sick animal

Healthy Animals	**Sick Animals**
They have close contact although scattered will run towards each other to form a group.	Usually isolated and not running with the flock/herd.
Definite physical activity. They are usually eating, walking, playing, grooming or cuddling. They will always stretch after rising.	Immobile and not interested.
Farm animals tend to be greedy if they are well and always want food.	Ill animals have no/little appetite.
The excretion pattern is the same and the dung consistency matches the feed type. There is never any blood and the urine is a light colour.	Diarrhoea or the absence of dung or urine is a sure sign that there is something wrong.
The bovine coat is usually shiny and has lick marks on it. The sheep's fleece is tight and not matted and it should be springy.	A dull coat in a bovine is a bad sign. If sheep are ill, usually their wool breaks or falls out.
The eyes are clear, bright and alert. Eye sockets should be pinky.	Ill animals have sunken eyes and dull. Eyelids stop blinking. If eye sockets are pale/white, this usually means anaemia.
There are no abnormal discharges from the body.	Ill animals can have discharges from eyes, mouth, nose, navel, anus, vagina, teats, ears or penis.
Healthy animals walk well and in a straight line.	Ill animals can walk stiffly, wobble or go round in a circle. Creaking and swollen joints are signs of ill health.
The metabolic traits (pulse rate, breathing and heartbeat) are normal.	The metabolic traits are higher, lower than normal or are erratic.

1.3 Recording Body Temperature, Pulse and Respiration Rates

1.3.1 Temperature

The internal temperature of the body, as measured by the clinical thermometer, reflects the steady state existing between heat production and heat loss. In farm animals, rectal temperatures are recorded. A short blunt bulb clinical thermometer with range of 36 °C (97 °F) to 42.5°C (108° F) is used.

Procedure: The Procedure for taking the temperature of an animal is tofirst shake the mercury column in the thermometer down below the lowest point likely to be recorded. This is achieved by means of a wrist flicking action with the thermometer held between the thumb and first two fingers of the hand. The bulb end of the thermometer should then be lubricated with soap or petroleum jelly prior to being gently inserted with a rotatory action through the anal sphincter into the rectum. Care should be taken to ensure that the bulb of the thermometer is inserted to the same depth in each particular species of animal and also that it makes contact with the mucous membrane of the rectum. In order to obtain an accurate determination of the body temperature, the thermometer should be left for about two minutes. Whenever there is aatony of anal sphincter or the presence of large masses of faeces in paralysis of the rectum, in female animals, temperature can be recorded at vagina, where it is approximately 0.5 °C (1.0 °F) higher than in the rectum. When the temperature has been taken the thermometer should be wiped clean with a piece of cotton wool and then placed in a beaker containing disinfectant fluid.

1.3.2 Pulse Rate

Expansion and elongation of arterial wall imparted by the column of arterial blood due to contraction of left ventricle.

Procedure: The technique of taking the pulse consists of placing the ball part of one or more fingers on the skin over the coccygeal artery/facial artery at a point where it overlies bone and applying gentle pressure until the pulse wave can be detected. Where the artery is large and tends to roll away from beneath the finger tips, it may be helpful to place the tips of two or even three adjacent fingers on the artery parallel to its long axis. In the examination of the pulse, rate, rhythm and quality should be considered.

1.3.3 Respiratory Rate

The physical actions by means of which air is brought into and is expelled from the lungs, is termed as respiration.

Procedure: The clinician should stand behind and to one side of the animal, so that both the thoracic and abdominal areas of the body are in view. It is advisable to observe the animal from both sides, in order to determine whether the respiratory movements are bilaterally similar or divergent. In quiet animals, the rate of respiration may be determined by placing the back of hand near the nostril and hot gushes of expelled air can be felt and counted. The rate or frequency (number/minute), type, rhythm (regularity) and quality (amplitude or depth of the respiratory movements) should be considered.

1.4 Normal values of body temperature, pulse and respiration rates

Body temperature

Animal	**Range**
Cattle & Buffaloes	100-101° F
Sheep	102-103° F
Goat	102-103 °F
Pig	101-102° F
Horse	99 - 100° F

Pulse Rate: Number per minute

Animal	**Range**
Cattle	60-70
Buffalo	50-70
Sheep & Goat	70-90
Pig	60-90
Horse	30-40

Respiration Rate: Number per minute

Animal	Range
Cattle & Buffaloes:	10-30
Sheep :	20-30
Goat :	20-30
Pig :	8-18
Horse :	10-14

Short Answer Type Questions

1. What is health
2. Define Disease.
3. What is the normal body temperature of cattle, sheep and goat and pig
4. What is the normal pulse rate of cattle, buffalo, sheep and goat
5. What is the normal respiration rate in cattle, buffalo, sheep and goat

Long Answer Type Questions

1. What are the signs of health and ill health of animals
2. Mention the procedure of recording body temperature of dairy animals
3. Mention the procedure of recording pulse and respiration rate of dairy animals

UNIT 2

Bacterial Diseases

2.1 Classification of livestock diseases - Bacterial, Viral, Protozoal, Helminthic, Metabolic diseases etc.

Livestock diseases are classified in to the following categories based on the causative agents.

1. **Bacterial Diseases:** These diseases are caused due to the bacteria. Eg: Anthrax, Black quarter(BQ), Haemorrhagic Septicaemia(H.S), Brucellosis, vibriosis, Tuberculosis, Jhones disease, Leptospirosis, Listeriosis, Actinomycosis, Actinobacillosis, CBPP, CCPP, Tetanus, Enterotoxemia, colibacillosis, Swinne Erysipelas and Fowl cholera etc.

   A bacterium is a normal inhabitant and some times during stress, it proliferates and produces disease eg: Pasteurella causing Haemorrhagic Septicaemia(H.S).

2. **Viral Diseases:** These are the diseases caused by the viruses. Eg: Foot and Mouth, Rinderpest, Pox disease, Ephemeral fever, Rabies, Bluetongue, PPR, Contagious Ecthyma, Hog cholera, Ranikhet disease and Mareks disease
3. **Protozoan Diseases:** Diseases caused due to protozoa. The protozoa which are in blood and cause disease are called haemo- protozoans and the diseases are called haemo-protozoan diseases. Eg: Theilariasis, Babesiosis, Trypanosomiasis, Anaplasmosis, Coccidiosis, Balantidiosis, and Trichomoniasis etc.
4. **Helminthic Diseases:** Diseases caused by helminths are called helminthic diseases. Helminths are classified in to three types.
   i. Round worms or nematodes eg: Ascariasis, Strongylosis.

   ii. Flukes: Diseases caused by flukes. Eg: Schistosomiasis, Fasciolasis and Amphistomiasis.

iii. Tape worms: They cause disease like Moneiziasis in ruminants.

5. Mycotic diseases: Diseases caused by fungus are called Mycotic diseases. E.g. Ring worm and Aspergellosis etc.

6. Metabolic Diseases or Production Diseases: Earlier, diseases which were a result of metabolic derangement are called metabolic diseases. Presently all diseases which result because of imbalance between input and output are termed production diseases. Eg: Milk fever, Ketosis, Pregnancy toxaemia etc.

7. Deficiency Diseases: Diseases are due to deficiency of minerals and vitamins in the diet. Eg: Rickets, Hypo vitamin sis A.

2.2 Anthrax

It is also known as splenetic fever or carbon. Anthrax is an acute infectious bacterial disease of domestic and wild animals. Humans are also susceptible to anthrax. The risk of human infection occurs when examining, skinning or cutting up an infected carcass.

Etiology :

It is caused by Bacillus anthracis which are gram positive capsulated, rod shaped, aerobic spore forming bacteria. Spores are formed within few hours and can survive for 15-20 years in soil.

Transmission :

It is transmitted through the ingestion of spores, blood sucking insects and biting flies. In cut aneus form, organisms gain entry through abrasions of skin.

Clinical signs: The disease may appear in three forms.

1. **Per acute form**: It is found in the beginning of an outbreak. The animals may be found dead without any symptoms.

2. **Acute form**: There is high body temperature 104-108°F. Animal is depressed followed by respiratory distress. Staggering convulsions. Bloody discharges from mouth, nostrils and anus shortly before or after death. Death takes place within 48 hours.
3. **Sub acute form:** It is characterized by oedema. Oedema is predominantly noticed under the neck, brisket region, thorax, abdomen and flank. This oedema produces respiratory distress. Jugular pulse is noticed at the terminal stage of the disease. Pregnant cattle may abort.

Fig 2.1 Anthrax

Diagnosis:

History of sudden death of animals with bloody discharges from mouth, nostrils and anus must be suspected for anthrax. Demonstration of anthrax bacilli in the blood smears. When blood films are stained with polychrome methylene blue will show the presence of large square ended blue rods in short chain with pink capsule (MC Fadyean's reaction). Ascoli test can be performed for its confirmation.

Treatment:

Intravenous broad spectrum antiobiotics like Cephataxime or Cephataxime with Tazobactum can be given for a period of five days. In less severe cases Penicillins or Oxytetracycline can be given for a period of five days.

Control:

- Affected and suspected animals should be isolated and treated.
- Animals in contact with the affected may be treated with a long acting antibiotic.
- Dead animals should be preferably burnt if not, buried deep with lime and common salt.
- Vaccination of the livestock in the outbreak areas with Anthrax spore vaccine.
- Fodder should not be purchased from anthrax endemic areas.

2.3 Haemorrhagic Septicaemia (H.S)

It is also known as septicemic pasteurellosis. It is an acute, infectious disease of cattle, buffaloes, sheep, goat, pigs and horses and characterized by sudden onset of disease, high temperature, oedematous swelling of subcutaneous tissues particularly of throat.

Etiology:

The disease is caused by gram negative bacteria Pasteurella multocida which are gram negative bipolar staining coccoid rods.

Transmission:

The organisms are normal inhabitants of respiratory tract. Any stress conditions to the animals cause outbreak of disease. Direct transmission is from infected to healthy animals by ingestion of contaminated feed and water.

Clinical signs:

Septicaemic pasteurellosis flares up as an outbreak during the environmental stress. There is high body temperature (104-107°F), with lachrymal and nasal discharges, visible mucus membrane, profuse salivation and death within 24 hours. Some cases show signs of abdominal pain, severe diarrhoea.

Oedematous form is more common in buffaloes. There is high body temperature; head, neck, dewlap become swollen due to infiltration of inflammatory exudates in the subcutaneous tissue. Profuse lacrimation is noticed. Buckle mucosa is congested, tongue swollen and protrudes out of mouth. Profused salivation and difficulty in swallowing and dyspnoea due to obstruction of airway, respiratory distress and death occurs within 20-24 hours.

Fig. 2.2 Haemorrhagic Septicaemia

Treatment:

- Sulphadimidine 150mg/kg b.wt or inj.Enrofloxacin 5mg/kg b.wt for 3 days or any broad spectrum antibiotics can be used. Route of administration is preferably I/V.
- Steroidal anti inflammatory drugs like Dexamethasone-5ml may be given I/V or I/M.

Control:

- Prophylactic vaccination of all susceptible animals in the enzootic areas once a year before the onset of monsoon.
- H.S alum adjuvant vaccine VBRI 5ml-S/C, 5 ml for 600 lbs b.wt., 10 ml if more than 600lbs body weight.
- Oil- adjuvant vaccine is given @ 2ml in animals weighing up to 150kg and 3ml in animals weighing above 150kg.

2.4 Black Quarter (B.Q)

It is also known as black leg or emphysematous gangrene. It is an acute infectious and highly fatal, bacterial disease of cattle. Buffaloes, sheep and goats are also affected. Young cattle between 6-24 months of age, in good body condition are mostly affected. It is a soil borne infection generally occurs during rainy season.

Etiology:

It is caused by Clostridium chauvoei which are gram positive spore forming bacteria.

Transmission:

The disease spreads through ingestion of contaminated feed and contamination of wounds.

Clinical signs:

Disease starts suddenly with high body temperature(104-106°F),loss of appetite, depression, dullness, suspended rumination, difficult breathing, lameness in affected leg, crepitation swelling over hip, back and shoulder, swelling is hot and painful in early stages whereas cold and painless later. Recumbency followed by death within 12-48 hrs.

Fig 2.3 Black quarter

Treatment:

Treatment with cephalosporin group of antibiotic cephtaxime@10mg/kg b.wt or cephtaxime with B- lactamase inhibitor@10mg/kg b.wt intravenous for 5 days.

NSAIDS and anti histaminics can also be used.

Control:

Isolation of the infected animals from healthy stock. Disposal of carcass has to be done either by deep burial or burning. Proper disinfection of surgical operation instruments prior to operation. Don't allow grazing in affected area. Alum precipitated Black quarter vaccine 5ml is given subcutaneously every year before rainy season.

2.5 Brucellosis

It is also called as Bangs disease or contagious abortion. Brucellosis is a highly contagious bacterial infection of all domestic animals characterized by abortion in females and infection of the testicles in bulls. Infected cattle will abort only once due to brucellosis and have apparently normal calving in subsequent years, but will continue to excrete large amounts of bacteria after calving.

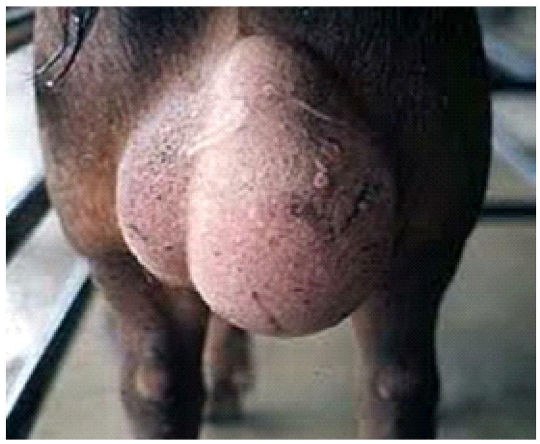

Fig. 2.4 Brucellosis showing Orchitis

Etiology:

It is caused by Brucella abortus in cows and buffaloes which are gram negative organisms. It has zoon tic importance as dairy workers, veterinarians or butchers may pickup infection by handling the infected foetal membrane, uterine discharge or aborted foetus.

Transmission:

Natural transmission occurs by ingestion of organisms, which are present in large numbers in aborted foetuses, foetal membranes and uterine discharges. Cattle may ingest contaminated feed and water or lick contaminated genitals of other animals. Venereal transmission by infected bulls to susceptible cows and transmission may occur by artificial insemination when Brucella contaminated semen is deposited in the uterus. Brucella may enter the body through mucous membranes, conjunctiva, wounds or intact skin.

Clinical findings:

Abortion is the most obvious manifestation. Infection may also cause still born or weak calves, retained placenta, reduced milk yield. Infected bulls develop orchitis and testicular abscess. Chronic infections may result in arthritic joints or hygromas in some cattle.

Treatment:

No treatment is allowed. All infected cattle and contacts that have been exposed to infection must be slaughtered.

Prevention:

Regular screening of breeding bulls from frozen semen collection centres for brucellosis and use brucellosis free bulls for semen production. Prevention of brucellosis is accomplished by official calf hood vaccination (strain 19) of heifer calves at age 2-4 months or 4-12 months using above and strain k 45 for pregnant ones.

Fig. 2.5 Brucellosis Hygroma

2.6 Vibriosis

Vibriosis is a venereal disease of cattle caused by bacteria spread at the time of coitus or at the time of artificial insemination .

Etiology:

The disease is caused by Campylobaterfetus.

Transmission:

The disease is transmitted from bull to cow and from cow to bull during natural service. During artificial insemination when infected semen is used the disease is transmitted to cow. Infection from bull to bull can occur at semen collection centre.

Clinical signs:

In cattle, abortion is the chief sign of infection in first two months of gestation. Mild endometritis , failure to conceive- return to service at normal time. Early embryonic death- delayed return to service. Late embryonic death and abortion (usually at 4-5 months) is also observed.

Treatment:

1. Infected cows can be treated with intrauterine infusion of broad spectrum antibiotics for elimination of organisms from female genital tract.
2. Infected bulls are treated with a course of broad spectrum antibiotic parentrally along with local treatment of preputial cavity for 5 days.

Control:

In infected herd stop using natural service until at least two years after initial infection began. If mature bull, treat it with antibiotics before it is used to mate cows and use it on small number of cows only so that its fertility can be monitored before it is used for service in the main herd.

2.7 Tuberculosis (T.B)

Tuberculosis in cattle is a chronic infectious bacterial disease of domestic animals characterized by the progressive development of turbercles in any of the organs in most of the species.

Etiology:

The disease is caused by Mycobacterium bovis which are acid fast, non sporulating bacteria. Bovines may serve as source of infection to man and it has zoonotic importance.

Transmission:

Transmission is through inhalation of organisms, ingestion of the organisms through contaminated feed and water. Direct transmission from infected to non infected animal and indirect through faeces, urine and other excretions are also noticed.

Clinical signs:

Affected animals with extensive tubercular lesions are clinically normal but progressive emaciation. Capricious appetite and fluctuating temperature is observed. Hair coat is rough. Affected animals tend to become more docile and sluggish but eyes remain bright and alert.

Pulmonary involvement is characterized by a chronic cough. Cough is never loud, occurring only once or twice, suppressed and moist. Dyspnoea (difficulty in respiration) with increased rate and depth is noted. Alimentary involvement causes diarrhoea. Enlargement of lymph nodes i.e. chronic painless swelling of the tuberculous mastitis with prominent enlargement of supra mammary lymph nodes. In early stages the milk is not abnormal but later fine floccules and amber fluid from udder is noticed.

Treatment:

In animals, it is not economically feasible. Hence detected animals are culled because of public health concern.

Control:

Control in a herd is made by removal of the infected animals, prevention of spread of infection. Detection of infected animals is by use of tuberculin test. All animals over 3 months of age should be tested and disposed. Hygienic measures to prevent the spread of infection. Feed troughs, water troughs should be thoroughly disinfected with hot 5% phenol. Screening of farm attendants for tuberculosis should be done regularly.

2.8 Johnes Disease (J.D)

It is also called as par tuberculosis.

Etiology :

It is caused by Mycobacterium par tuberculosis.

Transmission:

Calves may acquire the infection in their intra-uterine lives. Contaminated food and water with faecal materials are the potential ways of transmission. Milk may act as direct source of infection because the organisms are excreted in milk.

Fig. 2.6 Sign of Johnes Disease

Clinical signs:

The cardinal sign is diarrhoea which may be intermittent or continuous in nature. Dung is dark in colour and contain bubbles. The animal condition is hidebound, dry coat; progressive weight loss is prominent, appetite is normal, loose skin develops sub mandibular edema severe dehydration and results in death of the animal.

Treatment:

It requires prolonged treatment and it is not economical

Control:

All the animals should be tested by faecal culture once in 6 months. Intradermal Johnin test is used as a screening test in the herd. 0.1 to 0.2ml of Johnin is given on one side of the neck. Change in the skin thickness greater than 5mm is considered positive reaction. Positive animals should be disposed off. Faeces should be removed and heavy lime dressings are to be done to kill the bacteria. Proper disposal of dung is essential as faeces are the main source of infection.

2.9 Leptospirosis

It is an acute or chronic or clinically in apparent contagious disease of domesticated and wild animals as well as man. It is a disease of zoon tic importance.

Etiology:

Leptospirosis is caused by the genus Leptospira. In cattle the important species are L.pomona, L.grippotyphosa, L.canicola, L.icterohaemorrhagica and L.hardjo.

Transmission:

Transmission of Leptospira takes place through direct contact with the urine of infected animals or ingestion of urine contaminated water, feed and pasture.

Clinical findings:

1. Per acute / Acute form: Sudden elevation of body temperature, followed by anorexia, hemoglobinuria, dyspnoea, icterus , abortion and blood in milk. Liver damage can cause icterus.

2. Sub acute/ Mild Form: The affected animals show signs of anorexia, depression, haemoglobinuria and colic. Reduced milk yield, in coordination of hind quarters and blindness. Abortions are less common.

3. **Chronic/ Recurrent Form**: The affected animals show less marked signs for a longer period. Abortion is the prominent sign. Acute or chronic form of nephritis causing changes in urine like haematuria and anuria and leads to death of animal.

Treatment

A course of antibiotic like penicillin and streptomycin or any broad spectrum antibiotics are recommended for a period of 5-7 days. If kidney is involved, supportive therapy should be given to monitor kidney function like fluid therapy and diuretics. Corticosteroids can be used.

Control:

Strict sanitary measures should be adopted in the farm to prevent contamination of feed and water through urine of carrier animals. Infected animals must be segregated form rest of the herd. Effective rodent control should be undertaken as rodents are the main carrier of Leptospirosis.

2.10 Listeriosis

It is also called as circling disease. It is an infectious fatal disease of wide range of animals and characterized by signs of meningoencephalitis.

Etiology:

The disease is caused by Listeria monocytogenes.

Transmission:

It is transmitted by infected feed and soil contaminated by urine, aborted foetus and uterine discharges of infected animals. Silage is considered as a potential source of transmission. Carrier animals and rodents may spread the disease.

Clinical signs: The disease may be manifested in three types

1. **Encephalitis:** The affected animal is dull, depressed, high rise in temperature and dummy syndrome is noticed. Unilateral facial paralysis where head may be held to one side and drooling of saliva with circling either to left or right may be noticed.
2. **Abortion:** In cattle abortions between 4-7th month of pregnancy followed by retention of placenta are noticed.
3. **Septicaemia:** Only new born calves and lambs suffer with signs of depression, pyrexia, diarrhoea, emaciation, corneal opacity and dyspnoea and leads to death.

Treatment:

The disease has to be treated with a broad spectrum antibiotic for a period of 5-7 days. Supportive therapy with fluids, nervine tonics, and anti-inflammatory drugs may be used.

2.11 Actinomycosis

It is also called as Lumpy jaw. It is a chronic supportive disease primary of cattle and characterized in cattle by rarefying osteomyelitis of skull bones mandible and maxilla.

Etiology:

Actinomycosis is caused by Actinomycosis Bovis. The organism is known as fungus like bacteria

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ansmission:

The organism remains as resident population and establish the infection through abrasion, injury or wounds. The abrasion of buccal mucosa induced by coarse feed or surface material while chewing may set up infection.

Clinical signs:

Actinomycosis affects cattle between 2 to 5 years age and the lesion appear initially as a hard, painless, circumscribed protuberance at the level of central molar teeth of the mandible or maxilla. The invasion damages the bony tissues and at the same time stimulates bony growth causing osteitis, leading to suppurative and granulomatous changes. Mastication is affected leading to loss of general health. In some cattle, large granulomatous mass appear on the surface of the jaw followed by development of sinus tracts. The discharge from the tract is thick, mucoid and yellowish purulent exudate containing granules known as sulphur granules. The adjacent bones may be affected in long standing cases.

Treatment:

A course of antibiotic for 5-7 days. Injection streptopenicillin- 2.5g-I/M can be used. NSAID's can also be used. Lesion to be drained surgically and packed with povidine iodine.

Control:

Isolation of the infected animals and treatment to be given. Avoiding sharp objects and offer good feed to the animals.

2.12 Actinobacillosis

It is also called as wooden tongue. It is a sporadic chronic infectious disease of cattle and sheep.

Etiology:

The disease is caused by Actinobacillus lignieresi.

Transmission:

The disease is spread through infected discharges, contaminated pasture, injury of the oral mucosa due to abrasive feed stuffs.

Clinical signs:

Tongue is grossly affected and it may appear as Wooden tongue. There is drooling of saliva and difficulty in mastication due to involvement of tongue. Signs of ulceration at different parts of the tongue. Inter mandibular space is swollen and hard. Pussy discharge from the open abscess. Enlargement of submandibular lymph nodes. Progressive weight loss observed.

Treatment:

Surgical drainage of the abscess should be done and dressing with iodine is done. Antibiotics like Streptomycin may be given @5 gm/day for 3-5 days.

Control:

Isolation of the infected animals and treatment to be given. Avoiding sharp objects and offer good feed to the animals.

2.13 Contagious Bovine Pleuropneumonia (CBPP)

It is an acute, subacute or chronic disease of bovines.

Etiology:

The disease is caused by Mycoplasma mycoides var. mycoides.

Transmission: The infection spreads through inhalation of infected droplets. Exhaled breath contains large number of organisms and spread the infection to the close contact susceptible bovines. The infected animal excretes organisms through urine and inhalation of urine spread the disease. Inanimate objects do not transmit this disease.

Clinical Findings:

The affected animals manifest the following signs: High rise of temperature (104-106 ^{0}F), depression, anorexia, cough following exercise, reluctant to move, abducted elbow, arched back, extended head and neck, dilated nostrils, nasal discharges, oedematous swelling of throat and dewlap.

Fig. 2.7 Contagious Bovine Pleuro Pneumonia

Treatment:

Treatment is effective in the initial stages. Tylosintartarate – 5-10 mg/kg b.wt I/M for 5 days or drugs like enrofloxacin 5-10 mg/ kg b.wt can be tried. Supportive therapy includes NSAID's or corticosteroids to control edema. Diuretics like furosemide may be used.

Control:

Affected animals should be culled and strict hygienic conditions especially isolation of the suspect animal and treatment to be undertaken. Avoid overcrowding as the disease spreads rapidly were animals are kept in close association in the farm or during transit.

2.14 Contagious Caprine Pleuropneumonia (CCPP)

This is a contagious disease of goat having resemblance with CBPP.

Etiology:

The disease is caused by Mycoplasma mycoides Sub species mycoides.

Transmission:

The infection spreads through inhalation of infected droplets. Exhaled breath contains large number of organisms and spread the infection to the close contact susceptible cattle. Bot fly has been found to spread the infection.

Clinical signs:

The signs are comprised of fever, depression, anorexia, abdominal respiration, dry painful cough. Nasal discharges is watery in early stage and turns to thick mucopurulent to white in later stage.

Treatment:

Treatment is effective in the initial stages. Tyrosine @ 40 mg/kg b.wt I/M for 5 days and Tiamutin @ 36 mg/ kg b.wt can be used. Treatment with Tylosintartarate @ 10 mg/kg body weight I/M along with Cotrimaxazole tablet for 5-7 days have been suggested.

Control:

Vaccine may be used. Dose 0.2 ml to be given at the tip of the ear. Revaccination at 6 month interval is recommended. Affected animals should be culled and strict hygienic conditions especially isolation of the suspect animal and treatment to be undertaken.

2.15 Tetanus

It is an acute infectious disease of mammals caused by toxin and characterized by hyperaesthesia, muscular spasms and rigidity. Equines and human beings are highly susceptible.

Etiology:

It is caused by the toxins produced by Clostridium tetani, a spore forming Gram positive bacteria.

Transmission:

Transmission in all animals occurs as a result of wound infection due to castration, docking, parturition and in young animals through umblicus.

Clinical signs:

The initial signs are restricted movement, muscular stiffness and difficulty in walking. Decreased milk yield, lock jaw and hypersensitivity on little stimuli. Prolapse of the third eyelid, pump handle position of the tail are common feature. Bloat is a characteristic sign in ruminants and rumen appears drum like. The affected animal dies of asphyxia.

Treatment:

1. Antitoxin Therapy**:** To neutralize toxin this is indicated. Antitoxin at12 hours interval. Intravenous normal saliva can be given to dilute the toxin.
2. Antibiotic Therapy**:** Pencillins or latest generation cephalosporins with beta – lactamase inhibitors to be given intravenous. Wound debridement as the organism proliferates in anaerobic environment, removal of necrotic tissue and cleaning of the wound using hydrogen peroxide is recommended.
3. Muscle relaxants**:** Use of muscle relaxants to prevent asphyxia. Chlorpromazine – 0.1mg/kg b.wt, Magnesium sulphate 10-25% solution can be given subcutaneous.

Control:

1. Proper cleaning and removal of necrotic tissue and dressing of wounds.
2. Animals should not be allowed to graze near barbed wire fencing.
3. Sterile surgical instruments are to be used at the time of operation.
4. Tetanus toxoid should be given once in 6 months.

2.16 Enterotoxaemia (E.T)

It is also called as Pulpy kidney. It is an acute, highly fatal disease of sheep and goats.

Etiology:

It is caused by Clostridium perfringens type D in the intestine and liberation of epsilon toxin.

Transmision:

Transmission is by ingestion of contaminated pasture , fodder and feed.

Clinical signs:

Sudden death of sheep in the flock during monsoon season in per acute conditions. Symptoms like convulsions, champing of jaw, opisthotonus condition, bloat, salivation, exhibit blindness and dashing against objects are also seen. Temperature may increase upto 2-3^{0}F more than the normal in cases showing cerebral symptoms, if the convulsions are severe. In less acute cases, there is diarrhoea, loss of appetite, weakness, glycosuria, hyperglycemia. Adult sheep usually survive for longer period upto 24 hours. They show staggering and knuckling, champing of jaws, salivation and rapid shallow irregular respiration. Emaciation, anaemia and chronic diarrhoea are also noticed in goats.

Treatment:

Broad spectrum antibiotic initially, parenteral in emergencies and followed by oral route is being practiced. Intravenous dextrose saline to neutralize the toxin is also recommended.

Control:

1. Annual E.T vaccination in the month of May or before onset of monsoon.

2.17 Collibacillosis

Collibacillosis is one of the important diseases in new born calves, piglets and foals.

Etiology:

It is caused by Eschericia coli (E.coli).

Transmision:

Transmission is by contaminated feed and water. Discharges of aborted foetus, vaginal discharge, umblical discharge and intrauterine discharge may act as spreading agents to newly born animals.

Clinical signs:

The disease appears as acute, per acute or chronic form. Acute signs appear when the new born animal is 1-2 days old. The usual signs are depression, in appetence, stiffness, sunken eyes, tucked up abdomen, rough hair coat, elevation of temperature, rapid pulse and respiratory rate. There is profuse loose faeces with rapid peristalsis. A peculiar foetid odour is emitted from the faeces. There is soiling of anal, peri anal and hind quarter region. The chronic cases show joint ill, naval ill, or pneumonia. In per acute infection, there is marked diarrhoea, prostration and death within 12 hours or so.

Treatment

1. Furazolidone @60 mg/kg for 5-7 days and Ampicillin @7-10 mg/kg for 5-7 days may be given orally or parentrally.
2. Food should be withheld for 24 hours. New born animals may be allowed to suckle the mother.
3. Degree of hydration should be assessed and fluid should be given accordingly.

Control

1. Good hygiene and animal husbandry practices should be adopted for effective control of calibacillosis in a farm.
2. Overcrowding should be avoided as it is one of the most common causes of calf mortality due to colibacillosis.
3. Calves should be allowed to suck colostrum for a week or at least for the first 4 days.
4. Calves may be given tetracycline through milk immediately after birth.

Fig 2.8 Diarrhoea in calf

2.18 Swine Erysipelas

It is an infectious disease of pigs.

Etiology:

It is caused by Erysipelothrix rhusiopathiae.

Transmision:

Infection takes place through ingestion of infected food and water. The infection can be established by rooting in soil contaminated with the organisms. Natural infection takes place from infected skin wounds.

Clinical signs:

The disease can be divided as acute, sub acute and chronic form. In acute form the severely ill animals have high rise of temperature and signs of chilling. In sub acute form temperature is not high, appetite is unaffected and occasionally skin lesions may appear. In chronic form arthritis is the main sign.

Treatment:

1. Anti serum can be used to protect suckling pigs.

2. Antibiotics like Penicillin can be used @ 50,000 IU per kg body weight.

3. Corticosteroids can be used to treat arthritis.

Control:

1. Good hygiene and animal husbandry practices should be adopted for effective control.
2. Replacement of stock should be made from clean sources.
3. Chronically affected carrier pigs should be excluded from the farm.
4. Dead carcasses should be burnt properly.

2.19 Fowl Cholera

It is an acute or chronic contagious disease affecting domestic as well as wide range of wild birds causing septicaemic condition with high mortality in acute form.

Etiology:

The disease is caused by Pateurella multocida.

Transmision:

It is transmitted through ingestion of feed and water contaminated by P.multocida organisms. Bird to bird contact, aerosol way of transmission, vector transmission, animal bite transmission, transmission through fomites are the common routes of transmission.

Clinical signs:

In per acute form, death of large number of birds is noticed. In acute form, signs of respiratory distress, coughing and gasping, fever, depression, discharges from mouth, ruffled feathers along with diarrhoea is noticed. In chronic form, hyperemia and oedema of comb and wattles, in coordination, torticollis are noticed.

Treatment

1. Drugs like sulphonamides and antibiotics have been used.
2. Tetracyclines can be used parentrally in case of outbreak.

Control:

1. Good hygiene and sanitary measures should be adopted in the farm.
2. Isolate the infected birds and treat them properly.
3. Try to remove the recovered birds acting as carrier from the farm to prevent further transmission.
4. Carcasses must be disposed properly.
5. Fowl cholera vaccine is to be used.

Short Answer Type Questions

1. Name the causative organism of Haemorrhagic septicaemia, Black quarter and Brucellosis diseases.
2. Mention any four diseases communicable from animals to human beings.
3. Mention clinical signs of Enterotoxaemia in sheep.
4. Mention clinical signs of Collibacillosis in calves.
5. Mention clinical signs of Anthrax disease.
6. Mention prevention and control measures of Collibacillosis in calves.
7. Mention control measures of Tuberculosis.
8. Mention control measures of Brucellosis.

Long Answer Type Questions

1. Describe in detail about Haemorrhagic septicaemia disease.
2. Write in detail about Black quarter disease.
3. Describe in detail about Anthrax disease.
4. Write about the ‘Enterotoxaemia’ disease of Sheep and Goat.
5. Explain about brucellosis disease in cattle.

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UNIT 3

Viral Diseases

Structure

3.1 Rinderpest

3.2 Foot and Mouth Disease

3.3 Pox diseases: Buffalo pox, Cowpox, Sheep pox, Goat pox, Fowl pox

3.4 Infectious Bovine Rhinotracheitis

3.5 Ephemeral fever

3.6 Rabies

3.7 Blue tongue

3.8 Peste Des Petits Ruminants

3.9 Contagious ecthyma

3.10 Hog cholera

3.11 Mereks disease

3.12 Avian Leucosis Complex

3.13 Ranikhet disease

3.14 Avian Influenza

3.1 Rinderpest

It is also known as cattle plague. Rinderpest is an acute, highly contagious disease of ruminants and swine caused by virus.

Etiology:

It is caused by rinderpest virus(a morbilli virus).

Transmission:

Natural infection occurs by direct contact with infected animal by method of inhalation. Ingestion of contaminated feed and water.

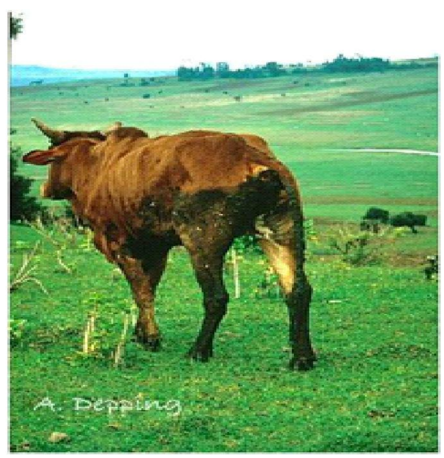

Fig. 3.1 Rinderpest Diarrhoea

Clinical signs:

It is characterised by high fever, pronounced lacrimation, nasal discharge, salivation, fine necrotic ulcers on buccal mucous membrane resembling particles of bran, shooting diarrhoea with offensive smell, pneumonia, skin eruptions, severe dehydration and prostration.

Treatment:

No effective treatment in Rinderpest. Antibiotics are used to control the secondary bacterial infections. Large doses of fluids and electrolytes to be given intravenous to prevent dehydration.

Fig. 3.2 Nasal Discharge

Control:

Vaccination of neighbouring animals, Quarantine stations and check posts in the main cattle route were adopted to prevent spread of disease from one part to other. Vaccination is done by Rinderpest tissue culture vaccine 1 ml through subcutaneous route. This disease has been controlled in India through National Eradication Progaramme i.e. Rinderpest zero programme. OIE has approved that India is free from Rinderpest.

3.2 Foot and Mouth Disease

It is an extremely contagious acute infectious viral disease of cloven footed animals i.e cattle, buffaloes, sheep, goats, pigs, deers, antelopes and also communicable to man.

Etiology:

The disease is caused by FMD virus which has 7 srains. In India, O, A, C and Asia-I and their sub strains are prevalent. Morbidity is up to100% while mortality is very low in adults.

Transmission:

The disease spreads by inhalation and ingestion, direct contact between infected and susceptible animals and indirectly through inanimate objects. Milk, milk products from infected animals act as a vehicle. Infected cattle semen is also a means for spread. The virus is air borne and travel as for as 100km (62miles) in most favourable circumstances. The virus is susceptible to changes in pH away from neutral. 1-2% sodium hydroxide, 1-2% formalin or 4% sodium carbonate can destroy the virus in few minutes.

Fig. 3.3 (a) Foot Lesion

Fig. 3.3(b) Mouth Lesion

Clinical signs:

The animal shows high temperature i.e., 40-41°C (104-106°F). Anorexia followed by acute painful stomatitis, abundant salivation, saliva hanging in long ropey strings.

Smacking of the lips and the animal chews carefully, vesicles (1-2cm in diameter) appear on buccal mucosa, dental pad and the tongue. These are ruptured within 24 hrs leaving a raw surface which heals in about a week.

Vesicles also appear on feet particularly in the clefts and on the coronet. Rupture of vesicles cause severe discomfort and animal goes lame often recumbent.

Secondary lesions develop on udder, teats, mastitis and drastic reduction in milk yield is also seen. Eating is resumed in 2-3 days as the lesions heal but the period of convalescence may be as long as 6 months.

A chronic syndrome of dyspnoea, anemia, overgrowth of hair and lack of heat tolerance and panting are seen, as an after effect due to endocrine damage.

Treatment:

1. Wash the mouth and feet lesions using potassium permanganate solution.
2. Foot lesions are to be applied with fly repellent and antiseptic ointments like neemlent to prevent flies and maggoted wounds.
3. Non- steroid anti inflammatory drugs like meloxicam- 0.2-0.5mg/kg b.wt- I/M for 3 days.
4. A course of broad spectrum antibiotics for 3 to 5 days to prevent secondary bacterial infections.
5. Prevention: Calves above 4 months age should be vaccinated. Adult annual vaccination against FMD using oil adjuvant vaccine.

Control:

Isolation and treatment of affected animals in the herd.

- Vaccination of healthy animals.

3.3 Pox diseases

3.3.1 Cow Pox/ Buffalo Pox

Cow pox is a contagious eruptive skin disease of cattle. It is mild cutaneous disease where the lesions are mostly confined to udder and teat. The disease is transmitted to human beings.

Buffalo pox is usually benign in nature and both localize and generalizedform may occur in buffaloes. This disease has been recorded to be transmitted in human beings as milker's nodule.

Etiology:

The diseases are caused by virus of vaccinia sub group of pox viruses. Cow pox virus is closely related to small pox virus. Both the viruses are related.

Transmission:

The disease is transmitted by direct contact with the affected cows, milker's hands, and mechanical transmission by insects and milking machine may transfer the infection from cow to cow in a herd.

Fig 3.4 Buffalo Pox

Clinical signs: **In Cow pox**

The affected animals may show mild increase in temperature, anorexia, suspended rumination and depression. Udder is swollen, hot and sensitive typical pock lesions appear on the teat and udder.

Fig. 3.5 Cowpox

Calf gets the infection while suckling its infected dam and pock lesions may be seen on the face of the calf. Lesions heal in two weeks. Mastitis may be noted due to secondary bacterial infection.

In buffalo pox, there is elevation of temperature (104-106°F), swelling of eyelids, lacrimation, mucopurulent nasal discharge, red spots on udder, teat, all visible mucosa and later pock lesions.

Treatment:

Symptomatic treatment is undertaken. The affected animals are isolated and treated. Anti-inflammatory preparations can be applied to udder. Eg. Mastilep, inflagel or wisprec ointments can be used. A course of antibiotics are given to prevent secondary bacterial infection. Mastitis scabs are to be painted with povidine iodine or any antiseptic ointment.

Control:

Isolation and segregation of the affected cattle is to be made and treated accordingly. Strict hygienic measures are to be adopted in the farm. Hands of the milker should be cleaned and washed with antiseptic solution and disinfection of milking machine has to be done. Teat dip may be used after milking. Calves should not be allowed to suckle infected mother. All the healthy animals should be milked first and diseased one at the last.

3.3.2 Sheep Pox / Goat Pox

It is a malignant acute viral disease of sheep and goat.

Etiology:

The disease is caused by DNA virus of the genus Capri pox virus.

Transmission:

The disease is transmitted by direct contact with the affected cows, milker's hands, and mechanical transmission by insects and milking machine may transfer the infection from cow to cow in a herd.

Transmission:

It is highly contagious and transmission takes place due to direct contact of the infected animal with the healthy one. It is also transmitted through nasal inhalation, wounds, abrasions and the biting insects. Contaminated feed and water act as source and attendants spread the virus through mechanical ways.

Clinical signs:

In goats, there is high rise in temperature (104-107°F). Macules followed by papules initially appear on hairless parts of the skin and then whole body, head and udder.

Fig 3.6 Sheep pox

Severe nasal and lacrimal discharges are seen. Swollen eye lids and later muco-purulent discharges from nostrils and eyes are noticed. Animals that survive develop scab with no vesicular or pustular stage. Pneumonia and enteritis are secondary complications which may result in death of the animals.

In sheep, 50% of lambs die when they are affected. Affected animals are dull, depressed with high fever (106-107°F).Pock lesions appear on eyelids, lips, nostrils, ears, inner side of thigh, under the tail, chest region and buccal mucosa.

Necrotic changes in vesicles lead to scab formation. Animals die due to respiratory distress.

Mild form is seen in adults, where the eruptions are confined around the eyes, lips and nose. Affected ewe may abort and foetus shows pock lesions. Lactating ewe show the signs of mastitis due to the lesions in the udder.

Treatment:

Antiseptic ointments are to be applied on the pock lesions and a course of antibiotics are given to prevent secondary bacterial infections.

Control:

Sick animals are to be segregated from healthy ones and strict sanitary measures are to be adopted. Animals from the infected area should not be allowed into healthy stock.

Sheep pox freeze dried tissue culture vaccine-0.1 ml intra dermal is given and to be repeated every year.

3.3.3 Fowl pox

Fowl pox is a common viral disease in backyard chicken.

Etiology:

It is caused by viruses of the family Pox viridae and the genus Avipoxvirus.

Transmission:

It is spread by biting insects (especially mosquitoes) and wound contamination d causes lesions on the comb, wattles, and beak. It is also spread by inhalation of the virus and causes a diphtheritic membrane to form in the mouth, pharynx, larynx, and sometimes the trachea.

Clinical signs:

- Typical pox lesions are seen on the comb and wattles. In rare cases, lesions are also found on the body, legs and even sometimes the softer parts of the beak.
- Fowl pox lesions in the mouth and throat can cause difficulty breathing, even death. Lesions in eyes may cause blindness.

Treatment:

Vaccines are available for fowl pox. Chicken are usually vaccinated with pigeon pox virus. This vaccine is usually given to chicken when between the age of 12–16 weeks of age, via the wing web method of injection.

Control:

- Management and hygienic measures are the important ways of control of this disease.
- The premises should be properly disinfected. All in all out method of rearing should be followed.
- Management of the mosquito population can help reduce outbreaks of fowl pox.

3.4 Infectious Bovine Rhinotracheitis(IBR)

IBR is an acute highly contagious viral disease of cattle.

Etiology:

It is caused by bovine herpes virus.

Transmission:

The virus is usually transmitted through infected feed and water. The virus can be spread through ocular, nasal and reproductive secretion and excretion of infected cattle. Droplet infection is the important way of transmission.

Clinical signs:

- Respiratory form is characterized by mild to severe rise of temperature, acceleration of respiration and dyspnoea.
- Vulvo-vaginal form is characterized by sharp fall in milk yield and appearance of erythematous and pustular lesions on the vaginal mucosa.
- Occular form is characterized by ocular discharges and conjunctivitis.
- Encephalitic form is manifested by in coordination, tremor, coma and death.
- The abortive form is manifested by abortions.

Treatment:

Secondary bacterial infection can be checked by broad spectrum antibiotic or sulphonamides.

Control:

- Strict isolation of the affected animals should be made.
- Live attenuated vaccines either through intramuscular or intranasal route may be given.

3.5 Ephemeral fever

It is also known as three-day-fever, Dengue fever or Tiwa.

Etiology:

The disease is caused by Rhabdo virus.

Transmission:

It is transmitted by sand fly and mosquitoes. Transmission does not occur by direct contact from animal to animal or via their discharges.

Clinical signs:

The disease is characterised by high fever ranging between 103-107^{o}F or more, shivering, muscle trembling, lameness affecting one or more limbs, anorexia and reduction in milk yield. Animal returns to normal condition after 3-4 days.

Treatment:

Analgesics and antipyretics like sodium salicylate, phenylbutazone, novalgin can be used. Antibiotics may be given to check the secondary bacterial infection.

Control:

Vector control is the important for prevention and control of the disease.

3.6 Rabies

Rabies is an acute, infectious and highly fatal disease of mammals.

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Fig. 3.7 Rabies

Etiology:

Rabies is a fatal disease of all warm blooded animals. It is caused by RNA virus of the family Rhabdoviridae and genus lyssa.

Transmission:

The disease is transmitted through the bite of rabid dog or cat or rodents or even if the saliva of the infected dog is deposited on cuts or abrasions. In India, dogs are the main transmitter of the disease (95%). The virus is maintained in wild carnivores like foxes and jackals.

Clinical signs:

Rabid cattle appear in coordinated. They show loss of appetite and sudden fall of milk yield. There is trembling of ears. There is excessive salivation and grinding of teeth with paralysis of muscles of deglutition. Continuous bellowing in low pitched voice is noted in cattle. Increased sexual excitement which mimics estrum in cows. In furious form , dogs become over sensitive and has a tendency to attack and bite even without provocations. The animal is kept under observation in isolation for 14 days.

Treatment:

Post bite measures:

- Dog bite wound should be immediately washed using any ordinary soap and water and thoroughly irrigated then dressed with an antiseptic solution. If it is done immediately after bite within 10-15 minutes, the chances of infection are minimised considerably. Cauterise with Nitric acid or Carbolic acid. Late cauterization has no use.
- Never attempt to suture the dog bite wound. Tetanus toxoid can be given. Never use corticosteroids along with vaccination.
  Post bite anti rabies vaccination has it be given as per the directions of vaccine manufacturer.

- No specific treatment is available for rabies and ones signs are noticed, the animal dies due to rabies invariably.

Control:

- Rabies can be controlled by following regular annual vaccination schedules in both the domestic and stray dogs.

- Suspected animal should be isolated and the attendants exposed should go for post bite therapy.

3.7 Blue Tongue

It is an infectious, non-contagious insect borne viral disease predominantly of sheep.

Etiology:

The disease is caused by a RNA virus belonging to arthropod born Orbivirus of Reoviridae family.

Transmission:

The disease is non – contagious and natural transmission occurs through biting insects. Blood sucking midges of genus Culicoides, sheep ked Melophagusovinus, mosquitoes like aedes transmit the disease mechanically.

Clinical findings:

The disease is characterized by high fever persisting for 5-6 days with progressive reddening of the buccal mucous membrane.

- In acute form, it is characterized by high fever, nasal and lacrimal discharges and swollen gums, tongue and lips. It results in drooling saliva, followed by ulceration on internal surface of tongue and lips and bluish appearance of the tongue. Cracks in the coronary band and separation of hoofs leads to lameness. Swallowing of fodder and feed is difficult. Diarrhoea and pneumonia may be seen.
- Sub acute form is mostly seen in cattle and generally goes unnoticed.
- Pregnant ewes when infected with the disease, abortions are also common.

Treatment:

- There is no specific treatment. To check secondary bacterial infections, antibiotics may be given parentally.
- NSAIDS may be used to reduce temperature, inflammation and lameness.
- Mouth wash with antiseptic solutions may be undertaken for quick healing of the oral lesions.
- Liquid diet and tender leaves can be given to prevent starvation.

Control:

- Grazing should be avoided in areas where there are lot of vectors.
- Reduction of vector population should be done by spraying insecticides in the sheds and premises. The floor in the sheds should be dry.
- Tissue culture vaccine can be used effectively to prevent the disease. Vaccine is available in India.
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3.8 Peste Des Petits Ruminants (PPR)

PPR is a highly contagious disease of small ruminants having resemblance to Rinderpest characterized by fever, loss of appetite, stomatitis, enteritis and pneumonia.

Fig. 3.8 PPR affected animal

Etiology:

PPR is caused by moribilli virus of paramyxo virus family.

Transmission:

Transmission occurs through direct contact with infected goat or sheep, indirect transmission occurs through contaminated food, water and other fomites.

Clinical signs:

- Acute form of the disease is characterized by high fever (104 -106°F), dullness, dry muzzle and congestive mucous membranes.
- There is profuse serous nasal discharge turns muco-purulent to purulent. The discharge matt the nasal and ocular surroundings and some animals show conjunctivitis and matting of eye lids.
- Ulcers are seen on lips, gums, dental pad and tongue.
- Diarrhoeic faeces and contain mucus and blood and leads to severe dehydration and death.
- Sub acute form is mostly seen in sheep and signs are observed in lower grade and pregnant animals abort.

Treatment:

- There is no specific treatment. A broad spectrum antibiotic like Enrofloxacin5mg/kg b.wt or Cephataxime @ 5-10 mg/kg b.wt can be given for 5-7 days.
- Non steroidalanti inflammatory drugs (NSAID) like Meloxicam @ 0.2-0.5mg/kg b.wt or Ketoprofen can be used.
- Fluid therapy with intravenous Ringers lactate is indicated to prevent dehydration but care to be taken if severe respiratory distress is noticed.
- Mouth wash with potassium permanganate and boro glycerine paste is applied. The affected animals should be fed soft gruel diet.

Control:

- Sick animals should be segregated and treated. PPR tissue culture vaccine-1ml- S/C has to be given every year.

3.9 Contagious ecthyma of sheep and goat (Orf)

Contagious ecthyma is also known as sore mouth and highly contagious viral disease of sheep and goats.

Fig. 3.9 Orf

Etiology:

The Orf virus belongs to the genus para pox virus of the family pox viridae.

The Orf virus is readily transmitted to humans.

Transmission:

The disease is transmitted by contact with affected animals or inanimate objects. Natural infection is due to invasion of the virus after skin damage. Suckling lambs or kids are affected from the udder of affected ewes or does. Scabs from affected animal fall off and act as a source of disease transmission.

Clinical signs:

- The initial signs of the disease are fever (106-108°F).
- Lesions develop initially as papules and then pustules, thick scabs covering a raised area of ulceration and granulation.
- The first lesion develops at the oral commissaries and then muzzle, nostrils, the surrounding haired skin and to lesser extent onto the buccal mucosa.
- Secondary bacterial infections may cause enteritis and bronchopneumonia.

Treatment:

No specific treatment. A course of antibiotics for 5-7 days may be given to check secondary bacterial infection. Local application of antiseptic ointments on skin lesions with provide in Iodine and other fly repellents.

Control:

Affected animals should be separated from rest of the flock. Strict hygiene and sanitary measures to be followed in the farm. Animal attendants with the presence of wounds and abrasions on the hands are at risk of infection. Hands to be washed thoroughly after attending the affected flock.

3.10 Hog Cholera/Swine fever

It is an acute contagious viral disease affecting only pigs of all ages.

Etiology:

Swine fever is caused by the pest virus genus being part of the family flaviridae.

Transmission:

Direct contact with the infected pigs is the principle way of disease transmission. The disease may enter through ingestion of garbage or contaminated feed and water.

Clinical signs:

- In per acute cases, young pigs die without any symptoms.
- In acute cases, there is sharp rise of body temperature (105-107°F), animals show dullness, anorexia, vomit ion and severe diarrhoea. Morbidity is 90% and mortality is 60-70%.
- In chronic cases, it is manifested by chronic diarrhoea, chronic pneumonia, alopecia and emaciation.

Treatment:

There is no specific treatment against swine fever virus. Hyper immune serum 50-150 ml per animal can be given in the early stages of illness.

Control:

- The premises should be properly disinfected. Recovered animals are strongly immune. Immune sows confer protection to their offspring through their colostrums.
- Attenuated lapin zed virus vaccine @ 1 ml per animal after reconstitution with normal saline is given subcutaneously annually for effective protection.

3.11 Mark's Disease

It is a highly contagious viral disease of poultry affecting mostly 12-24 weeks of chicken.

Etiology:

It is caused by Herpes virus.

Transmission:

It is transmitted through inhalation of infected material from the environment and poultry litter. The disease is not transmitted through eggs.

Clinical signs:

The disease is manifested by lameness, limping, paralysis of legs, neck and drooping of the wings. The split leg stance is the usual feature. Blindness is also noticed in some cases.

Treatment:

There is no specific treatment against Maker's disease.

Control:

- Management and hygienic measures are the important ways of control of this disease.
- The premises should be properly disinfected. All in all out method of rearing should be followed.
- Three types of MD vaccines are commonly used i.e. Attenuated MDV, a virulent MDV and turkey herpes virus vaccine.

3.12 Avian Leucosis Complex (ALC)

Avian leucosis is an infectious cancerous condition of the mature birds involving the haemopoetic and lymphoid tissues like liver, bursa, spleen, gonads, kidneys, bones etc.

Etiology:

It is caused by a RNA virus, C type retro virus under sub family Oncovirinae.

Transmission:

Main route of transmission is through infected eggs to the progeny, as the virus is excreted in eggs. Transmission can occur indirectly through close contact with infected pen-mates and surroundings.

Clinical signs:

The birds are lethargic, weak, drop in egg production, gradually become weaker and eventually die having a long course of illness.

Treatment:

There is no specific treatment.

Control:

- Birds should be procured from breeders where the parent stock is free from this virus.
- Affected birds should be culled and disposed off properly.
- Vaccine is not available.

3.13 Ranikhet Disease(New castle disease)

It is an acute rapidly transmitting viral disease of domestic poultry and other avian groups with high morbidity and mortality.

Etiology:

The disease is caused by paramyxo group-I virus.

Transmission:

Chicken are infected with droplet (aerosol) method. Infection may spread through faeces, eggs and infected carcasses.

Fig 3.10 Ranikhet disease

Clinical signs:

The young ones are more susceptible over old birds. Birds show severe respiratory distress, gasping, tremors, excrete watery white (chalky) faeces. In adult birds watery diarrhoea, sharp decline in egg production, nervous signs (torticollis) and paralysis are observed.

Treatment:

There is no specific treatment. Broad spectrum antibiotics may be used to control the secondary bacterial infections.

Control:

- Standard hygienic and sanitary measures are to be followed
- Sick birds are not to be treated but segregated. If treatment is at all resorted, it should be done in a separate shed, as sick birds will remain as potential source of infection.
- Segregation and disposal of dead birds should be done with proper care with bleaching powder or lime.
- Three types of vaccines are commonly used.

i. Lasota strain or F strain vaccine

ii. R_2B vaccine

iii. Newcastle disease killed vaccine

3.14 Avian Influenza (Bird Flu)

It is a mild or even asymptomatic to an acute and fatal infectious disease of birds caused by type A strains of the influenza virus.

Etiology:

The disease is caused by virus belongs to Orthomyxoviridae family.

Transmission:

Waterfowl, wild and domesticated seabirds are the major natural reservoir of influenza viruses. Contact of these birds with commercial flocks results in outbreaks. Healthy birds usually get the infection by coming in direct contact with secretions and excretions of the infected bird or on contact with contaminated surfaces. Spread of disease through contaminated shoes, clothing, crates and other equipment has been reported.

Clinical signs:

Majority of the outbreaks in birds are caused by Low pathogenic Avian Influenza (LPAI).Outbreaks with LPAI forms usually result in either no illness or mild illness.

In the HPAI (High pathogenic Avian Influenza) form of the disease, onset is sudden with mortality approaching almost 100%.Respiratory distress, oedema of face and head, purple discolouration of the wattles, combs and legs, diarrhoea and nervous signs like lack of coordination are seen in per acute cases.

Treatment:

There is no effective treatment. Good husbandry measures, healthy diet and broad spectrum antibiotics to control secondary bacterial infections may help to reduce the mortality rates.

Control

- Routine serological monitoring for the virus in endemic areas for avian influenza.
- Early reporting of outbreaks to facilitate rapid undertaking of Proper measures like culling of infected stocks or voluntary isolation of infected flocks.
- Strict bio-security measures should be followed in the poultry farms.

Short Answer Type Questions

1. What are the major symptoms of sheep and goat pox
2. Mention the clinical signs of sheep Ephemeral fever
3. What are the clinical signs of contagious ecthyma
4. What are the clinical signs in hog cholera
5. Mention the common viral diseases of Poultry.
6. Expand PPR and IBR

Long Answer Type Questions

1. Write briefly about Rinder pest disease
2. Explain about the PPR viral disease in Sheep.
3. Write about the 'Rabies' disease.
4. Explain about Blue tongue disease in sheep.
5. Write about Foot and Mouth disease in cattle.
6. Write about Ranikhet and Fowl pox disease in poultry.

UNIT 4

Protozoan Diseases

Structure

4.1 Trypanosomiasis

4.2 Babesiosis

4.3 Theileriasis

4.4 Anaplasmosis

4.5 Leishmaniasis

4.6 Coccidiosis

4.7 Amoebiasis

4.1 Trypanosomiasis

It is also called as Surra. Trypanosomiasis is an infectious disease of cattle, buffalo, goat, sheep, pig, horse, donkey, camel and dog.

Etiology:

It is caused by Trypanosoma evansi which is an extra cellular haemoprotozoan parasite.

Transmission:

The disease is mechanically transmitted through the bites of flies, tabanus, lyperosia, stomoxys etc.

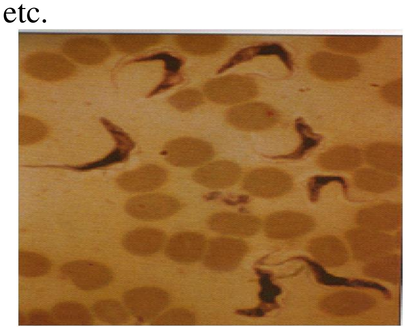

Fig. 4.1Trypanosomes in blood Smear

Fig 4.2 Chronic Trypanosomiasis

Clinical signs:

- In cattle and buffaloes, the disease is characterized by high fever (103-106°F)
- Animal may move in circles aimlessly and falls down, frequent urination and defecation.
- Sub acute form is manifested as gradual loss of condition, oedema of legs, intermittent fever and progressive anaemia.

Diagnosis:

Diagnosis is by the detection of parasite in the fresh blood at the high temperature by their motility. It can be viewed through 40X objective of the microscope. The organism can be detected in the stained blood smears.

Treatment:

Treatment is by use of quinapyramine salts @ 3-5 mg/kg b.Wt-

Sub cutaneus. Supportive therapy is by giving 20% Dextrose @ 0.5g/kg b.wt

I/V and B-complex injection.

Prevention:

- Prophylactic injections of quinapyramine salts can protect the animals from surra.
- Control of flies by maintaining cleanliness in the sheds. Clearing bushes and preventing water logging around the cattle sheds to prevent flies. Spraying of insect repellents and insecticides on the animal and in the shed.

4.2 Babesiosis

The disease is also known as Tick Fever, Red Water disease and Bovine Piroplasmosis. Babesiosis is a tick transmitted intracellular haemoprotozoan infection of cattle, buffalo, sheep, goat, horse, dog, pig, wild animals. Mostly cross bred cattle are more susceptible.

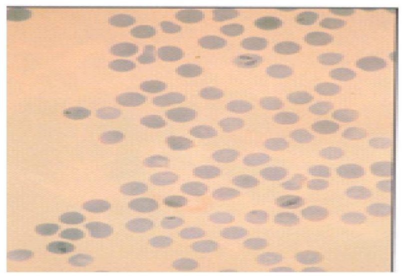

Fig. 4.3Babesiosis

Fig 4.4 Haemoglobunuria

Etiology:

The disease is caused by Babesia bigemina, Babesia bovis in cattle.

Transmission:

It is transmitted from affected to healthy animals through ticks namely Bhoophilus, Rhipicephalus, Ixodesricinus.

Clinical signs:

- The affected animals show high fever (104-106^{0}F).
- Haemoglobunuria (coffee coloured urine) may be noted within about 48 hours of the appearance of the high temperature.

- Mucus membranes are pale. Sometimes jaundice may be seen. In fatal cases, the animals are unable to stand on their feet in spite of support.

Diagnosis:

Diagnosis is made on the presence of parasites in the blood smear. Rod, coma shaped organisms are seen in the RBC.

Treatment:

Dimanazeneaceturate 3.5mg/kg.b.wt deep intramuscular. Oxytetracycline @ 10mg/kg.b.wt- I/M or I/V for 5 days can be tried if the drug of choice is not available. Supportive therapy with Dextrose 20%- one litre- I/V and haematinics should be administered.

Control:

- Affected animals should be isolated and treated. When animal is tick infested, insecticides i.e deltamethrin or cypermethrin can be sprayed.
- Control of ticks in the sheds and on animals by spraying cypermethrin, deltamethrin, flumethrin etc., in recommended dilutions.

4.3 Theileriasis

The disease is also known as East coast fever, Tropical theileriasis or Tropical Piroplasmosis. It is an important, highly fatal intracellular haemoprotozoan disease in exotic and crossbred cattle.

Etiology:

It is caused by Theileria annulata in cattle.

Fig 4.5 Theileriosis

Transmission:

It is transmitted by nymph and adult ticks of Rhipicephalus appendiculatus.

Clinical signs:

- The affected animals show high fever (104-106^{o}F).
- Enlargement of pre scapular lymph nodes.
- The conjunctiva mucous membranes is pale which later turns yellow in affected animals. Mortality may be as high as 80-90%.

Diagnosis:

Diagnosis is made by detection of Theilaria annulata in red blood cells and demonstration of Koch's Blue Bodies in the fluid obtained from a superficial lymph gland with a long needle.

Treatment:

Drug of choice is Bupavarqunone- 1ml/20kg.b.wt- I/M. Supportive therapy with 20% dextrose @ 0.5g/kg b.wt I/V; B-complex and haematinics should be under taken.

Control:

- Control is by regular spraying cypermethrin, deltamethrin, flumethrin etc., in recommended dilutions in tick infested areas and rotational grazing.
- Prophylaxis by use of schizontal vaccine Raksha Vac-T which is stored in liquid nitrogen.

4.4 Anaplasmosis:

Anaplasmosis is an haemoprotozoan disease of cattle, sheep and goats. It is also known as gall sickness. Indian breeds of cattle are carriers. It is severe in exotic and crossbreds.

Etiology:

It is caused by Anaplasma marginale seen in red blood cells.

Transmission:

It is transmitted by ticks from infected to healthy animals.

Clinical signs:

- Affected animals show high fever 105°F, lack of rumination and loss of appetite.
- Animals walk with stiff unsteady gait. Glands are enlarged and there is rough coat with edema around the eyes.
- Mucus membrane turns pale to yellow in colour and progressive anaemia. Oedematous swelling of the body may be noticed.
- In late pregnancy, animals may abort. Recovered animals remain carriers for life but are resistant to further infection.

Treatment:

Oxytetracycline @ 10mg/Kg.b.wt I/V or I/M for 3 to 5 days. Use of B-complex and haematenic drugs are recommended.

Prevention:

- Isolation and disposal of carrier animals.
- Insect control in the sheds and on animals by spraying insecticides.

4.5 Leishmaniasis

Leishmaniasis is a haemoprotozoan disease and recorded in dogs and bovines in India. It is also referred as oriental sore or Delhi Boil.

Etiology:

The Visceral form of the disease is caused by Leishmania donovani and cutaneous form seen in adults caused by L.tropica .

Transmission:

Transmission of infection is through the saliva of the vector i.e sand fly (Phlebotomus sp).

Clinical Signs:

The incubation period ranges from 3 months to several years. Leishmaniatropica causes cutaneous leishmaniasis where small focal lesions appear on the skin. Leishmaniadonovani causes visceral leishmaniasis where generalized skin diseases are noted. Besides skin lesions there is loss of body weight, poor appetite and lymphadenopathy are also observed.

Diagnosis:

By demonstration of parasite in the peripheral blood.

Control:

By control of sand flies by using insecticides in the sheds.

4.6 Coccidiosis

Coccidiosis is a contagious enteritis. It is more common in young animals below 6 months age.

Etiology:

It is caused by Eimeria bovis, E.zurnii, E.ellipsoidales in all domestic animals.

Transmission:

Ingestion of contaminated feed and water.

Clinical signs:

Sudden onset of bloody offensive diarrhoea with mucus with straining. It leads to dehydration, emaciation and death.

Fig 4.6 Coccidiosis

Diagnosis:

Diagnosis is by faecal examination for oocyst.

Treatment:

Gut acting sulpha drugs like sulphaguanidine or pthalylsulpathiazole, Furazolidone or Furazolidone with Metranidazole bolus can be given orally followed by use of B-complex and haematinic drugs are recommended.

Control:

Control is by maintaining hygienic conditions in young animal sheds.

4.7 Amoebiasis

Entamoeba bovis in the intestines of cattle is non-pathogenic. Transmission of infection is by ingestion of contaminated feed and water with mature cysts.

Symptoms: In acute disease, dysentery may develop, which may be fatal, progress to chronicity, or resolve spontaneously. Chronic cases may show chronic diarrhoea or dysentery and weight loss.

Diagnosis: The disease is diagnosed by examination of faeces for the presence of trophozoites and cysts.

Treatment: Metronidazole (10–25 mg/kg, PO, bid for 1 week) or furazolidone (2–4 mg/kg, PO, tid for 1 week) is suggested for treatment.

Short Answer Type Questions

1. Mention the control of tick born diseases.
2. Mention the causative organisms of Theileriasis and Surra.
3. Mention the symptoms of Coccidiosis disease.
4. Mention the symptoms of Trypanosomiasis disease.
5. What are the clinical signs of Babesiosis” disease

Long Answer Type Questons

1. Explain in detail about ‘Trypanosomiasis’ disease.
2. Write about the Theileriasis disease in crossbred cattle
3. Write briefly about Babesiosis” disease in cattle.
4. Explain briefly about Analasmosis disease in cattle.

Ψ

UNIT 5

Helminthic and External Parasitic Diseases

Structure

5.1 Round Worms

5.2 Tape Worms

5.3 Liver and Stomach Flukes

5.4 Nasal Schistosomiasis

5.5 Flies

5.6 Ticks and Mites

5.7 Common Helminthic and External Parasites of Sheep and Goat

5.1 Round Worms

Ascariasis is a common parasitic infestation in calves, especially in buffalo calves.

Etiology:

The disease Ascariasis is caused by Toxocara vitulorum or Neoascaris vitulorum.

Transmission:

It is transmitted by ingestion of ova and neonatal transmission through colostrums. When the dam is not properly dewormed the colostrums may be a potent source of infection to the calf.

Clinical signs:

Clinical signs are anorexia, pot belly, anaemia, stunted growth, rough hair coat, constipation and sometimes intestinal obstruction with worms.

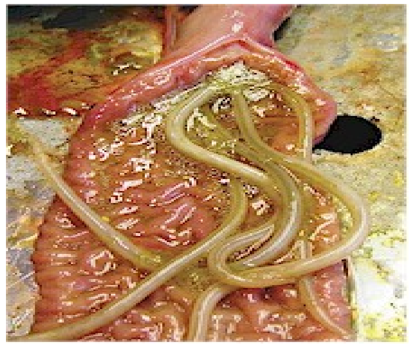

Fig 5.1 Round Worms

Diagnosis:

Diagnosis is by faecal examination for the presence of Ascarid eggs.

Treatment:

Treatment can be undertaken by Piperazine salts (Piperazineadipate— 300 mg / kg b.wt, Piperazinehexahydrate 250mg/kg b.wt) or any broad spectrum anthelminthic. It is better to use Piperazine every 3 weeks. When the faeces is not passed normally, carminative mixture, magnesium sulphate has to be given orally. Intravenous fluid therapy is necessary, if the calf is off fed and dull.

Control:

Regular deworming, application of muzzle to young calves and adoption of better management practices. Avoid overcrowding. Pregnant animals are to be dewormed so that worms are not voided through colostrum.

5.2 Tape Worms

The common tape worm is Moneizia expansa.

Transmission:

It is transmitted by ingestion of infective stage from the intermediate host i.e. oribatid mite. Calves below 6 months are mostly susceptible.

Clinical signs:

Clinical symptoms are dullness, rough body coat, pot-bellied, stunted growth, excretion of tape worm segment in the faeces, constipation and sometimes diarrhoea.

Fig 5.2 Tape worm

Diagnosis:

Diagnosis is by examination of faecal sample for detection of tape worm segments.

Treatment:

Niclosamide @50mg/kg b.wt or Praziquantal @ 5mg / kg b wt., orally to be repeated every 3 months. Supportive treatment with B-Complex and iron preparations can be taken up.

Control:

Control is by periodic deworming and by following good management practices. Number of oribatid mites can be reduced by thorough ploughing of permanent pastures.

5.3 Liver and Stomach Flukes

5.3.1 Liver Flukes

Liver flukes Fasciola gigantica, Fasciola hepatica and Faasciola indica cause fascioliasis in cattle, sheep and goat.

Transmission:

Mode of transmission is by ingestion of meta cercaria. Snails are intermediate hosts. (Lymnaea sp).

Clinical signs:

In acute form of disease, the affected animal exhibits anorexia, depression, anaemia and death.

In chronic form of disease, animal shows loss of appetite, constipation followed by diarrhoea, oedema below the mandible is known as bottle Jaw, oedema of dependant parts, purulent discharge from eyes, emaciation and death.

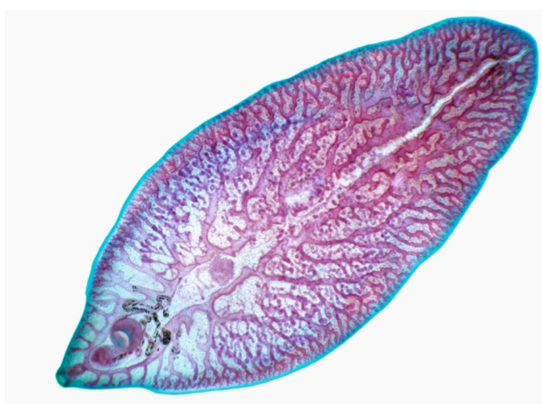

Fig 5.3 Liver fluke

Diagnosis:

Diagnosis is by clinical signs especially bottle jaw condition and examination of faeces for fasciola ova.

Treatment:

Treatment is with Oxyclozanide-10-15mg/kg b.wt or Triclabendazole 12mg/kg b.wt or closantel-10mg/kg b.wt orally.

Control:

The disease can be controlled by periodical deworming with flukicides. Do not allow grazing on water stagnated pasture and snail population has to be controlled.

5.3.2 Stomach Flukes:

Paramphistomiasis cause chronic disease of cattle, characterized by severe enteritis and oedema of brisket region. (Cotylophoroncotylophorum, paramphistomumcervi and Gastrothylaxcruminifer)

Transmission:

Transmission is through ingestion of contaminated pasture and water with metacercaria.

Clinical signs:

Clinical signs are due to immature flukes which cause severe enteritis accompanied by weakness, emaciation, depression, loss of appetite, oedema of brisket region. Animal become very thirsty and drink frequently. There may be sub maxillary oedema and pale mucus membrane. Death is due to severe dehydration.

Diagnosis:

Diagnosis is made by presence of immature flukes in the faeces and also presence of amphistome eggs in the faeces.

Treatment:

Flukicides like Rafoxanide at 7.5mg/kg b.wt orally or closantel 5mg/kg b.wt orally.

Treatment should be undertaken to replace the fluid and electrolytes lost by using Ringers lactate-I/V.

Control:

Snail control is to be done by any one of the following methods to control the spread of disease.

1. Chemical: use of copper sulphate to control the snails.

Mechanical: removal of vegetation, drainage of swamp to reduce snails.

3. Biological- propagation of plants like soapberry, shikakai which inhibit growth and reproduction of snails.

It is also called as Nasal granuloma. It is a disease of cattle, sheep, goat, pig, dog and man caused by Schistosome worms known as Schistosomiasis.

Etiology:

It is caused by Schistosoma bovis, S.nasalis, Schistosoma indicum, S.spindaleans.

Transmission:

It is transmitted through the intermediate host- snail.

Clinical signs:

Nasal schistosomiasis is manifested by rhinitis and mucopurulent discharge from nostrils, granulomatous growth in nasal chambers, stenotic (snoring) sounds along with dyspnoea and low milk production. In acute heavy infection, there is profuse diarrhoea or dysentery and in chronic cases animals become emaciated with loss of weight along with anaemia.

Diagnosis:

Confirmative diagnosis can only be done by examining faecal sample or nasal discharge which are usually mixed with mucous and blood and having typical shaped ova.

Fig 5.4 Schistosomiasis

Treatment:

Treatment can be undertaken by tartar emetic at the dose rate of 2 mg per kg s/c or i/m daily for 6 days.

Sodium antimony tartarate @ 1.5mg/kg wt in 10% glucose, three times daily for two consecutive days is administered. Anthiomaline is also used to treat nasal schistosomiais in cattle @1.7mg/kg daily for 6 days.

Control:

Control can be achieved by means of two ways:

i. Control of Intermediate hosts.
ii. Treatment of infected animals and prevention of animals from getting infected.

5.5 Flies

Common flies are housefly, buffalo gnats, buffalo flies, stable fly, oestrus ovis fly etc. They cause annoyance to the livestock and results in reduced production. They have capacity for transmitting infectious diseases. Unattended wounds attract flies and results in maggoted wounds.

Control of flies is by keeping the surroundings clean and dry. Quick and proper disposal of waste and dung. Fly repellants like neem oil can be used. Valuable animals should be protected by using mosquito nets.

Smoking the shed with dried neem leaves is also effective against flies and mosquitoes.

5.6 Ticks and Mites

Ticks:

Number of species of ticks affect cattle. They are found on ear, armpit, groin, ventral aspect of tail and other regions from where animals cannot get rid off by licking and rubbing.

Fig. 5.5 Soft tick

Ticks are classified in to soft ticks (Eg: Boophilusannultatus) and hard ticks (Eg: Rhipicephalusappendiculatus). They cause local irritation, resulting in wounds, cause loss of production of meat, and decrease value of hides. They suck considerable amount of blood and cause anaemia and death.

Ticks act not only as vectors but also reservoir for number of diseases like anaplasmosis, babesiosis and thieleriosis.

Control of ticks is by spraying insecticides i.e malathion, sumithion,delta methrin and cypermethrin on the animals and also in the sheds and injecting the animal with ectoparasiticides.

Mites

Mites are microscopic and cause mange in animals characterised by scratching, thickening of skin and wrinkled condition of skin.

Fig. 5.6 Mite-sarcoptes

Transmission is by direct contact from infected animal to other animal. Indirectly through inanimate objects like beddings etc.

Treatment is by clipping the affected area and applying benzyl benzoate as external application. Control is by immediate segregation and through cleaning of all parts of skin with acaricides and a course of antibiotics to prevent secondary bacterial infection.

5.7 Common Helminthic and External Parasites of Sheep and Goat

5.7.1 Round Worm/ Haemonchosis

The common round worm in sheep and goat is Haemonchosis contortus, popularly known as stomach worm or wire worm. Haemonchosis is one of the most pathogenic blood sucker infestation of sheep and goat. It occurs in the abomasum caused by various Haemonchus species.

Transmission:

Transmitted by accidental ingestion of 3rd stage (infective) larva by the animals while grazing.

Clinical signs:

Young animals suffer acute form of the disease. Clinical signs like dung like faeces or bloody diarrhoea, stunted growth, dull, anaemia and going down in condition.

Diagnosis:

Diagnosis of the disease is by faecal examination for detection of ova.

Treatment:

Treatment is undertaken by the use of anthelminthic drug like tetramisole or levomisole. Deworming should be done once in 3-4 months. Different groups of drugs have to be used as rotational deworming to prevent anthelminthic resistance.

5.7.2 Tape Worms:

The common tapeworm found in sheep and goat is Moneizia expansa and M.benedini.

Transmission is by ingestion of oribatid mites containing infective eggs by the animals while grazing and un hygienic conditions in the sheds.

Signs like stunted growth, not putting on weight, rough coat, digestive disturbances and passing of tape worm segments along with faeces.

Diagnosis is by the examination of faecal sample for tape worm segments and eggs.

Treatment:

Anticestodal drugs like Niclosamide @ 150 mg/ kg b.wt or Praziquantel 5mg/kg b.wt once in 3 months.

Control:

Periodical deworming to sheep and ploughing of the permanent pasture for reducing the number of mites in the grazing area should be practiced.

5.7.3 Liver Flukes and Stomach Flukes

Sheep and goats reared near water reservoirs like tanks, canals and water stagnated areas, suffer from this disease.

Acute fasciolasis in sheep causes sudden death with discharge of frothy blood through nostrils and anus confusing with anthrax. Other signs like diarrhoea, yellow conjunctiva and bottle jaw condition are also seen.

Stomach flukes, mostly immature flukes cause severe enteritis, dehydration, pale conjunctiva, bottle jaw condition and death.

Diagnosis:

Diagnosis of the disease is based on history of grazing animals near ponds and tanks and signs like oedema of dependant parts especially bottle jaw and faecal examination for the presence of immature flukes and ova.

Treatment:

Treatment is by using flukicides like oxyclozanide 10 mg/kg b.wt or Triclabendazole 12mg/kg b.wt or for immature flukes Niclosamide 150 mg/kg b.wt or Rafoxanide 7.5 mg/kg b.wt orally. Liver extract injections as supportive treatment.

Control:

Control is by combating the snail population. Prevent animals to graze in water stagnated areas and pastures or near water reservoirs.

5.7.4 Nasal Bots

It is caused by Oestrus ovis fly in sheep. The fly lays eggs in the nasal cavity of sheep and goat and the larvae are present in the nasal cavity causing irritation. It results in sneezing, unilateral nasal discharge. Sometimes larvae expelled out while sneezing. Animal is trying to rub the nose bridge and face against hard objects.

Treatment is by injection of Ivermectin 1ml /50 kg b.wt or 0.2 mg/kg b.wt subcutaneously.

5.7.5 Ticks and Mites

Various species of ticks are found on the face, groin, ear etc and cause irritation resulting in scratching, anaemia, decreased body weights and decreased value of hide. They suck blood and transmit protozoal and viral diseases.

Ticks

Ticks can be controlled in flock by spraying of insecticides to the animals and also in the sheds. Dipping tanks are used for dipping of sheep in case of large flock size.

Mites

These are microscopic and cause mange. Several species affect sheep and goat. It is an infectious skin disease and spreads in the flock from one animal to the other. Sarcoptic mange has zoonotic importance. Psorptic mange is common among sheep and goat.

Clinical signs like itching, rubbing against hard objects, loss of hair and white crusts all over the body and spreads rapidly among the animals.

The affected animals are to be separated from healthy animals. Topical application of Benzyl benzoate, Amitraz, flumethrineetc in recommended dilutions can be used. Vitamin A injections and a course of antibiotics can be given to prevent secondary bacterial infection.

Short Answer Type Questions

1. What are the clinical signs of Ascariasis disease in young calves
2. Mention the control measures of Liver flukes in cattle and sheep.
3. What are the methods to control snails
4. Name the common tape worm found in sheep and goat.
5. What are the clinical signs of Haemonchosis disease in sheep

Long Answer Type Questions

1. Write about Liver flukes disease in cattle.
2. Briefly write about Nasal schistosomiasis disease in cattle.
3. Write in detail about 'Tape worms' in cattle and sheep.
4. Write about the effect of flies, ticks and mites and their control.
5. Write briefly about stomach fluke disease in cattle.

Ψ

UNIT 6

Mycotic Diseases

Structure

6.1 Ring Worm

6.2 Aspergillosis

6.1 Ring Worm

Ringworm is a fungal disease caused by various fungi of Trichophyton and Microsporum species in animals.

Etiology:

In cattle, the disease is caused by Trichophytonverrucosum, T. mentagrophytes and T. Megnini

Transmission:

Transmission of the disease is by contact with infected animals and indirectly through inanimate objects like utensils, blankets.

Clinical signs:

Clinical signs are loss of hair, itching and circumscribed lesions of 0.5-2'' in diameter. Lesions are commonly seen around eyes, ears and extend up to the neck region.

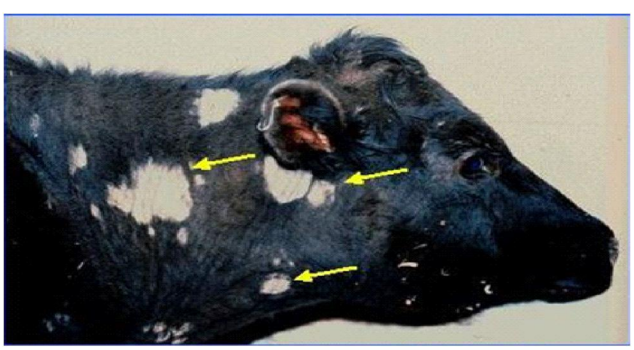

Fig. 6.1 Ring worm

Diagnosis:

Microscopic examination of skin scrapings reveal mycelia and rounded spores.

Treatment:

- Clipping the hair and applying antifungal ointments like salicylic and benzoic acid preparations.
- Topical fungal lotions containing ketaconazole and miconazole can be applied for a week even after regression of lesions.
- Supportive therapy with antihistamines, vitamin A, B-complex and antibiotics can be undertaken.

Control:

- Segregation of affected animals and treating them with oral and topical antifungal preparations.
- Maintaining hygiene and regular grooming of the animals.

6.2 Aspergellosis

Aspergellosis is a primary disease of the respiratory system characterized by granulomatous lesion in the lungs.

Etiology:

It is caused by Aspergillus fumigates.

Transmission:

Transmission is through inhalation of dust containing fungal spores.

Clinical signs:

- In adults, abortions occur during 6th -8th month of pregnancy.
- The pulmonary form of the disease appears as chronic, sub acute or acute pneumonia. All the forms are fatal and characterised by open mouth breathing, profuse salivation and muco-purulent nasal discharge.

Diagnosis:

Microscopic examination of the nasal secretions will reveal the presence of mycelia.

Treatment:

No effective treatment is available. Hamycin and flourquinolones can be used.

Control:

Control is by avoiding overcrowding, proper ventilation and maintaining hygiene in the animal sheds.

Short Answer Type Questions

1. What is the Etiology of 'Ring worm'
2. What is 'Aspergellosis'
3. Mention the clinical signs of Ring worm
4. Mention the clinical signs of Aspergellosis
5. Write about the control of Ring worm and Aspergellosis

Ψ

UNIT 7

Production and Systemic Diseases

Structure

7.1 Ketosis

7.2 Milk fever

7.3 Downer Cow Syndrome

7.4 Pregnancy toxaemia

7.5 Bloat

7.6 Acid and Alkaline indigestion

7.7 Mastitis

7.8 Pneumonia

7.9 Enteritis

7.10 Dermatitis

7.1 Ketosis

Ketosis is also called as Acetonemia or Hypoglycemia. It is a disorder of energy metabolism characterized by ketonemia, ketonuria, hypoglycemia and low levels of hepatic glycogen. It occurs usually within 6-8 weeks after parturition usually during peak yield.

The disease is manifested in two forms:

1. Wasting type

Wasting type of ketosis is more common in buffaloes. Animal exhibits gradual and moderate decrease in appetite, refusal of concentrate and decrease in milk yield. Woody appearance of the skin is seen buffaloes. A characteristic odour of ketones is detectable on breath and often in milk.

2. Nervous Type

Sudden onset is common in cows. Nervous signs like walking in circles, aimless movements, vigorous licking of the skin and inanimate objects. Moderate tremors and staggering gait is also noticed.

Diagnosis:

Estimation of ketones in urine and milk by employing Ross Modified Rotheras test will help in detecting subclinical ketosis.

Fig. 7.1 Ketosis

Treatment:

- Glucose replacement using Glycerine or Propylene glycol225g twice daily for 2 days orally.
- Injection of 20% Dextrose @ 0.5 g/ kg b. Wt – I/V.
- Injection of catosal – 5 ml/100 kg b. wt – I/M or I/V.

- Proper feeding of the animals during pregnancy. Prophylactic feeding of glucose precursors after calving.

7.2 Milk Fever or Hypocalcaemia

It is also called as Parturient paresis. It is a production disease occurring most commonly in adult cows and buffaloes within 7 days after calving. It may also occur several weeks before or after calving.The clinical signs are exhibited in three stages.

1. Stage of excitement and tetany

Animal is excited and hypersensitive, grinding of teeth, muscular tremors which are more in hind legs, stiffness, protrusion of tongue. Temperature is normal or increased by 1^{0}F.

2. Stage of sternal recumbency

Animal sits down on sternum. Head and neck deviated towards the flank. 'S' shaped posture of the animal. Temperature is sub normal. Animal responds to treatment only till this stage. If untreated the animal goes to next stage.

Fig. 7.2 Milk Fever

3. Stage of lateral recumbency

Animal lies on lateral recumbency leads to Coma and death.

Diagnosis:

By the history of recent parturition that is 48-72 hrs or high milk yielders and also animal exhibiting any one of the above signs. Estimation of calcium in the urine by sulkowitch test will help in detection of subclinical hypocalcemia.

Treatment:

- Calcium borogluconate 25%- 450 ml slow intravenous morning and evening or intravenous followed by subcutaneous injections or calcium gel orally.
- Treatment gives a magic relief and the recovery confirms the diagnosis.
- Calcium gluconate-15 ml i/m for 3days is very useful for maintenance of blood calcium levels. It may be given along with above calcium therapy or afterwards to avoid relapse.

Prevention:

Prevention is by feeding of gel calcium before and after calving. Mineral mixture @ 50gms per day should be given along with concentrate mixture throughout the lactation period and dry period to the high milk producing dairy animals.

7.3 Downer Cow Syndrome

It is a condition occurs in cattle usually after parturition but exceptionally may occur in pregnant animals. It is characterized clinically by prolonged recumbency even after two successive treatments with calcium.

Etiology:

Metbolic disturbances, injuries to musculoskeletal system, infections, toxaemias and such other possibilities are various etiological factors.

Clinical signs

Animal is quite alert, normal appetite, attempts to get up unsuccessful. Animal if made to stand forcibly cannot bear weight either on forelegs or hind legs. It is sort of benumbing and flaccid atrophy of hip and thigh muscles.

Fig 7.3 Downer Cow syndrome

Treatment:

1. Provide comfortable bedding and turn the cow from side to side several times daily to minimize the degree of ischemic necrosis.
2. Attempts at slinging are usually unsuccessful unless the cow is partially able to get up on her own.
3. Corticosteroids, Non steroidal Anti-inflammatory Drugs, Nervine tonics and vitamin E selenium preparations can be tried.
4. Sand is an ideal form of bedding.
5. Physiotherapy to avoid muscle damage. Massage with liniment camphor, infra red fomentation, diathermy may be useful.
6.

Control:

Early detection and treatment of hypocalcaemia /parturient paresis recumbent cows to be coaxed and assisted to stand if possible. If unable to stand, should be rolled from one side to another side. Dairy cows should be placed in a box for calving and left in that box until at least 48 hours after parturition in the event that milk fever develops.

7.4 Pregnancy toxaemia

It is a highly fatal metabolic disease of sheep and goat occur in late pregnancy.

Etiology:

Deficiency of blood glucose level is the main cause for the disease.

Clinical signs:

- Anorexia followed by depression is the first sign.
- There is twitching of muscles, rapid respiration and ataxia.
- Animals may be apparently blind and they stand with their heads pressed against some object. Animal go down and become paralysed and die.

Treatment:

1. Trenbolone acetate 30 mg once daily through intramuscular route can be used to improve appetite.
2. Animal should be kept away from sun and hot.
3. Adequate water should be provided to the animal.
4. Forced feeding should be resorted.

Control

- Provision of concentrate containing 10% protein @0.25 kg per day should be made in the last 4 weeks.
- Animal should be provided with Vitamin A rich feed during pregnancy.

7.5 Bloat or Tympani

It is an abnormal distension of the rumen and reticulum caused by excessive retention of the gases of fermentation. It can be broadly classified into

a. Primary tympani or leguminous bloat or frothy bloat, which is dietary in origin and occurs in cattle on legume pasture and on high level grain diets. Gas is in the form of a persistent foam mixed with the rumen contents.

b. Secondary ruminal tympani or free gas bloat, which is due to failure of eructation of free gas because of a physical interference with eructation. Spasms of oesophagus and inability to eructate are seen in tetanus affected animal.

Clinical signs:

- Sudden distension of upper left flank and sometimes whole of the abdomen is enlarged. On striking the left flank (percussion) with fingers, drum like sounds are heard.
- The animal may get up and lie down frequently, kick at the belly and even roll.
- Animal exhibits increased respiration, difficulty in breathing and protrusion of tongue. Bloat is one of the common cause of sudden death in cattle.

Fig 7.4 Bloat

Treatment:

- Animal has to be made to stand with anterior elevation.
- Tying of neem stick in the mouth.
- Smearing of salt on the tongue to increase salivation.
- Drenching of sweet oil (cooking oil) 100 to 200 ml or anti bloat preparations i.e Bloatosil, Bloaton 50-100ml as drench. Antihistaminics inj., are also given.

Control:

1.Roughage to the extent of 10-15% to be added to complete feed.

2.Leguminous fodder to be restricted to not more than 1/3 of the total green fodder.

7.6 Acid and Alkaline Indigestion

7.6.1 Acid Indigestion/Rumen acidosis/Impaction

It may be defined as simple digestive disturbance which is clinically manifested by anorexia and distended rumen with fluid.

Etiology:

- Accidental ingestion of excessive starch containing foods.
- Enthusiastic over feeding of whole or crushed grains.
- Feeding of decomposed silage.
- Sudden change in the quality of concentrate feed.

Clinical signs:

1. Dull, depression and anorexia within 8-12 hours of feeding.
2. Rumen is distended with fluid.
3. Sluggish ruminal motility.
4. Palpation may reveal firm and doughy condition.
5. Dyspnoea due to genesis of gas.

Treatment:

- Use of saline purgative i.e. Magnesium sulphate.
- Correction of ruminal pH by Sodium carbonate.
- Principle treatment is to evacuate the ruminal contents by rumenotomy and to include rumen liquor from healthy cow.
- Use of oral antibiotics.

Control:

- 1:1 combination of sodium and Potassium carbonate at the rate of 2% in concentrate.
- 2% sodium bicarbonate and 0.25% thiopeptin in the ration.
- Regular exercise of animals.
- Strict monitoring of feeding schedule

7.6.2 Alkaline Indigestion

It is a simple digestive disturbance and manifested by anorexia, dull and depression along with aatony of rumen.

Etiology:

- Accidental ingestion of excessive protein rich feeds.
- Intake of placenta following calvings.
- Ingestion of decomposed protein.
- Sudden change of ration from carbohydrate to protein.

Clinical signs:

- Anorexia and constant drooling of saliva.
- Depressed rumen motility both in frequency and amplitude.
- Increased pulse and respiration rate.
- Tremor, ataxia and convulsions.

Treatment:

- Correction of ruminal pH by 5-10% solution of Acetic acid.
- Principle treatment is to evacuate the ruminal contents by rumenotomy in emergency cases.
- Use of oral antibiotics.

Control:

- Strict monitoring of feeding schedule and regular exercise of animals.

7.7 Mastitis

Mastitis is the inflammation of the mammary gland and characterized by physical, chemical and microbiological changes in the milk and pathological changes in the glandular tissues of the udder.

Etiology:

It is due to infectious organisms bacteria like Streptococci species, Corynebacterium species, Pseudomonas species, Klebsiella species, E.coli, Proteus, Mycobacterium species, other infectious agents including virus (pox), fungi, Mycoplasma. Physical trauma like suckling calves, barbed wires any injuries to udder and teats also causes mastitis.

Transmission:

The source of infective agents are udder and environment. It is transmitted from infected to non infected animals through the contaminated milker hands, milking machine cups, biting insects and allergic reactions.

Clinical signs:

- Swelling of udder, hot, painful and presence of abrasions on udder and teats.
- Change in the colour, consistency, presence of flakes, clots and blood in milk.
- The affected animal shows loss of appetite, rise in body temperature and recumbence.

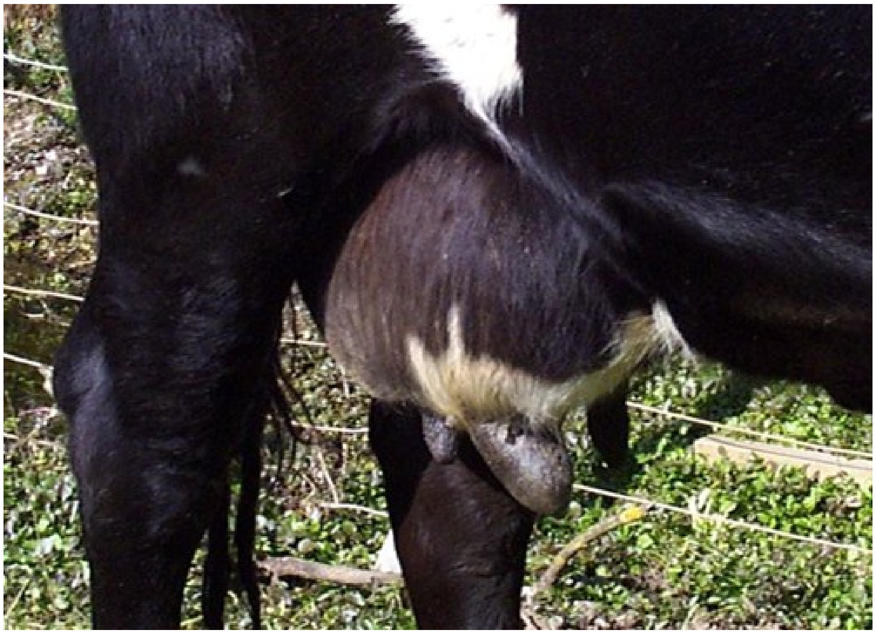

Fig 7.5 Mastitis

Treatment:

- Remove all the milk from the affected teats.
- Apply topical ointments like Mastilep and Wisprec ointment etc.
- A course of broad spectrum antibiotic for a period of 5-7 days.
- A course of NSAIDS for a period of 3-5 days.
- A course of anti histaminics for a period of 3 days.
- Udder supportive like mammidium or masticare for 4 days orally.

Control:

- Proper hygiene in the sheds and Udder and milker hands are to be washed with mild antiseptic lotion thoroughly before milking.
- Use of teat dips after milking.
- Prompt attention to teat injuries, maintaining proper pressure in machine milking.
- Suspected milch animals should be milked at the last.

7.8 Pneumonia

It is inflammation of lungs.

Etiology:

- The disease may be due to bacteria like Streptococci sps, Staphylococcus sps, CBPP, CCPP, Mycobacterium sps, Pasteurella etc., other infectious agents include virus, fungal, and parasites.
- Physical agents like inhalation of dust , pollen and smoke.
- Aspiration pneumonia occurs in farm animals due to faulty drenching of medicines and liquids.

Clinical signs:

- All affected animals show high body temperature, nasal discharges initially serous then mucoid and mucopurulent.
- Moist painful productive cough, extension of head & neck, tendency to lie down and severe respiratory distress.

Treatment:

- Use of specific antibiotics and antipyretics for a period of 7 days.
- Provision of a comfortable well ventilated environment and avoid dusty feeds.

Control:

- Isolation of affected animals and providing treatment to the sick animals.
- Ventilation of the sheds. Dusty feeds to be avoided.
- The animals should be provided proper shelter during rainy and winter seasons.

7.9 Enteritis

It is an acute or chronic inflammation of the intestinal mucous membrane and characterized by frequent passing of loose faeces with or without blood**.**

Etiology: It may be caused by

- Physical agents: Over feeding, mouldy food, decomposed food, excess colostrum feeding in calf, feeding of poisonous plants etc.
- Chemical agents: Accidental feeding of corrosive chemicals, fertilizers, excess use of antibiotics etc.
- Bacterialagents:Escherichia.coli,Mycobacteriumparatuberculosis, Clostridium perfringens type A, B and C etc.
- Viral agents: Rinderpest virus
- Protozoal agents: Eg. Balantidium coli, Coccidiosis
- Helminthic parasites.

Clinical signs:

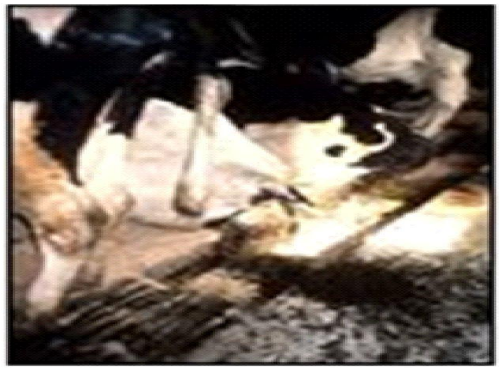

Fig. 7.6 Diarrhoea

- Major clinical symptom in enteritis is diarrhoea i.e. passing of loose watery faeces, if with blood called dysentery, abdominal pain, dehydration.
- High body temperature, congested conjunctiva mucous membrane, sunken eyes are seen in bacterial or viral enteritis.
- The animal is severely dehydrated and increased skin tenting time. Muscular weakness due to loss of electrolytes and dehydration leads to death.
- In chronic cases, the faecal consistency may be semisolid, animal is hidebound, rough hair coat, pale conjunctiva mucous membrane.

Treatment: Treatment is given based on the cause of the disease.

- If it is due to helminths, anthelminthic drugs are used.
- If it is due to viral and bacterial agents only gut acting antibiotics are used. Eg: Sulphadimidine, Gentamicin etc.
- To counteract dehydration, Ringers lactate should be given intravenous and the best way to assess rehydration is urine output. If the animal urinates, it is rehydrated.
- Oral astringent powder is given i.e. Neblon powder, Diaroak powder can be used. For dysentery combination of furazolidone and metronidazole can be used.

- Supportive therapy includes B-complex injections and if hypothermia prevails, calcium preparations may be used.

Control:

Isolation and treatment of affected animals following routine deworming schedule based on the result of random faecal examination.

7.10 Dermatitis

Inflammation of dermis and epidermis including blood vessels and lymphatics are brought under the purview of dermatitis.

Etiology:

Dermatitis may result due to infectious or non infectious causes.

Clinical signs:

Manifestations varies with the nature of causative agents. In bacterial infection pyoderma is the main manifestation while seborrhoea condition will be observed in acarodermatitis. In viral infection there will be signs of viremia and systemic infections. In allergic dermatitis itching and oedema are the cardinal signs.

Treatment:

The primary cause (s) should be ruled out and appropriate measures should be adopted to eliminate them. Bacterial dermatitis will require local and systemic antibiotic therapy. Allergic dermatitis is treated with antihistamines.

Control: Isolation and treatment of affected animals.

Short Answer Type Questions

1. Mention major clinical signs of Bloat.
2. What is pneumonia.
3. What is the cause for milk fever.
4. Mention major clinical signs of Downer Cow syndrome.
5. What is dermatitis.

Long Answer Type Questions

1. Write about Milk fever disease in dairy animals.
2. Explain in detail about Mastitis in dairy animals.
3. Explain in detail about Enteritis in livestock.
4. Write in detail about the ‘Ketosis’.
5. Write briefly about Acid Indigestion.
6. Explain about Pregnancy toxaemia.

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UNIT 8

Diseases of Newborn

Structure

8.1 Calf Scours

8.2 Calf Septicaemia

8.3 Hypoglycemia and hypothermia

8.4 Piglet anemia

8.5 Joint ill and Septic arthritis

8.1 Calf Scours

Calf scours is called as bacterial enteritis or Colibacillosis. It isone of the the common diseases seen in calves and it is responsible for calf mortality during early age (below 3months age.). Buffalo calves are highly suceptble.

It is of three types. Digestive type scouring is due to excessive intake of colostrum/milk. White scours or Escherichia coli infection is due to bacteria. When calves do not get adequate immunity which is due to delayed or inadequate intake of colostrum, then the E.coli takes an upper hand and produce diarrhoea and dysentery leading to death of calf.

More details are presented under **2.17Colibacillosis in Bacterial diseases**.

Fig 8.1 Calf Scours

8.2 Calf Septicaemia

Calf septicaemia is a condition where the bacteria is rapidly multiplying and produce toxaemia resulting in death of the calves. The bacteria commonly involved are Proteus morgani, Pseudomonas aeroginosa, Streptococci, Pasteurella multocida, Brucella abortus and Salmonella.

8.3 Hypoglycaemia and hypothermia

Hypoglycaemia is the low blood glucose levels in calf and it is characterized by sepsis, hypothermia, hypoxic-ischemic brain injury etc., in new born animals. The important clinical signs are irritability, varying degree of altered consciousness, seizures, tachypnea and apnea. Glucose administration through intravenous route should be taken up immediately to save the new born animals.

8.4 Piglet anaemia

Piglet anaemia is also called as iron deficient anaemia and characterized by microcytic-hypochromic anaemia. It is caused in young piglets due to deficiency of iron in the diet or in piglets reared on concrete floor. The first sign of iron deficient anaemia is roughness of hair coat and loss of pigmentation of mucous membrane. In severe cases, pigs may be identified by dyspnoea, increased heart and respiratory rates.This symptom is commonly known as Thumps. It can be treated by administering iron dextran injection.

8.5 Joint ill and Septic arthritis

Joint ill or naval ill is due to bacteria Streptococcus, Corynebacterium or E.coli. These organisms gain entry through umbilicus and may form abscess at umbilicus or they may gain entry in to circulation and then localize at joints causing joint ill.

General line of treatment for calf hood diseases:

1. De worming as early as 7-10days and then every 3 weeks with Piperazine salts till 3 months. Then monthly once with broad spectrum anthelminthic till 6 months of age.
2. If Pneumonia, septicemia or scours are seen in calves, a course of broad spectrum antibiotic should be given intravenously for at least 3 days then followed by intramuscular for 2 days.
3. In calf scours, dehydration should be prevented by giving Ringers lactate intravenous @ 30ml/ kg b.wt, depending on severity of dehydration.
4. Supportive therapy using B-Complex injection can be given.

General Control measures:

1. The resistance of the calf depends on the colostrum feeding. The volume of colostrum to be fed to calf is 10% of the body weight during first 24 hours of life. Of which, 5% should be within 3-5 hours of birth.
2. The young ones should be reared away from the adult stock.
3. Maintenance of strict hygiene and better manage mental practices will reduce the mortality among calves.

Short Answer Type Questions

1. Mention general control measures of diseases in new born animals.

2. What is ‘Calf scours.’

3. What is ‘Piglet anaemia’.

4. What is ‘Hypoglycemia.’

5. What is Joint ill.

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UNIT 9

Reproductive Disorders

Structure

9.1 Anoestrus
9.2 Repeat breeding
9.3 Retained Placenta
9.4 Endo metritis
9.5 Pyo metra
9.6 Infertility - Causes and Prevention
9.7 Other Diseases Associated with reproduction
9.8 Dystocia

9.1 Anoestrus

It is a period of absence of sexual (oestrus) cycles in a dairy animal and no manifestation of heat symptoms. There are two types of anoestrus.

1. Anoestrus having functional CL (Corpus lustrum).
2. Anoestrus without functional CL (Corpus lustrum).

1. Anoestrus having Functional CL

1. Pregnant animals will have CL. So they will not come into oestrus. It is a physiological anoestrus but it is not a disease.
2. Anoestrus due to retained or persistent CL
   a)Persistent CL due to gross uterine pathology.
   b)Retained CL due to early embryonic death/ foetal death.

3. Anoestrus due to sub oestrus/ weak oestrus/ silent oestrus.

4. Anoestrous due to unobserved oestrus/missed heats.

Treatment:

- Daily observation of each and every animal both morning and evening.
- Educating the owners about identification of oestrus symptoms in animals.
- Daily examination of external genital organs for the presence of discharges, blood etc.
- Maintenance of heat expectancy charts for each breed able animal.
- Frequent rectal examination of genital organs by the veterinarians to decide the time of A.I in silent oestrus animals.
- Enucleating of CL by experienced veterinarian, so that animal comes to heat within 2-7 days. If it is not done properly, it leads to development of adhesions and sterility.
- Administration of estrogens: Estrogens cause regression of CL.

(a) Estradiolvalerate- 5mg single I/M on day 4 or day 8 will cause luteal regression.

(b) Diethyl stilbesterol- 10- 100 mg, 2-3 inj at 48 hrs intervals will cause luteal regression.

  - Combination of estrogens and glucocorticoid will cause luteal regression in mucometra and mummified foetus.

- Estrus synchronization by using PGF2 alpha in silent estrus, sub estrus either single or double injections at 11 days interval.

- Estrus synchronization using progesterone preparations.

2. Anoestrus due to absence of functional CL

The animals are true anoestrus cows/buffaloes. They are non-cyclic, ovaries are small, inactive with no functional CL.

1. Anoestrus due to debility or marked loss of weight i.e. low plane of nutrition.
2. Senility or old age leads to cessation of oestrus
3. Season:

Winter sterility in very cold climatic conditions.

Summer sterility in very hot climatic conditions.

4. Due to cystic ovaries.

Treatment:

- Anoestrus due to cystic ovaries - LH or HCG should be given.
- Freemartin, bilateral ovarian hypoplasia, ovarian tumours, tumours of pituitary gland - cull the animal by slaughter.
- Emaciated chronic debilitating conditions like Tuberculosis, Johnes disease - cull the animals.
- Correcting the nutritional deficiencies.

9.2 Repeat-breeding

Cows/Buffaloes have normal or nearly normal oestrous cycle and come in heat regularly but do not conceive in spite of serving by fertile male or by A.I. with semen of good quality for three or more times consecutively. These animals show normal genitalia and clear oestrus genital mucous discharge.

Etiology:

- Ovarian causes: An- ovulatory oestrus, delayed ovulation and progesterone deficiency
- Environmental causes: High temperature and humidity.
- Uterine causes: Uterine infection and biochemical changes in uterus.
- Genetic and heredity causes: Chromosomal defects and inbreeding.
- Artificial Insemination: Poor semen quality, Insemination technique, oestrus detection and insemination time.

Any one of the above cases result in fertilization failure and embryonic mortality leading to repeat breeding.

Treatment:

Delayed Ovulation

- In case of delayed ovulation the animals required to be inseminated more than once depending upon the time of ovulation to reduce repeat breeding syndrome.
- HCG or LH hormone preparations at a dose level of 1500 to 3000 I.U. on the day of A.I. by intravenous route.
- Bromocryptin 1 mg by intra muscular route on the day of estrus.
- In delayed ovulators when C.L. is palpable through per rectum examination of ovary, intramuscular injection of 25-50 mg natural prostaglandin or synthetic prostaglandins in the following heat may be administered. Good result is obtained provided A.I. is taken up about 80 hours post injection.

Anovulatory Oestrus

- HCG or L.H. at the dose of 1500 to 3000 IU may be used in next oestrus to get good result.
- Gn RH (Receptal or Fertagyl) preparation may be given I.M.

9.3 Retained Placenta

Normally the placenta(foetal membranes) are expelled within 3 to 8 hours after parturition. Retention of placenta is the most common condition after parturition is observed mostly in buffaloes and cows, rarely in other species. However, if the placenta is not expelled within 8 to 12 hours it is considered as retained placenta problem.

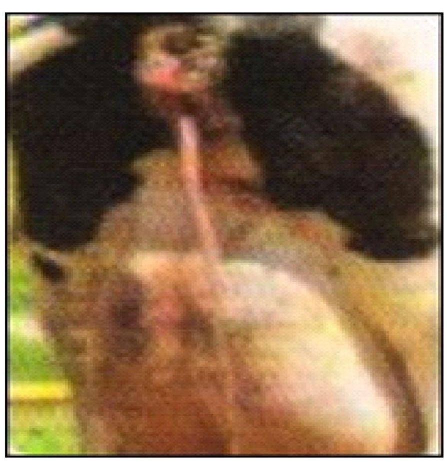


Fig. 9.1 Retained placenta

Retention of placenta may be caused due to seasonal factors, abortions , dystocia, stillbirths and other abnormal parturitions (low levels of progesterone or imbalance of estrogen and progesterone levels leading to weak contractions of uterus and placental retentions), deficiencies of Vitamin A and D or oxytocin or serum calcium and phosphorus and uterine inertia, etc.

Symptoms:

- The symptoms of retention of placenta are characteristic with the hanging placenta. In some cases, the entire placenta may be retained inside the genital tract.
- The body temperature, appetite and milk yield may be normal if there is a low grade infection. In severe cases of longer duration, straining, high fever, accelerated pulse, reduced pulse and low milk yield may be seen.
- The placenta is discoloured, dry and the animal voids foul smelling discharge which may be blood stained.

Treatment:

Retention of placenta has been treated by a variety of techniques, drugs and hormones.

- The usual practice is manual removal of placenta and the best time for this is 24 to 48 hours after parturition. This should be done very gently by grasping each placentome between thumb and fingers and the two structures may be gently separated by rolling, pushing and screwing action and this can be coupled with traction by the other hand those in the cervical area of the uterus and vagina, should be removed first.
- The non-gravid horn should be cleared first and later on the gravid horn should be examined.
- After the manual removal of the placenta, sulpha and antibiotic pessaries may be introduced into the uterus.
- In severe cases, parenteral administration of antibiotics can control infection.

- However, manual removal may be injurious to the endometrium. To avoid this, antibiotic preparations along with proteolytic enzymes were tried without placental removal and it has given good results.

9.4 Endometritis

Endometritis is the common cause of infertility in the field. It is inflammation of endometrium of uters.

- It is caused by sporadic uterine infections by Corynebacterium pyogenes, Coli forms, Pseudomonas aeuroginosa, Streptococci, Bacillus species, Proteus or combination thereof.
- It may be due to abortion, dystocia, retained placenta, genital prolapse, uterine inertia and traumatic lesions in the uterus, cervix and vagina.
- Endometritis may also occur in cows and heifers after coitus or after artificial insemination under unhygienic conditions.
- Endometritis is more prevalent in cows/buffaloes under village management conditions mostly because of unhygienic conditions in the animal sheds and premises.

Symptoms:

- Repeated services/A.I and failure of conception by a fertile bull.
- Muco-purulent discharges from uterus may be seen in vagina. Presence of plaques of pus in oestrus discharge.
- Mucus of estrus is cloudy or milky in appearance due to WBC or leukocyte infiltration.
- Length of the cycle may be reduced to 18-12 days because of prevention of development of corpus luteum.
- Per rectal examination reveals thick walled uterus.

Fig. 9.2Endometritis

Treatment:

- Lugols solution (2%) 20-30ml is given through intra uterine route. It is the first choice when a clear cut diagnosis of the uterine infection is not known.

Appropriate antibiotic treatment is given only after the antibiotic sensitivity test. Solutions of antibiotics as intrauterine infusions for 3 to 5 days will give satisfactory results.

Control:

Hygienic conditions should be maintained in the sheds during calving and after calving.

9.5 Pyometra

Pyometra is inflammation of uterus and is characterized by the failure of estrum and the retention of pus or muco-purulent material in the uterus. Pyometra can be seen as a specific form of chronic endometritis i.e. one with a retained persistant corpus luteum (PCL). It may be due to abortion, foetal maceration, retained placenta and chronic endometritis.

Symptoms:

- Pus is observed when the cow lies down, urinates or defecates.

- The pus is usually thick mucoid and creamy and yellow, white or greenish-gray in colour.
- On per rectal examination, usually in pyometra uterus will not be tonic, the feeling is doughy. The uterine horn enlargement is felt.
- The enlargement of uterine horns may be unilateral or bilateral. Uterine horns are flacid. No foetal bump is felt.

Treatment:

Prostaglandins therapy is effective for evacuation of the uterus due to luteolysis of the PCL. Once the uterus has opened intrauterine antibiotics solution is given to control the uterine infection.

9.6 Infertility - Causes and Prevention

Infertility is the inability of animal to reproduce successfully. It is a temporary sterility of animals.

Causes of infertility

I. Infectious causes: Trichomoniasis, Vibriosis, Brucellosis, Granular venereal disease, Infectious Pustular Vulvovaginitis due to IBR- IPV, Tuberculosis, Mycoplasma etc.

II. Hormonal causes: Cystic ovary, anoestrus, repeat breeding.

III. Nutritional causes: Under feeding or starvation, obesity due to overfeeding, vitamin and mineral deficiency.

IV. Hereditary and congenital: Anatomical defects of reproductive tract.

(1) Ovarian hypoplasia
(2) Agonadal condition
(3) Developmental defects of tubular genitalia

- White heifers disease
- Congenital lack of endometrial glands
- Congenital anomalies of cervix , vagina etc.

V. Pathological causes.

- Ovary: ovarian tumours, ovaritis, ovarian cyst.
- Oviduct: salphingitis, hydrosalphinx, pyosalphinx.
- Uterus: endometritis, pyometra, peri and para metritis, sclerotic metritis etc.

- Cervix: cervicitis, cysts of cervix, complete stenosis of cervix, muco cervix, tumours of cervix.
- Vagina: vaginitis, cysts and tumours.
- Vestibule and vulva- vestibulitis, vulvulitis, cysts and tumours.

Hormonal causes of infertility

1. Cystic ovaries: The ovaries are said to be cystic when they contain one or more Persistant fluid filled structures larger than a mature follicle (>2.5cms in diameters) on one or both the ovaries.

There are three types of cystic ovaries.

1. Follicular cyst/ cystic degeneration of graffian follicle
2. Luteal cyst/ luteinized cyst
3. Cystic corpora lutea

Both follicular and luteal cysts are anovulatory cysts, where as cystic corpora lutea is ovulatory cyst.

Follicular cyst: It is an anovulatory cyst that persists on ovary for about10 days and is characterized by nymphomaniac or continuous irregular estrus and finally anestrus.

Luteal cyst: It is also anovulatory follicle which is prolonged period and ischaracterized by anoestrus.

Cystic Corporalutea: This is an ovulatory cyst and following ovulation, acentral fluid filled cavity is formed. This is most common of all the cystic conditions. In this condition, animal comes to cycle normally, ovulate normally and pregnancy is carried without any problem. So this condition is not pathological.

Causes of Cystic Ovaries

- Hereditary causes
- Incidence is more in high yielding dairy cattle at their peak level lactation
- High protein diets predisposes to cystic ovaries
- Incidence is more in summer than winter
- Stress of production and husbandry: This leads to elevated ACTH from anterior pituitary which interferes with LH release.

- Continuous administration of steroids will interfere with ovulation.
- Fatty liver syndrome predisposes to cystic ovaries.
- Incidence is more between 2nd and 5th lactation.
- High protein levels leads to ovulatory failure and development of cysts.
- Deficiency of beta- carotene leads to reduced secretion of estradiol from the ovary and this may predispose to failure of LH surge.

Symptoms of Cystic Ovaries

Cystic ovaries are more common in non-pregnant dairy cattle between 15-45 days post- partum. Cows with cystic ovaries can be divided in to two groups

- Nymphomaniac group
- Anestrus group

Nymphomaniac Group

The animal shows frequent, irregular and prolonged signs of oestrus. The animals are nervous, restless, vicious and bellowing frequently. Animals are mounting on other animals and refuse mounting by other. Homosexual characters are highly aggrevated and the affected cows are called bullers. The animal loses weight and elevated estrogen levels causes relaxation of sacro- sciatic ligaments and elevation of tail head which is called Sterility hump.

Anestrus Group

The animals does not show signs of estrum of long periods of time, several months are more. In some animals the signs are mild and infrequent and few refuse to stand for bull or other cows to mount them.

Treatment

- LH- 1500-3000I/U or HCG-5000IU-I/V, 10000IU- I/M
- Administration of GnRH:

a) Receptal and fertagyl- 5ml I/M

b) Gonadorelin – 500-1000 micro grams.

- Administration of PGF 2 alpha is indicated in luteal cyst.

Prevention of infertility in dairy animals:

- The animals having the infectious causes of infertility are to be treated. When they are not responding for any treatment, they are to be removed /culled from the herd.
- Proper heat detection in animals. Those animals should be inseminated at right time.
- Teaser bulls should be maintained in buffalo farm to detect silent heat animals.
- Proper maintenance of breeding records in the farm.
- Hygienic conditions should be maintained in maintaining the A.I equipment and at the time of A.I
- The animals should be offered balanced ration with all minerals and vitamin supplements that are required for reproductive health. Good feeding should be given 2 months before calving and 3months after calving.
- Hygienic maintenance of animal sheds is very much required to prevent the infectious causes of infertility in the farm.
- Animals should be protected from hot climate by following all summer management practices in the farm.
- Animals are to be screened for brucellosis, T.B and Jones disease. Animals with anatomical defects, other chronic problems like brucellosis, T.B and Jones disease should be detected and culled from the herd.

9.7 Other Diseases Associated With Reproduction

9.7.1 Prolapse of Vagina and Cervix

This is one of the disorders of pregnancy in ruminants. It can also occur as a post partum accident. It is common in cows and buffaloes during the last trimester of pregnancy.

Causes:

- It may be due to confinement of cattle in sheds without exercise.
- Feeding mouldy feeds or grasses containing phyto oestrogens.
- Irritation of vagina, bladder and intestines leading to contractions of vagina and cervix.
- Increased intra pelvic pressure on account of over distension of abdomen or deposition of excessive amounts of loose pelvic fat.
- Due to secretion of estrogenic hormones from placenta seen in the last two to three months of gestation.
- Too much back slope in the cow/buffalo shed.

In postpartum conditions, in addition to the above, applying more traction to relieve large calf or in a case with dry birth canal. When foetal membranes are pulled too much in cases of retained placenta or in cases of eversion of uterus may also lead to cervico- vaginal prolapse.

Symptoms:

- The prolapsed mass of vagina and cervix of a tennis ball size to that of large ball size is seen during recumbence position.
- The animal expresses pain, anxiety and increased respirations.

Treatment:

- A local anaesthetic of 2%, 5-8ml should be given as epidural anaesthesia.
- The prolapsed portion is gently lifted towards base of the tail to relieve the pressure on the urinary bladder causes the bladder to become empty and in turn reduces straining.
- The mass washed with potassium permanganate lotion and suture the severe lacerations with chromic catgut.

- The genitalia is smeared with antiseptic cream and first the part or portion which is near to the vulval lips is pushed and finally the portion away from the vulval lips is pushed.
- A rope truss is applied if necessary by using ½ to ¾ inch thick cotton rope. The double loop falls at the brisket region and each end comes on either side of the neck and a knot is made at the withers or hump region, then both the ropes are passed along the back bone and get bifurcated at tail and passed below the tail and a knot is made below the anus. The ropes are then taken in between the thighs on either side of the udder and passed forwards and are tied to the ropes in front to the loop now just below the vulval lips both the ropes are sewed together with twine rope and tied tightly. This rope tuss is removed after straining has stopped.
- To prevent further prolapse, the animal is fed with gruel, hay water and fodder feeding is done insmall quantities 3 times a day.The animal is tied in an incline position such that hind feet is an elevated position.
- If progesterone deficiency or excess of estrogens have been suspected, daily 50-100 mg of progesterone I/M or 500mg proluton depot in a fortnight is injected. In case of cystic ovaries with such prolapse it is advised to give 1500 to 3000 IU of HCG or LH or 1000 mcq or natural GnRH.
- Caesarean operation can be indicated in last 2-3 weeks of pregnancy.

9.7.2 Prolapse of the Uterus

It is common in the cow and ewe. In cattle the condition seems to be more common in fat animal with excessive slackening. Outbreak occurs on some farms during one calving season and may be associated with ration with high estrogen content.

Etiology:

- It may be due to Poor Uterine Tone (uterine inertia). In cattle, hypo calcaemia(a cause of primary uterine inertia) may predispose this condition.

- Increased straining which may be caused by pain or discomfort after parturition.

- Excessive traction at assisted parturition and the weight of retained foetal membranes have been suggested as other predisposing factors.

- Other causes are increased intra-abdominal pressure, including tympany and recumbency.

Clinical signs:

- The cow or buffalo is usually found with eversion of uterus with endometrium and cotyledons comprising red angry mass hanging out of the vaginal passage.
- The cow may be standing and apparently unconcerned or she may be shocked and recumbent. The uterus may be grossly contaminated with bedding and faeces.
- It may also be lacerated, engorged and oedematous.
- If it is recently prolapsed, it is warm to the touch but later becomes cold and discoloured.
- Death may be due to haemorrhage from the ovarian arteries.

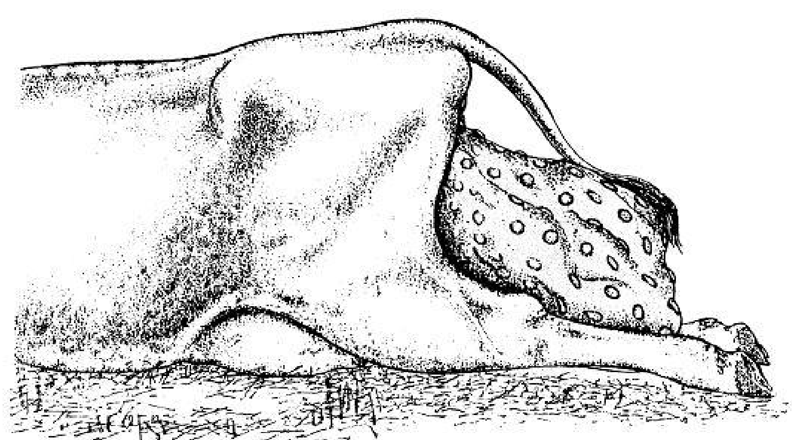


Fig: 9.3 Prolapse of the Uterus

Treatment:

The uterus should be protected from further damage. Wrapped on a clean moist sheet, and, if possible, held above the level of the vulva. Cleaning the exposed mass with antiseptics. Pushing it in with closed fist using gentle force and application of truss to help in retention, combined with appropriate antibiotic therapy to control infection are essential. The success rate depends on early treatment.

9.8 Dystocia: Difficulty in parturition is called as dystocia.

Incidence

- Maternal dystocia is more common than foetal dystocia.
- It is common in primipara than pluripara animals.
- Male calves and in twinning condition dystocia is common.
- Abnormally low litter size in multipara due to foetal over size.
- Prolonged gestation, leads to foetal oversize that will cause dystocia.
- Close confinement and overfeeding of mother will lead to dystocia.

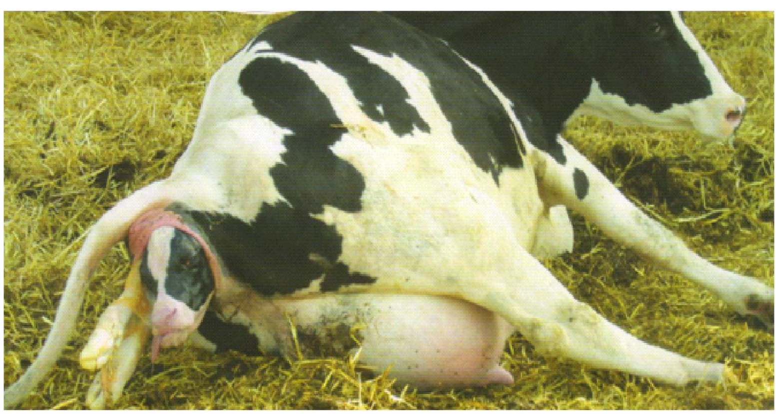


Fig. 9.4 Dystocia

Causes

1. Maternal causes

The maternal causes of dystocia include those factors that either cause narrowing of birth canal or that prevents normal entrance of foetus into birth canal. These include

- Fracture of pelvis
- Small size of pelvis due to breeding at very young age or stunted body growth
- Congenital hypoplasia of birth canal
- Compression of birth canal due to trauma
- Peri vaginal fat
- Uterine torsion
- Failure of cervix to dilate
- Uterine inertia
- Hydropsy of foetal membranes
- Inguinal/ ventral hernia
- Rupture of pre pubic tendon
- Uterine infections- abortions, foetal emphysema and dystocia
- Transverse presentations
- Twinning due to double ovulation.

2. Foetal Causes

- Postural abnormalities
- Excessive size of foetus.

The incidence of dystocia is high in posterior presentation in unipara postural abnormalities include presentation, position and posture of the foetus.

Presentation: The relation of the spinal axis of the foetus to that of dam.

Presentation is either longitudinal or transverse.

The portion of foetus that is entering pelvic cavity/ birth canal. It is anterior or posterior in longitudinal presentation dorsal or ventral in transverse presentation

Position: The relation of dorsum (in longitudinal presentation) of foetus tothe quadrants of maternal pelvis. These are sacrum, right ilium, left ilium and pubis.

Posture: The relation of extremities (Head, neck, limbs) to the body offoetus. The extremities may be flexed, extended or retained beneath or above the foetus.

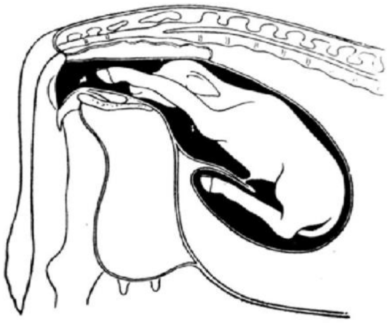
The normal presentation-anterior longitudinal

Position- Dorso-sacral

Posture - Head resting on pelvic cavity and extended forelegs.

Types of dystocia

1. Dystocia due to pathological presentation, position and posture of foetus
2. Abnormal size of foetus
3. P.M changes in the foetus
4. Uterine displacements
5. Uterine inertia



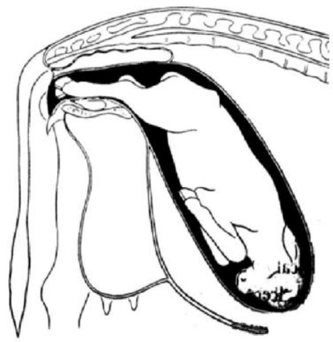


Fig. 9.5 Normal Anterior Presentation **Fig 9.6 Posterior Presentation**

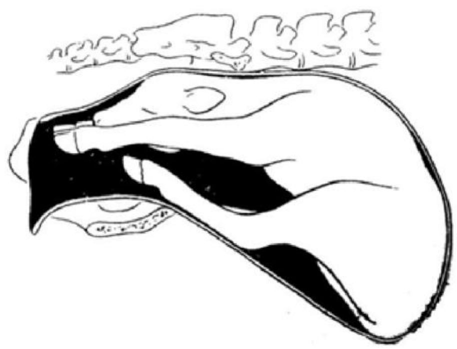


Fig 9.7 Anterior presentation with dog sitting posture

Fig 9.7 Breech Presentation

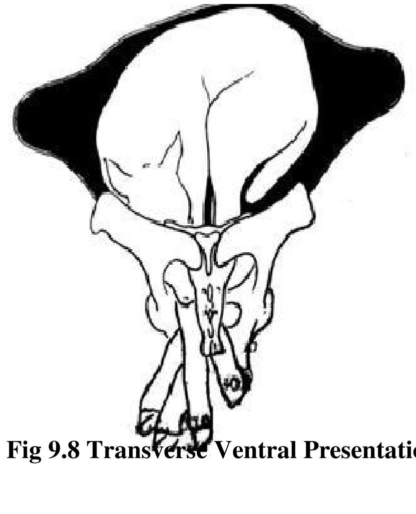


Fig 9.8 Transverse Ventral Presentation

Treatment: Dystocia is relieved by using one of the following methods.

- Rotation
- Torsion
- Repulsion
- Foetotomy

Short Answer Type Questions

6. Mention reproductive disorders in dairy animals
7. What is Anoestrum and repeat breeding
8. What are the causes of Retained Placenta
9. What is Endometritis and Pyometra
10. What is meant by Infertility and dystocia

Long Answer Type Questions

1. Write about the causes and treatment of repeat breeding problem in cattle
2. Write about the causes and treatment of Anoestrus in dairy animals
3. Explain the symptoms and treatment of Endometritis
4. What are the causes of infertility and explain the prevention of infertility in a dairy farm.
5. Write in detail about prolapse of the uterus

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UNIT 10

Prevention and Control of Diseases

Structure

10.1 Isolation of sick animals

10.2 Quarantine

10.3 Vaccination schedule for livestock and poultry

10.4 De worming schedules in livestock and poultry

10.5 Hygienic disposal of dead animals

10.6 Disinfection of premises

10.7 Sterilization of equipment - Hot / Cold / Chemical Method

10.1 Isolation

Isolation means segregation of animals known to be or suspected to be affected with a contagious disease from the apparently healthy animals. Those segregated animals should be housed in a separate isolation ward located far away from the normal animal houses.

When such a separate housing is not available, the segregated animals should be placed at one end of animal sheds.

10.2 Quarantine

Quarantine means the segregation of apparently healthy animals which have been exposed to the risk of infection from healthy animals. It is commonly practiced to the animals being introduced into the herd or a country for the first time. The purpose is to allow sufficient time, for any contagious disease that the quarantined animals may have in the incubation stage, to become active and obvious. Quarantine measures may be applied at the national or regional or herd level. A period of 30 days is generally accepted as Quarantine period. This period may be more for certain diseases. For example, quarantine period for rabies is 6 months.

The Quarantine period depends on

1. Incubation period of the disease.
2. Time taken for the infection to be confirmed. (Time taken for confirmation of lab reports)
3. Time taken for the infected animal to become non-infectious either with or without treatment.

10.3 Vaccination schedule for livestock and Poultry

Vaccination in advanced pregnancy is not recommended.

Cattle and Buffaloes

- Haemorrhagic septicaemia vaccination**-** Once in 6 months for adult cattle Alum precipitate vaccine-subcutaneously. Time of vaccination is last week of May or June i.e before onset of monsoon.
  Calves above 4 months age should be vaccinated for first time.

- Black Quarter vaccination is practiced only in white cattle. Time of vaccination is last week of May or June i.e before onset of monsoon.

- Foot and Mouth Disease vaccination is practiced in March or April and August or September. Alum precipitate vaccine is to be given subcutaneously once in 6 months. Oil adjuvant vaccine is given annually by intramuscular injection.

- **Anthrax** spore vaccine-1ml-subcutaneously is given in February to May in endemic areas only.

- Vaccination against The ileriosis in crossbreds can be undertaken at any time of the year.

Sheep and Goat

- PPR vaccine- 1ml- Subcutaneously is given in January

- Foot and Mouth Disease - 1-2ml- subcutaneously is given in March and September
- Sheep pox vaccine- 0.1ml- Intra dermal is given in March and November
- Enterotoxaemia vaccine - 2-2.5ml subcutaneously is given in May. Sheep and goat are vaccinated above 3months age for first time.
- Anthrax vaccine1ml – sub cutaneously is given during out breaks in endemic areas only.

Vaccination schedule for Layers

0day: MDV-Turkey Herpes Vaccine S/C 0.2ml

5-7days: RD vaccine-RDVF O/N

12-14days: IBDV-Pruning Intermediate Georgia. O/N or Water

28-30days: RD vaccine Booster-Lasota Water

8th week: RD vaccine –RDVK or R2B S/C or I/M

18th week: RD vaccine –RDVK or R2B S/C or I/M

Vaccination schedule for broilers

0 day : MDV-Turkey Herpes Vaccine S/C 0.2ml

5-7days: RD vaccine-RDVF O/N

10th day: Infectious Bronchitis Vaccine. O/N

12-14days: IBDV-Intermediate Georgia O/N

28th day: Booster RD Lasota Water

10.7 Deworming schedules in Livestock and Poultry

Cattle and Buffaloes

Calves should be dewormed against round worms on day 7, 28, 60, 90, 120 and every 3 months till one year of age. After 3 months of age, a drug against tapeworms should be included within the routine deworming.

Adult cattle should be dewormed twice in a year and if the cattle grazing area is around ponds and tanks, a flukicide should be included.

Sheep and Goat

Deworming should be done basing on the type of helminths.

March – deworming against round worms and flukes.

June – deworming against round worms and flukes.

September – deworming against round worms and Tapeworms.

December – deworming against round worms and flukes.

However, if the flock shows any clinical signs of worm infestation, faecal samples should be examined and deworming should be undertaken accordingly.

Poultry

Intestinal worms are commonly diagnosed during necropsy of pullets, cockerels and occasionally broilers. A preventative deworming program is suggested in rearing poultry depending on the incidence and severity of intestinal worms. Severe intestinal worm infestations can cause diarrhoea, poor absorption of nutrients, and enteritis. Clinical signs commonly seen with intestinal worm infestations include rough feathering, retarded growth, pasty vents and palebirds. Worms can be carriers of infectious diseases, including blackhead (*Histomonas meleagridis*).

Early preventative programs are necessary for control of intestinal worms. Cleaning out houses and placing new litter with every flock will minimize exposure to intestinal worms. Not only do houses containing built-up litter harbour intestinal worm eggs that could affect the next flock, they also serve as a reservoir for darkling beetles that are associated as carriers for worm transmission. Although preventative programs are ideal, occasionally outbreaks will occur.

10.5 Hygienic disposal of dead animals

Prompt and proper disposal of carcasses of animals died /destroyed by contagious diseases is of great importance in controlling the spread of diseases. The following precautions should be taken during disposal of carcass.

- Carcasses should never be thrown into a river or stream or village common lands.
- An animal died of a contagious disease should not be allowed to remain longer in the sheds as biting insects, rodents etc can reach it and spread the disease.
- Unless approved by a veterinarian, it is not safe to open carcasses of animals died of a contagious disease.
- Disinfect the shed properly after the carcass is removed.
- Dispose of the materials like dung and bedding of the animal. Nearly 5cm soil from where the dead animal was lying (if it is not cemented) and left over feed along with the carcass should be disposed.
- The carcass should be carried in a trolly and never by dragging along the ground.

Burying or burning are the two common efficient methods of carcass disposal.

Burial of Carcasses

It is the most common method of carcass disposal. This is reasonably safe method if done deeply enough and in soil from which there is no drainage to neighbouring places. Deep burial is necessary to prevent worms carrying bacterial spores to the surface as well as to prevent jackals and foxes from digging up and spreading the carcass.

The carcass(dead animal) should be carried to the burial place in a trolley and never by dragging it over the ground. The burial pit should be got ready before the carcass is taken there. The pit should be so dug that the highest part of the carcass must be at least 1.5m below the level of the surrounding terrain, the width and length of the burial pit depending on the size of the carcass.

Drainage of water out of the burial place can be checked by seeing to it that the burial place is an area where the general water level is at least 2.5m below the ground. After the carcass is in the grave its skin should be slashed to discourage grave-diggers to exhume the carcass later for its skin. Then, in order to make it unpalatable to scavenging animals, it may be drenched with kerosene, crude phenol or a comparable odorous and bad tasting substance. The carcass is then covered with a thick layer of freshly burnt quicklime and then filled with work materials and topped with some rocks, to further prevent scavenging.

Burning of Carcasses

It is the most sanitary method of destroying carcasses.

The trench should dug after deciding the site for burning .The trench should be at least 0.5m deep, shallower towards the ends, and comparing in width and length to the carcass size. General direction of the trench should be that of the prevailing wind direction. The trench is first fitted with wood, some iron bars placed across it and the carcass placed thereon. By firing the wood, the carcass will be completely burnt and with it all infections material.

In carcass frying or rendering plants, the skins are removed with due regard for the dangers of disease dissemination. After removal the skins are usually disinfected by immersion in a disinfecting solution and the remainder of the carcass, fried out for its fat, the latter being used in manufacture of soap. Farmers can inform these plants whenever there is a carcass so that the same can be collected by these utilization plants.

10.6 Disinfection of premises

Disinfection is an integral part of successful animal health programme. It means destruction of pathogenic micro organisms from a place so that the place becomes free from infection. Disinfectant, germicide or antiseptic is a substance can destroy microorganisms and their spores at appropriate concentrations.

Disinfectants

The common disinfecting agents available to the livestock farmers are sunlight, heat and chemical disinfectants. Sunlight has strong disinfecting properties. Direct sun rays have U.V. rays which are the most effective germ killers. The farm buildings should be so oriented as to take full benefit of this natural resource. The dairy utensils should also be kept in the sun for drying and disinfection after cleaning.

Application of heat by steam, boiling water, burning are effective methods of disinfection. It should be remembered that all pathogens are not susceptible to the same disinfectant. Affectivity of chemical disinfectants is greatly reduced in the presence of organic matter. Hence, a thorough cleaning of the area should be done before applying the disinfectant.

Disinfection of Animal Houses

Under ordinary conditions, daily scrubbing and washing of the floors, water troughs and mangers and the action of sunlight falling in the animal sheds are sufficient to keep them germ free to some extent. It should also be supplemented with periodic white- washing of the walls, mangers and water troughs.

Whenever there is a disease outbreak in the farm, disinfection is should be carried out scrupulously. All floors, walls up to a height of 1.5m, interior of mangers, water troughs, other fittings and equipment used for animals are must be disinfected.

The first step in disinfection of animal sheds is removal of all the filth and feed residue. The floors, walls up to a height of 1.5m, interior of water troughs and mangers should be completely scrubbed and washed with water. In case of an outbreak of anthrax, the dung, litter etc should first be disinfected in situ by thorough sprinkling of suitable disinfectant. If the floor is of earth which is generally the case in Indian villages, the top 5 cm earth should be removed and disposed off along with litter.

After the removal of filth, the place should be scrubbed and washed with 4% hot washing soda solution (i.e.4kg washing soda in 100 litres of boiling water). The approved disinfectant solution should be sprinkled or sprayed liberally over the place and left to act for one day. After this period, the animal shed should again be washed with clean water and left to dry with wind and sunlight. The interior of water troughs and mangers should be white washed. The animal shed is fit for housing healthy animals.

Disinfection of Pastures

Use of chemical disinfectants on pasture is not practicable under village conditions. Carcass (dead animals), aborted foetus and dung etc. can be removed from over the pasture land. Prevent the animals from grazing on these pastures under question for at least three to four months. The pasture can be ploughed up and left fallow for about six months during which period the pathogens would be destroyed by direct sunlight and wind.

10.7 Sterilization of Equipment - Hot/Cold/Chemical Methods

Sterilization is a process by which an article is rendered free from all forms of living microorganisms. Sterilization can be achieved by three methods. Heat, chemical and radiation.

Heat: Sterilisation by heat is the oldest and most commonly used and recognized process.

Heat sterilisation involves either dry or moist heat. The dry heat sterilisation include direct exposure of instruments to flame and the use of hot air oven. The flame method is not reliable. Hence, hot air ovens are used. Sterilisation by dry heat is a slow process and long exposure time at a high temperature is required as spores are relatively resistant to dry heat. Various temperature and time combinations are given for dry heat Sterilisation. Exposure time relates to the time after specific temperature has been achieved. Selection of temperature depends upon the resistance of the material to the heat. Stainless steel items and glassware can be sterilized at 160°c in 60 minutes. Material which can be sterilized by dry heat in an oven include glass ware, glass syringes, dry material in sealed containers, powders, oils, swabs, drapes etc.

Moist heat Sterilisation includes boiling in water and use of an autoclave. Boiling of instruments in water at 100°c for 10-15 minutes can be used in an emergency as a lesser method of sterilisation.

Moist heat in the form of saturated steam under pressure is the most dependable and recognized method of Sterilisation. In routine, materials are autoclaved at 121°c under 15 pounds pressure for 30 minutes. Sharp instruments like scissors, needles and other routine instruments of a surgical pack, excluding sharp scalpel blades can be autoclaved. Proper loading and correct packing are the prerequisites for effective Sterilisation by autoclaving. If the items are tightly packed, steam fails to penetrate and results in ineffective Sterilisation.

Under field conditions, if an autoclave is not available a large capacity pressure cooker can be used to sterilize a surgical pack and pressure should be maintained for 45 minutes. Chemical sterilisation or cold sterilisation is used for sharp edged instruments like scalpel blades and hypodermic needles.

Absolute ethyl alcohol or one percent cetrimide can be used for continuous immersion of the needles for ready use. Preparations containing 2% gluteraldehyde or 1 or 2% formaldehyde are commercially available. Due to irritant nature of the solutions, instruments must be rinsed in saline before use. Instruments can be disinfected by immersion in 1:30 concentration of savlon in 70% ethyl alcohol for 2 minutes. Chemical sterilisation is not a substitute to autoclaving but used for disinfection of endotracheal tubes, plastic sheets and drainage catheters. A 70% ethyl or isopropyl alcohol has maximum germicidal action because of presence of water which easily denatures the protein.

Bulky rubber goods, gum boots etc. can be disinfected with a solution containing 135ml of (38%) formalin and 10g of sodium hydroxide in one litre of distilled water.

Radiation:

Non-ionizing radiation is generated from ultraviolet lamps. Ultraviolet radiation from the lamp can be used to sterilize operation theatres. Ionizing radiations includes X-rays and gamma rays and are very lethal to living cells. Such radiations is used to sterilize pre packed items like disposable syringes, catheters, endotracheal tubes, intravenous sets etc.

Short Answer Type Questions

1. What is Vaccination
2. What is meant by isolation of animals
3. Explain quarantine in livestock farms
4. Explain sterilization of equipment
5. Explain radiation for sterilization of equipment

Long Answer Type Questions

1. Write about vaccination schedule of cattle, sheep and poultry
2. Write about deworming schedule of cattle, sheep and poultry
3. Write about hygienic disposal of dead animals.
4. Write about the isolation, quarantine and disinfection of animal sheds.
5. Write in detail about sterilization of equipment

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UNIT- 11

First Aid

Structure

11.1 Definition of First Aid and its Principles

11.2 Attending to Traumatic Conditions- Wounds

11.3 Attending to Poisoning Cases

11.4 Identification of Obstetrical difficulties

11.5 First Aid to burns and scalds

11.6 Attending to Fracture

11.7 First Aid Kit

11.8 First Aid during natural calamities

11.1 Definition of First Aid and Its Principles

Emergency medical help given to a sick or injured animal before treatment is available, is called as first aid.

Principles

The first aid giving person should get a history of the case. Other steps include,

Arresting of severe haemorrhage.

- Provision of plenty of fresh air to the patient.
- Provision of warmth to check fall in temperature and in shock.
- Provision of rest by changing the position of the animals into an easy posture.
- Covering with a clean dressing in all skin injuries.
- Keeping the animal immobile (especially when fractures occurred) by drugging or by diverting its attention towards some food.

The importance of providing an early veterinary aid cannot be over emphasized.

11.2 Attending to Traumatic Conditions-Wounds

The common traumatic conditions are bruises, open wound, teat injuries, feet injuries, eye injuries, horn injuries and haemorrhage.

Trauma is a result of physical injury due to fall, fight between animals or impact with stationary or moving objects. Basing on the intensity, there can be a simple skin cut or multiple fractures. The first thing to do in all these cases is to arrest bleeding.

Haemorrhage

Bleeding may occur from an injured capillary, vein or artery. Bleeding from capillaries stops as soon as clot has formed but bleeding from vein and artery must be arrested by keeping a pad over the injury by means of a bandage. On limbs a tourniquet must be applied. A folded cloth, cotton tape or a rubber tube can be used for a tourniquet. Any one of the above material is looped around the limb and the two ends tied together with a knot. A stick is inserted into the loop and by twisting it the loop is tightened. After the bleeding is stopped the stick should be secured in position with another bandage.

Bruises

Bruises are characterized by rupture of capillaries in the skin following a blow or fall giving reddish blue or purplish colouration of skin. The area should be treated with cold water on first day then followed by two or three times a day with warm water. It may result in accumulation of blood under the skin which is known as haematoma. When haematoma is small in size, it is absorbed otherwise veterinary aid is desired.

Open Wounds

It is a wound with a break in the continuity of skin. The wound should be washed with clean cold water or with potassium permanganate lotion and dusted with antiseptic dressing powder. Wet wounds are dusted with antibiotic powders. Dry wounds are with antibiotic skin ointments.

In case of maggoted wounds, the maggots(larvae) should be removed after applying the turpentine oil with cotton. Antibiotic or fly repellent ointments are to be applied after complete removal of maggots from the wound.

Eye injuries

Eye injuries may be caused by any foreign body or physical trauma. The eye should be washed with 2-3% boric acid lotion and any antibiotic eye drops should be instilled into both the eyes.

Horn injuries

Separation of the horny cover of the horn core sometimes happens due to traumatic injury. This is called avulsion of horn. When the horn core is injured there will be bleeding from nostril on the corresponding side. The injury should be washed with cold antiseptic lotion and the horn is protected by means of a pad or bandage and tincture benzoin should be poured on the injury.

Teat injuries Any small injury on the teats should be treated promptly to prevent mastitis. The injury should be washed with antiseptic lotion and antiseptic ointment should be applied on the injury.

11.3 Attending to Poisoning Cases

Poisoning in farm animals may be due to feeding of toxic plants and fodder sprayed with agricultural insecticides which are used by the farmers. The affected animals should be shifted to a place to prevent intake of more poison and the animal is to be provided with clean fodder and drinking water.

The poison in the stomach should be diluted by giving plenty of water through stomach tube. The alkaloid poison present in most of poisonous plants can be oxidized by dilute potassium permanganate solution or it can be precipitated by using strong tea decoction or catechu. Starch gruel, milk, eggs etc., should be given to decrease the irritation of stomach. Purgatives like Epsom salts can be given orally to promote excretion of poison from the body.

11.4 Identification of Obstetrical Difficulties

The obstetrical difficulties commonly encountered are dystocia, prolapse of vagina or uterus and retention of placenta.

Dystocia means difficulty in parturition. In case of dystocia in small animals attempt should be made to keep the animal quiet and comfortable. If needed gentle traction to the foetus may be applied to aid delivery. It is better not to introduce hands/fingers per vagina but get veterinary aid from qualified veterinarian.

First aid during calving should be undertaken with utmost precaution. Hands and obstetric ropes should be clean especially the finger nails should be trimmed properly to avoid injury. The first aider should attempt simple obstetric conditions like flexion of legs but should never apply traction but await veterinarian help.

Prolapse of vagina occurs towards late pregnancy or immediately after calving and prolapse of uterus occurs after calving. The organ hanging outside should be washed with potassium permanganate solution (1 in 10000) then covered in a clean cloth and wait for the veterinary help. In few cases animal strains and during straining the organs are visible for some time and then withdrawn inside. In such conditions, the owner has to be advised to provide feed and water in small quantities in more number of times. The hind quarters of the animal should be at a higher level. This can be achieved by raising the ground below the hind feet.

In retained placenta cases, the hind quarters of the animal should be washed with warm water taking care to see that the hanging membranes (placenta) does not get entangled. Isolate the animal and take the help of veterinarian, if the placenta does not fall even after 24 hours.

11.5 First Aid to Burns and Scalds

Burns and scalds are very painful. Hence, controlling the animal becomes difficult. Burnt hair, skin and other tissues are visible in burns. In case of scalds the hairs are struck together and scab covers the injury with discharge of serum. Antibiotic or antiseptic ointments may be smeared on a clean piece of cloth and applied to the burns and then bandaged.

Acid burns should be treated with an alkali like washing soda 10gm in one liter of water and burns caused by alkalies must be treated with equal parts of vinegar and water. The animal should be offered plenty of water. Veterinarian help should be taken immediately.

11.6 Attending to Fracture

Fracture is break in the continuity of hard tissue like bone, cartilage etc. It is better not to attempt to bring the fragments of fractured bone together and retain them in that position with a bandage unless the person attending is sufficiently experienced. The wound should be kept free from dirt and the animal should be kept as quiet as possible otherwise the damage to bone and surrounding tissue will be more. Never attempt rubbing the area but wait for veterinary aid.

11.7 First Aid Kit

A box containing below mentioned materials should be available in all livestock farms. It should be kept handy so that it can be reached quickly in case of emergencies.

Absorbent Cotton, Gauge bandages and Bandage cloth.

Surgical scissors – curved and straight made of Stainless Steel.

Forceps – rat toothed and plain

Artery forceps

Splints or split bamboos

Clinical thermometers

Rope/ rubber tube for tourniquet

Antiseptics – potassium permanganate, savlon

Dry dressing powder (Zinc oxide + boric acid)

Oil of turpentine (for maggoted wounds)

Neem oil

Any anti bloat preparations

Surgical spirit

Tincture iodine

Tincture benzene

Antiseptic ointments for wound dressing

Eye drops

Boric acid

Obstetric ropes, chains & hooks

Cotton ropes for restraint

Pocket knife

Old cotton and plastic sheets

11.8 First Aid during Natural Calamities

Tsunami, cyclone, floods, fire accidents, earth quakes are the common natural calamities. Tsunami, cyclones can cause flooding of the villages resulting in loss of animal life due to drowning. In such situations, animals should be moved towards elevated areas and any wounds, bruises or traumatic conditions should be attended immediately. The dead animals should be removed from the water as soon as possible and the carcasses should be burnt to avoid spread of the diseases.

In case of fire accidents, the tied animals in the sheds should be let loose and be driven out of the sheds. The burnt animals should be attended to immediately. The animals should be protected from the smoke to avoid suffocation and respiratory problems. First aid should be given immediately to all injured animals.

Short Answer Type Questions

1. What are the principles of first aid
2. What are the common traumatic wounds.
3. What is the first aid for poisoning cases in animals.
5. What is the first aid for Burns and Scalds.
6. What are the common natural calamities

Long Answer Type Questions

1. What are the principles of first aid and contents of first aid box.
2. What are the first aid measures for traumatic wounds in livestock
3. Write first aid for Poisoning cases and natural calamities.

Ψ

LIVESTOCK MANAGEMENT AND DAIRYING

Paper – II

Dairy Economics, Extension and Quality control of milk

INDEX

Unit 1 :	**Dairy Economics**	**137**
Unit 2:	**Milk Procurement**	**181**
Unit 3:	**Dairy development programmes**	**192**
Unit 4:	**Dairy Cooperatives**	**204**
Unit 5:	**Marketing**	**227**
Unit 6:	**Extension**	**244**
Unit 7:	**Composition of milk**	**264**
Unit 8:	**Physico - chemical properties of milk**	**272**
Unit 9:	**Adultrants and preservatives**	**280**
Unit 10:	**Microbiology of milk**	**285**
Unit 11 :	**Estimation of microbes in milk**	**299**

UNIT 1

Dairy Economics

Structure

1.1 Estimation of costs and returns in dairy farming.

1.2 Management practices involved to enhance profit in dairying.

1.3 Economic institutions supporting dairy development programmes.

1.4 Project reports to be submitted for financial institutions for 2,10 and 50 Animal Dairy units.

In India, the dairy farming still exists as a subsidiary to the agriculture. It gives additional income to agricultural labours, small and middle farmers. Dairy animals fits well in any diversified farming programmes i.e. it can be integrated with agriculture, fisheries and horticulture, etc. In agriculture, different types of roughages such as paddy straw, jowar straw, wheat straw etc., are bulky and fetching less amount and are also not possible to transport them to long distances economically. Dairy animals are efficient convertors of roughage to produce milk. Legumes and grasses which are grown on farm provide fodder to the animals. These crops are soil conserving and soil building crops. The prices of most of the agricultural produce show great fluctuation where as milk will not have such fluctuations in price. The income from agriculture is seasonal and the farmer receives income on harvesting crop only while the income from livestock can be obtained daily and it is distributed throughout the year. Dairying also improves the family diet in terms of nutrition. The manure produced will be utilized as natural organic fertilizers for cultivation of agricultural crops economically. The manure can also be utilized for bio-gas production and vermin compost.

The term dairy economics may be explained as how people are utilizing the scarcely available resources towards the dairy farming for the best advantage of mankind of the present and of the future. Farm production economics is concerned with the choice of production pattern and resource uses in order to maximize the objective function of the farm operator, their families, the society or the nation, within a frame work of limited resources. The laws of production economics explain the conditions under which profit, output, national income can be maximized or cost, use of physical input can be minimized.

The main objectives of production economics are

- To determine the conditions provided for optimum use of resources.
- To determine the extent of deviation of the existing use of resources from the optimum use.
- To analyze the factors responsible for the existing production patterns and resources use.
- To delineate means and methods for changing the existing use of resources to the optimum level.

1.1 Estimation of costs and returns in Dairy farming

The costs are divided in to variable cost and fixed cost. The method of estimating different components of variable cost and fixed cost and returns (income) are given as follows.

Capital or Non- recurring expenditure: It includes the cost of construction of farm buildings, land development, bore wells, farm equipment and implements, farm vehicles and cost of animals etc.

Variable cost : It includes the costs of using variable inputs i.e feed cost, labour cost, cost of medicines, vaccines and veterinary service charges, electricity and water charges and other miscellaneous cost during the lactation period and dry period.

Feed cost: It includes the cost of green fodder, dry fodder, concentrates and feed supplements during the lactation period and dry period. The green fodder cost should be evaluated at the prevalent market price in the area for the landless labourers, whereas the cost of production of fodder should be taken into account for the green fodder producing dairy farmers. The prevalent market rates are considered to calculate the cost of dry fodders, concentrate mixture and feed supplements.

Labour cost: The labour input is categorized as hired and family labour. Each category is further sub classified into male, female and child. The actual time used and the prevalent wage rate should be considered for calculation of labour cost.

Veterinary aid and miscellaneous cost: Actual cost of medicines, vaccines and veterinary service charges, electricity and water charges, other miscellaneous materials and minor repairs during the lactation period and dry period is taken into account.

Fixed cost: It includes depreciation on the cost of animal sheds, equipment, milch animals and interest on the capital cost. Depreciation on the buildings is charged on the basis of type of construction and the life of the buildings i.e @ 2 per cent of the cost of building for the permanent sheds and 10 per cent of the cost of the temporary (kuchha) sheds. Depreciation on the equipment is based on the useful life. Interest on the capital investment is charged on the basis of prevailing national bank rate of interest.

Gross cost: It is the total cost incurred on different cost component (Variabcost+Fixedcost) as given above.

Net cost: It is obtained by subtracting the value of dung from the gross cost.

Cost of milk production per litre = Net cost per day per milch animal is divided by Milk yield per day of that animal. Cost of milk production can be decreased mainly by increasing milk production per animal and decreasing the feed and labour cost.

Gross income: It includes total value of milk produced during lactation period of the animal and value of dung during lactation period and dry period. It mainly depends on milk production of the animal during lactation period and sale price of milk.

Net income: Gross income - Gross cost.

The following example is given to understand the method of estimation of economics of milk production. The cost of the inputs and income varies from place to place and time to time.

Cost and returns of Milk production per animal per day (in rupees)

S.No	Particulars	Murrah buffalo (8 lts/day)	Crossbred cow (10 lts/day)
	A.VARIABLE COST		
1.	Green fodder	60	50
2.	Dry fodder	15	15
3.	Concentrates	36	36
4	Total feed cost	111	101
5	Family labour	25	25
6	Medicines and Vaccines	5	5
7	Miscellaneous expenses	8	8
8	Total Variable cost (4+5+6+7)	**149**	**139**
	B.FIXED COST		
9	Depreciation on housing (2%)	11	11
10	Depreciation on equipment (10%)	3	3
11	Interest on capital (8%)	11	11
12	Total Fixed cost (9+10+11)	**25**	**25**
13	Gross cost	**174**	**164**
	C.INCOME		
13	Sale of milk	400	300
14	Sale of dung	16	15
15	Gross Income (13+14)	**416**	**315**

16	Net Income (15-13)	**242**	**151**

Measures to reduce the cost of milk production in a dairy farm

- High milk yielding animals should be selected for increasing milk production in the farm. High milk production in the farm will decrease the cost of production per litre of milk.
- In dairy farming, the cost of feeding accounts for 60 to 65 per cent of the gross cost. Economic feeding practices are important to decrease the cost of production of milk. Feeding of adlibitum of green forages including legumes will decrease the feed cost and reduce the cost of milk production. Feeding of certain amount of leguminous fodders also increase the milk production.
- The optimum use of land, high yielding fodder varieties, manure and irrigation resources increase the fodder yield per acre and resulting economic milk production.
- Long and thick green and dry fodders must be chaffed and fed to the dairy animals in a clean feed manger in the sheds.
- Feeding of agro-industrial bi-products and unconventional feeds will decrease the feed cost resulting in low cost of milk production. There should not be any wastage of feed and fodder in the farm.
- Good health management practices are required to increase and maintain high milk production for reducing the cost of milk production. Ill health reduces the milk production drastically and it takes more time to reach original production.
- The farm labour working efficiency should be increased for reducing the cost of milk production.

1.2 Management practices involved to increase profit in dairying

- High milk producing cattle or buffalo breeds which are suitable to the local climatic conditions should be selected. A cow or buffalo should produce minimum 2500to 3000 litres of milk in a lactation period. On average, a dairy animal should produce minimum 8 to 10 litres of milk per day. Depending on the local market demand of milk, feed and fodder resources and housing facilities, Murrah , graded Murrah buffaloes, Holstein Friesian and

Jersey cross bred cows, Sahiwal and Gir cows may be selected for dairying. The cross bred cows should have 50 to 62.5% exotic inheritance in hot and humid climatic areas.

- The animal should conceive within 3 months after calving to achieve 12to13 months of calving interval in dairy animals. Nearly 80% of the dairy animals should be in milk and the remaining 20% dry and pregnant in the herd. The dry period should be not more than 2 months. Extension of dry period beyond 2 months leads to extra feed and fodder, labour and other costs. Hence, good feeding and reproduction management should be practiced for optimum reproductive efficiency of the dairy animals. A teaser buffalo bull can be maintained to detect the silent heat in buffaloes.
- Balanced feeding is required to get the maximum milk production per animal.The dairy animals should be fed as per their maintenance and milk production requirements. Adlibitum feeding of green fodder including legumes reduces the use of concentrates and resulting low cost of milk production.
- The surplus green fodder during rainy season should be converted into silage / hay and it can be efficiently used during fodder scarcity period particularly during summer season.
- The use of locally available agricultural bi- products like straws and stovers etc will decrease the cost of milk production. These bi-products are cheaper during crop harvesting season. Hence, they should be procured in large quantity during crop harvesting season.
- Certain unconventional feed ingredients which are not used for any purpose can be used in concentrate mixture formulation to decrease the cost of concentrate mixture as the cost of concentrates place an important role in the cost of milk production. Sufficient good quality concentrate mixture should be given based on the milk production of dairy animals.
- Good housing is required to protect the animals from extreme climatic conditions and to provide comfort to the animals to produce more milk and good health condition. The animal sheds can be constructed using low cost material. Exorbitant expenditure on construction of livestock buildings should be avoided so that it will reduce the capital expenditure.
- The cost of labour ranks second after feed cost in dairy farming. The labour engaged on the farm should be properly, effectively and optimally utilized. Hard working, honest and reliable people are to be selected to work in the livestock farms. All the labour operations should be inter-linked so that labour will not sit idle at any time. Effective use of labour depends on proper planning and arrangement of cattle housing unit.

- The low milk producing animals and animals suffering from chronic diseases, sterility, stunted growth and male animals should be culled from the farm. They should be replaced by farm born calves/heifers or by purchase. It is scientifically proved that replacement of dairy stock by growing their own calves/heifers is more economical and also have the information about the animal.
- Clean environment will produce more milk and prevent health problems in the farm. Proper protection of animals against harsh environmental conditions like heat and cold helps to maintain the production .Maintenance of proper timings of feeding and milking helps in maintaining the optimum production. Maintenance of cattle health by proper vaccination, deworming, control of ecto-parasites, insects, correct diagnosis and prompt treatment definitely helps in increased milk production and decreased mortality in the farm. The mortality in the farm should be less than 2to 5% in the farm.
- The profitability of dairy farming mainly depends upon the sale price of milk. Even a marginal extra price per litre of milk will increase the profitability per year. It is better to practice direct sale of milk to the consumer, hotels, hostels and any organisations to get higher price for milk.
- During flush season more milk is produced and the milk collection centres will pay less price. To get maximum profits some milk can be converted into products like cream, ghee, butter, paneer etc., depending on the local market demand. It will also solve the problems of marketing of milk and gives 30-40% extra profits over the cost of milk.

1.3 Economic Institutions Supporting Dairy development Programmes

Most of the milk producers are poor or middle income people and they cannot afford to invest large amounts for establishment of any size of dairy farms. Several institutions are concerned either directly or indirectly in the activities or providing finance to establish dairy farm, milk collection centres, dairy plants etc.

Indian Dairy Corporation: Earlier it is the financing agency for all the dairy developmental activities i.e. establishing dairy plants, chilling centres, progeny testing farms, formation of dairy Cooperatives under Anand pattern. Now there is no Indian Dairy Corporation and it is merged with NDDB.

National Dairy Development Board: Earlier it is only agency implementing all the dairy developmental programmes throughout the country. After merging of Indian Dairy Corporation, now it is acting as financial as well as implementation of dairy developmental activities in the country. It provides finance to all the state owned milk cooperative federations for establishing and increasing the capacity of milk processing for dairy products factories, chilling centres, feed factories, establishing progeny testing farms, improving artificial insemination centres. The NDDB also acts as an agent for international business / loan for the development of dairy industry. NDDB will provide finance to the state federations or cooperative society by taking guarantees from the respective state government. The finance will be different types i.e. with nominal interest, no interest and repayment of one scheme to investment for other scheme. NDDB also involved in the research activities of dairying. Eg : Embryo transfer Technology, cross breeding programme, indigenous dairy processing equipment development.

National Bank for Agriculture and Rural Development (NABARD): This is the apex bank for refinancing for all types agricultural operations for the commercial banks at less interest. NABARD will not directly finance to the dairy farms, dairy factories or allied business, but only through commercial banks. It will finance directly to the state government to provide basic amenities to agriculture and related fields. For community works the interest rate is very low.

Commercial Banks: In our country, nationalized banks and many rivate banks are financing for dairying. These banks will finance for small to large dairy farms, dairy factories, feed mixing plants other dairy based business. The amount of finance will vary from 75-85% of the cost of project depending upon scheme or non scheme projects. For dairy farms, one should have their own land and no loan will be given for land. The interest rates charged will be changed from time to time.

Cooperative bank: Apex cooperative bank will be there in each state. In each district, cooperative bank will have branches throughout the district in rural areas. Just like commercial banks, cooperative banks will give for all dairying projects for both short term and long term loans. The rules and regulations are almost same as commercial banks with little less interest rates.

Cost of the Project	
Loan from Bank	158000
Margin amount from entrepreneur	29000
Total Cost of the Project	187000

Village Cooperative Societies: For a cluster of villages cooperative societies will be there, which will give loans for small scale animal husbandry activities. The finance for these societies will be by cooperative banks. The interest rates will be less compared to commercial banks.

State Financial Corporation: Each state will have state financial corporation SFC). It will also finance for dairy projects. The interest rates are almost equal to commercial bank. In combined Andhra Pradesh state financial corporation is located at Hyderabad and it has branches in all district headquarters.

Dairy Development Cooperative federation: The state dairy development cooperative federation will get some loans from NDDB and other agencies for development of dairying, which will be provided to district unions, who will inform in turn to give loans to milk producers. They will not give loans directly to the beneficiaries, but they will procure good genetic high milk producing animals and distributed to the beneficiaries. Part of the amount will be subsidy and the remaining amount will be treated as loan with less interest rates.

District Rural Development Agency (DRDA): In each district, one DRDA will be there. It will operate most of the centrally and state sponsored schemes. DRDA will assist programmes like

Draught Prone Area Programmes (DPAP)

Small Farmers Development Agencies (SFDA)

Marginal Farmer and Agricultural Labour Development Agency

Integrated Rural Development Programmes.

The DRDA will sponsor the above schemes by sanctioning loans by commercial, banks and provide subsidies from 25-50 % depending upon the classes of people involved in the schemes. The department of rural development (Velugu) under Society for the elimination of rural poverty (SERP) also involves in giving loans to the beneficiaries.

B.C and SC Corporation: SC and BC corporations will arrange loans for dairy programmes of respective class of people through commercial / cooperative banks and provide subsidy of 25-50 %.

Integrated Tribal Development Agencies (ITDA): The Government established tribal development agencies in tribal areas for the development of scheduled tribes. It provides subsidies and arrange loans through financial institutions. The commissioner/Director of tribal welfare is the chief controlling officer for Departmental budget. He/She formulate, directs the process of implementation and monitors the progress of all tribal development programmes in state. He/She coordinates with other departments on implementation of TSP and also implementation of constitutional safeguards.

1.4 Project reports to be submitted for financial institutions

Dairy farming is gradually becoming commercial enterprise. Many entrepreneurs are coming forward for establishment of new dairy farms. Banks are also encouraging starting of dairy farms by sanctioning loans. There is a need for project report for obtaining bank loans.

The items in the project report have to be as follows:

1. Importance: The importance of the project, opportunities for dairy farming at the given location, marketing facilities, land for raising fodder, availability of veterinary aid and artificial insemination etc., have to be explained briefly.

2. Location: The location of dairy farm, the total land available, the distance from the nearest town, the distance from the bank, water supply, electricity, road and transport facilities etc. have to be detailed. If possible, the site plan of the location has to be given.

3. Ownership: The name of the entrepreneur, address, qualifications, experience, land any financial status etc. have to be mentioned in the report.

	DETAILS OF BANKABLE INVESTMENT		
S.No.	**Particulars**	**Value in Rs.**	
A	**Fixed Investment**		
1	Cost of Animals	160000	
2	Cost of Building	11000	
3	Cost of Equipment	600	
4	Cost of Milking Machine	0	
	Total Fixed Investment	**171600**	

4. Housing: Different sheds required for various categories of dairy animals should be mentioned along with total area and cost per sq.m have to be mentioned. The plans and estimates of the various sheds are also to be enclosed.

B	**Working Capital (For 3 Months)**		
1	Insurance Charges for Animals	7200	
2	Labour Charges	0	
3	Cost of Concentrate Feed	6480	
4	Cost of Green Fodder	250	
5	Cost of Dry Fodder	1440	
6	Veterinary Aid	150	
7	Electricity Charges	0	
8	Miscellaneous Charges	100	
	Total Working Capital	**15620**	
	Total Cost of the Project	**187220**	

5. Equipment: Different equipment like chaff cutter, chains, milk pails, milk cans, buckets, balance, measures etc. have to be listed along with number and cost. The quotations from the suppliers of these items have to be attached. Some models of projects are given below.

Model-1: Project reports to be submitted for Financial institutions for 2 Animal Dairy units.

TECHNO-ECONOMIC ASSUMPTIONS				
Type of animal :BUFFALOES				
Number of animals	2	1	in I hallf &	1
Cost of animals (Rs./animal)	80000			
Floor space requirement (Sq.ft/cow)	55			
Cost of construction of animal shed (Rs./Sq.ft)	100			

Floor space requirment of store room (Sq.ft)	0			
Cost of construction of store room(Rs./Sq.ft)	0			
Cost of equipment (Rs./animal)	300			
Cost of milking machine & Chaff cutter	0			
Insurance premium/animal (%)	4.5			
Rate of Interest (%)	12			
Depreciation on building (%)	0			
Depreciation on feeding equipment (%)	5			
Depreciation on milking machine (%)	0			
Margin money requirement(%)	15			
Repayment period in years	5			
Veterinary aid/animal/year (Rs.)	300			
Unit labour cost per month (Rs.)	0			
Electricity charges (Rs./year)	0			
FEEDING				
a.Concentrate feed requirement (Kg/day)				
Total lactating days	305			
-For lactating animals	6			
Total dry period in days	60			
-For dry animals	2.5			
Cost of concentrate	18			
b.Dry fodder requirement (Kg/animal/day)	4			
Cost of dry fodder (Rs./Kg)	2			
c. Fodder area requirement	0.5			

Fodder cultivation cost in first year (Rs. /ac.)	2000			
In subsequent years (Rs. /Acr)	1000			
Returns				
Milk yield (lit/day/animal)	10			
Sale price of milk(Rs./litre)	55			
Number of heilfer calves	1			
Sale price of heifer calves (Rs./animal)	10000			
Number of bull calves	1			
Sale price of bull calves(Rs./animal)	4000			
Sale of manure and gunny bags (Rs./animal)	500			

	DETAILS OF BANKABLE INVESTMENT
S.No.	**Particulars**
A	**Fixed Investment**
1	Cost of Animals
2	Cost of Building
3	Cost of Equipment
4	Cost of Milking Machine
	Total Fixed Investment
B	**Working Capital (For 3 Months)**
1	Insurance Charges for Animals
2	Labour Charges
3	Cost of Concentrate Feed
4	Cost of Green Fodder
5	Cost of Dry Fodder

6	Veterinary Aid
7	Electricity Charges
8	Miscellaneous Charges
	Total Working Capital
	Total Cost of the Project
	Cost of the Project
	Loan from Bank
	Margin amount from entrepreneur
	Total Cost of the Project

Sl.No	**Particulars**
A	**FIXED INVESTMENT**
1	Cost of animals
2	Cost of building
3	Cost of equipment
4	Cost of milking machines
	Total Fixed Investment
B	**FIXED COST**
1	Insurance cost
2	Wages of labourers
3	Electricity charges

	Total Fixed Cost
C	**VARIABLE COST**
1	Cost of concentrate feed
2	Cost of green fodder production
3	Cost of dry fodder
4	Veterinary aid
	Total Variable Cost
GRAND TOTAL	

PRODUCTION DETAIL **I.Lactation Period**							
Particulars	**I year**	**II year**	**III year**	**IV year**	**V year**	**VI year**	**VII year**
First batch	270	305	305	305	305	275	275
Second batch	180	275	275	275	275	275	275
Total	**450**	**580**	**580**	**580**	**580**	**550**	**550**
			II.Dry Period				
Particulars	**I year**	**II year**	**III year**	**IV year**	**V year**	**VI year**	**VII year**
First batch	95	60	60	60	60	90	90
Second batch	0	90	90	90	90	90	90
Total	**95**	**150**	**150**	**150**	**150**	**180**	**180**

INCOME-EXPENDITURE STATEMENT

Particulars	I year	II year	III year	IV year	V year	VI year	VII year
Income							
From Sale of milk	247500	319000	319000	319000	319000	302500	302500
From sale of manure & gunny bags	1000	1000	1000	1000	1000	1000	1000
From sale of heifer calves	10000	10000	10000	10000	10000	10000	10000
From sale of bull calves	4000	4000	4000	4000	4000	4000	4000
Total Income	**262500**	**334000**	**334000**	**334000**	**334000**	**317500**	**317500**
Expenditure							
On concentrate feed	52875	69390	69390	69390	69390	69390	67500
On green fodder	1000	500	500	500	500	500	500
On dry fodder	4360	5840	5840	5840	5840	5840	5840

On veterinary aid	600	600	600	600	600	600	600
On labour	0	0	0	0	0	0	0
On insurance	7200	7200	7200	7200	7200	7200	7200
On electricity	0	0	0	0	0	0	0
On depreciation							
-Building	0	0	0	0	0	0	0
-Equipment	30	29	27	26	24	23	22
On interest	18960	15168	11376	7584	3792	0	0
Total Expenditure	**85025**	**98727**	**94933**	**91140**	**87346**	**83553**	**81662**

PROFIT AND LOSS STATEMENT

Particulars	**I year**	**II year**	**III year**	**IV year**	**V year**	**VI year**	**VII year**
Expenditure							
Total Expenditure	85025	98727	94933	91140	87346	83553	81662

Net Expenditure (TE- Dep &Int)	66035	83530	83530	83530	83530	83530	81640
Income							
Total Income (TI)	262500	334000	334000	334000	334000	317500	317500
Net Profit(TI-NE)	196465	250470	250470	250470	250470	233970	235860

CASH FLOW STATEMENT							
Particulars	**I year**	**II year**	**III year**	**IV year**	**V year**	**VI year**	**VII year**
Income							
From Sale of milk	247500	319000	319000	319000	319000	302500	302500
From sale of manure & gunny bags	1000	1000	1000	1000	1000	1000	1000
From sale of heifer calves	10000	10000	10000	10000	10000	10000	10000
From sale of bull calves	4000	4000	4000	4000	4000	4000	4000
Total Cash Inflow	**262500**	**334000**	**334000**	**334000**	**334000**	**317500**	**317500**
Outflow							
On concentrate feed	52875	69390	69390	69390	69390	69390	67500
On green fodder	1000	500	500	500	500	500	500
On dry fodder	4360	5840	5840	5840	5840	5840	5840

On veterinary aid	600	600	600	600	600	600	600
On labour	0	0	0	0	0	0	0
On insurance	7200	7200	7200	7200	7200	7200	7200
On electricity	0	0	0	0	0	0	0
Total Outflow	**66035**	**83530**	**83530**	**83530**	**83530**	**83530**	**81640**
Net Cash Inflow	**196465**	**250470**	**250470**	**250470**	**250470**	**233970**	**235860**

FINANCIAL ANALYSIS OF THE PROJECT							
Particulars	**I year**	**II year**	**III year**	**IV year**	**V year**	**VI year**	**VII year**
Capital Investment	187000						
Working Capital	66035	83530	83530	83530	83530	83530	81640
Total Cost	253035	83530	83530	83530	83530	83530	81640
Total Benefit	**262500**	**334000**	**334000**	**334000**	**334000**	**317500**	**317500**
Net Cash Flow	**9465**	**250470**	**250470**	**250470**	**250470**	**233970**	**235860**
DCF at 20%	0.833	0.694	0.579	0.482	0.402	0.335	0.279
Disc. Benefit	218750	231944	193287	161073	134227	106330	88608
Disc.cost	210863	58007	48339	40283	33569	27974	22784
NPV at 20% DCF	**7888**	**173938**	**144948**	**120790**	**100658**	**78356**	**65824**
DCF at 25%	0.800	0.640	0.512	0.410	0.328	0.262	0.210
Disc. Benefit	210000	213760	171008	136806	109445	83231	66585
Disc.cost	202428	53459	42767	34214	27371	21897	17121
NVP at 25% DCV	**7572**	**160301**	**128241**	**102593**	**82074**	**61334**	**49463**
NPV at 20%	**692401**			**B:C ratio at 20%**		**2.567**	
NPV at 25%	**591577**			**B:C ratio at 25%**		**2.482**	

Model-2: Project report for 10 buffalo unit.

TECHNO-ECONOMIC ASSUMPTIONS						
1	Type of animal	Buffaloes				
2	Number of animals	10	5	in I hallf&	5	in II half of first year
3	Cost of animals (Rs./animal)	80000				
4	Floor space requirement (Sq.ft/cow)	55				
5	Cost of construction of animal shed (Rs./Sq.ft)	100				
6	Floor space requirment of store room (Sq.ft)	0				
7	Cost of construction of store room(Rs./Sq.ft)	0				
8	Cost of equipment (Rs./animal)	1000				
9	Cost of milking machine & Chaff cutter	0				
10	Insurance premium/animal (%)	4.5				
11	Rate of Interest (%)	12				
12	Depreciation on building (%)	10				
13	Depreciation on feeding equipment (%)	15				
14	Depreciation on milking machine (%)	15				
15	Margin money requirement(%)	15				
16	Repayment period in years	5				
17	Veterinary aid/animal/year (Rs.)	500				
18	Unit labour cost per month (Rs.)	9000				
19	Electricity charges (Rs./year)	12000				
20	**FEEDING**					
21	a.Concentrate feed requirement (Kg/day)					
	Total lactating days	305				
	-For lactating animals	5				
	Total dry period in days	60				
	-For dry animals	2.5				
	Cost of concentrate	16				
	b.Dry fodder requirement (Kg/animal/day)	4				
	Cost of dry fodder (Rs./Kg)	2.5				
	c. Fodder area requirement	2 ac.				
	Fodder cultivation cost in first year (Rs. /ac)	25000				
	In subsequent years (Rs. /ac.)	12000				
22	**Returns**					
	Milk yield (lit/day/animal)	9				
	Sale price of milk(Rs./litre)	55				
	Number of heifer calves	5				
	Sale price of heifer calves (Rs./animal)	5000				
	Number of bull calves	5				
	Sale price of bull calves(Rs./animal)	2500				

	Sale of manure and gunny bags (Rs./animal)	400				

DETAILS OF BANKABLE INVESTMENT

S.No.	Particulars	Value in Rs.
A	**Fixed Investment**	
1	Cost of Animals	800000
2	Cost of Building	55000
3	Cost of Equipment	10000
4	Cost of Milking Machine	0
	Total Fixed Investment	**865000**
B	**Working Capital (For 3 Months)**	
1	Insurance Charges for Animals	36000
2	Labour Charges	27000
3	Cost of Concentrate Feed	24000
4	Cost of Green Fodder	12500
5	Cost of Dry Fodder	9000
6	Veterinary Aid	1250
7	Electricity Charges	3000
8	Miscellaneous Charges	500
	Total Working Capital	**113250**
	Total Cost of the Project	**978250**
	Cost of the Project	
	Loan from Bank	831000
	Margin amount from entrepreneur	147000
	Total Cost of the Project	978000

INVESTMENT AND COST FOR ONE YEAR

Sl.No	Particulars	(Rs.)
A	**FIXED INVESTMENT**	
1	Cost of animals	800000
2	Cost of building	55000
3	Cost of equipment	10000
4	Cost of milking machines	0
	Total Fixed Investment	**865000**

B	FIXED COST	
1	Insurance cost	36000
2	Wages of labourers	108000
3	Electricity charges	12000
	Total Fixed Cost	**156000**

C	VARIABLE COST	
1	Cost of concentrate feed	199000
2	Cost of green fodder production	50000
3	Cost of dry fodder	27250
4	Veterinary aid	5000
	Total Variable Cost	**281250**

GRAND TOTAL **1302250**

PRODUCTION DETAIL

I.Lactation Period

Particulars	I year	II year	III year	IV year	V year	VI year	VII year
First batch	1350	1525	1525	1525	1525	1375	1375
Second batch	900	1375	1375	1375	1375	1375	1375
Total	**2250**	**2900**	**2900**	**2900**	**2900**	**2750**	**2750**

II.Dry Period

Particulars	I year	II year	III year	IV year	V year	VI year	VII year
First batch	475	300	300	300	300	450	450
Second batch	0	450	450	450	450	450	450
Total	**475**	**750**	**750**	**750**	**750**	**900**	**900**

INCOME-EXPENDITURE STATEMENT

Particulars	I year	II year	III year	IV year	V year	VI year	VII year
Income							
From Sale of milk	1113750	1435500	1435500	1435500	1435500	1361250	13612[illegible]0
From sale of manure & gunny bags	4000	4000	4000	4000	4000	4000	40[illegible]0
From sale of heifer calves	25000	25000	25000	25000	25000	25000	250[illegible]0
From sale of bull calves	12500	12500	12500	12500	12500	12500	125[illegible]0
Total Income	**1155250**	**1477000**	**1477000**	**1477000**	**1477000**	**1402750**	**14027[illegible]0**
Expenditure							
On concentrate feed	199000	262000	262000	262000	262000	262000	2560[illegible]0
On green fodder	50000	24000	24000	24000	24000	24000	240[illegible]0
On dry fodder	27250	36500	36500	36500	36500	36500	365[illegible]0
On veterinary aid	5000	5000	5000	5000	5000	5000	50[illegible]0
On labour	108000	108000	108000	108000	108000	108000	1080[illegible]0

On insurance	36000	36000	36000	36000	36000	36000	360[illegible]0
On electricity	12000	12000	12000	12000	12000	12000	120[illegible]0
On depreciation							
-Building	5500	4950	4455	4010	3609	3248	29[illegible]3
-Equipment	1500	1275	1084	921	783	666	5[illegible]6
On interest	99720	79776	59832	39888	19944	0	[illegible]0
Total Expenditure	**543970**	**569501**	**548871**	**528319**	**507836**	**487413**	**4809[illegible]9**

PROFIT AND LOSS STATEMENT

Particulars	I year	II year	III year	IV year	V year	VI year	VII year
Expenditure							
Total Expenditure	543970	569501	548871	528319	507836	487413	480989
Net Expenditure (TE- Dep&Int)	437250	483500	483500	483500	483500	483500	477500

Income							
Total Income (TI)	1155250	1477000	1477000	1477000	1477000	1402750	1402750
Net Profit(TI-NE)	718000	993500	993500	993500	993500	919250	925250

REPAYMENT SCHEDULE

Year	Profit	Open Balance	Instalment	Interest	Total Debit	Surplus
I	718000	831000	166200	99720	265920	452080
II	993500	664800	166200	79776	245976	747524
III	993500	498600	166200	59832	226032	767468
IV	993500	332400	166200	39888	206088	787412
V	993500	166200	166200	19944	186144	807356
VI	919250	0	0	0	0	919250
VII	925250	0	0	0	0	925250

CASH FLOW STATEMENT

Particulars	I year	II year	III year	IV year	V year	VI year	VII year
Income							
From Sale of milk	1113750	1435500	1435500	1435500	1435500	1361250	1361250
From sale of manure & gunny bags	4000	4000	4000	4000	4000	4000	4000
From sale of heifer calves	25000	25000	25000	25000	25000	25000	25000
From sale of bull calves	12500	12500	12500	12500	12500	12500	12500
Total Cash Inflow	**1155250**	**1477000**	**1477000**	**1477000**	**1477000**	**1402750**	**1402750**
Outflow							
On concentrate feed	199000	262000	262000	262000	262000	262000	256000
On green fodder	50000	24000	24000	24000	24000	24000	24000
On dry fodder	27250	36500	36500	36500	36500	36500	36500
On veterinary aid	5000	5000	5000	5000	5000	5000	5000
On labour	108000	108000	108000	108000	108000	108000	108000
On insurance	36000	36000	36000	36000	36000	36000	36000
On electricity	12000	12000	12000	12000	12000	12000	12000
Total Outflow	**437250**	**483500**	**483500**	**483500**	**483500**	**483500**	**477500**
Net Cash Inflow	**718000**	**993500**	**993500**	**993500**	**993500**	**919250**	**925250**

FINANCIAL ANALYSIS OF THE PROJECT

	Particulars	I year	II year	III year	IV year	V year	VI year	VII year
	Capital Investment	978000						
	Working Capital	437250	483500	483500	483500	483500	483500	477500
	Total Cost	1415250	483500	483500	483500	483500	483500	477500
	Total Benefit	**1155250**	**1477000**	**1477000**	**1477000**	**1477000**	**1402750**	**1402750**
	Net Cash Flow	**-260000**	**993500**	**993500**	**993500**	**993500**	**919250**	**925250**
	DCF at 20%	0.833	0.694	0.579	0.482	0.402	0.335	0.279
	Disc. Benefit	962708	1025694	854745	712288	593573	469778	391482
	Disc.cost	1179375	335764	279803	233169	194308	161923	133261
	NPV at 20% DCF	**-216667**	**689931**	**574942**	**479118**	**399265**	**307855**	**258220**
	DCF at 25%	0.800	0.640	0.512	0.410	0.328	0.262	0.210
	Disc. Benefit	924200	945280	756224	604979	483983	367722	294178
	Disc.cost	1132200	309440	247552	198042	158433	126747	100139
	NVP at 25% DCV	**-208000**	**635840**	**508672**	**406938**	**325550**	**240976**	**194039**
	NPV at 20%	**2492665**			**B:C ratio at 20%**		**1.990**	
	NPV at 25%	**2104015**			**B:C ratio at 25%**		**1.926**	
		IRR	**382%**					

Model-3: Project reports to be submitted for Financial institutions for 50 Animal Dairy unit.

TECHNO-ECONOMIC ASSUMPTIONS

1	Type of animal	Cross bred animals (Jersy or HF cross)				
2	Number of animals	50	25	in I hallf &	25	in II half of first year
3	Cost of animals (Rs./animal)	60000				
4	Floor space requirement (Sq.ft/cow)	55				
5	Cost of construction of animal shed (Rs./Sq.ft)	150				
6	Floor space requirment of store room (Sq.ft)	300				
7	Cost of construction of store room(Rs./Sq.ft)	0				
8	Cost of equipment (Rs./animal)	500				
9	Cost of milking machine & Chaff cutter	50000				
10	Insurance premium/animal (%)	4.5				
11	Rate of Interest (%)	10				
12	Depreciation on building (%)	10				

13	Depreciation on feeding equipment (%)	15
14	Depreciation on milking machine (%)	15
15	Margin money requirement(%)	15
16	Repayment period in years	5
17	Veterinary aid/animal/year (Rs.)	300
18	Unit labour cost per month (Rs.)	7000
19	Electricity charges (Rs./year)	7000
20	**FEEDING**	
21	a.Concentrate feed requirement (Kg/day)	
	Total lactating days	305
	-For lactating animals	7
	Total dry period in days	60
	-For dry animals	3
	Cost of concentrate	12
	b.Dry fodder requirement (Kg/animal/day)	3
	Cost of dry fodder (Rs./Kg)	2.5
	c. Fodder area requirement	10
	Fodder cultivation cost in first year (Rs. /Acr)	25000

	In subsequent years (Rs. /Acr)	15000
22	**Returns**	
	Milk yield (lit/day/animal)	12
	Sale price of milk(Rs./litre)	40
	Number of heilfer calves	25
	Sale price of heifer calves (Rs./animal)	5000
	Number of bull calves	25
	Sale price of bull calves(Rs./animal)	1500
	Sale of manure and gunny bags (Rs./animal)	250

DETAILS OF BANKABLE INVESTMENT

S.No.	Particulars	Value in Rs.
A	**Fixed Investment**	
1	Cost of Animals	3000000
2	Cost of Building	412500
3	Cost of Equipment	25000
4	Cost of Milking Machine	50000
	Total Fixed Investment	**3487500**

B Working Capital (For 3 Months)

1	Insurance Charges for Animals	135000
2	Labour Charges	21000
3	Cost of Concentrate Feed	126000
4	Cost of Green Fodder	62500
5	Cost of Dry Fodder	33750
6	Veterinary Aid	3750
7	Electricity Charges	1750
8	Miscellaneous Charges	2500
	Total Working Capital	**386250**

Total Cost of the Project 3873750

Cost of the Project	
Loan from Bank	3291000
Margin amount from entrepreneur	582000
Total Cost of the Project	3873000

INVESTMENT AND COST FOR ONE YEAR

Sl.No	Particulars	(Rs.)
A	**FIXED INVESTMENT**	
1	Cost of animals	3000000
2	Cost of building	412500
3	Cost of equipment	25000
4	Cost of milking machines	50000
	Total Fixed Investment	**3487500**
B	**FIXED COST**	
1	Insurance cost	135000
2	Wages of labourers	84000
3	Electricity charges	7000
	Total Fixed Cost	**226000**
C	**VARIABLE COST**	
1	Cost of concentrate feed	1030500
2	Cost of green fodder production	250000
3	Cost of dry fodder	102187.5
4	Veterinary aid	15000
	Total Variable Cost	**1397688**
	GRAND TOTAL	**5111188**

PRODUCTION DETAIL

I.Lactation Period

Particulars	I year	II year	III year	IV year	V year	VI year	VII year
First batch	6750	7625	7625	7625	7625	6875	6875
Second batch	4500	6875	6875	6875	6875	6875	6875
Total	**11250**	**14500**	**14500**	**14500**	**14500**	**13750**	**13750**

II.Dry Period

Particulars	I year	II year	III year	IV year	V year	VI year	VII year
First batch	2375	1500	1500	1500	1500	2250	2250
Second batch	0	2250	2250	2250	2250	2250	2250
Total	**2375**	**3750**	**3750**	**3750**	**3750**	**4500**	**4500**

INCOME-EXPENDITURE STATEMENT

Particulars	I year	II year	III year	IV year	V year	VI year	VII year
Income							
From Sale of milk	5400000	6960000	6960000	6960000	6960000	6600000	6600000
From sale of manure & gunny bags	12500	12500	12500	12500	12500	12500	12500
From sale of heifer calves	125000	125000	125000	125000	125000	125000	125000
From sale of bull calves	37500	37500	37500	37500	37500	37500	37500
Total Income	**5575000**	**7135000**	**7135000**	**7135000**	**7135000**	**6775000**	**6775000**
Expenditure							
On concentrate feed	1030500	1353000	1353000	1353000	1353000	1353000	1317000
On green fodder	250000	150000	150000	150000	150000	150000	150000
On dry fodder	102187.5	136875	136875	136875	136875	136875	136875

On veterinary aid	15000	15000	15000	15000	15000	15000	15000
On labour	84000	84000	84000	84000	84000	84000	84000
On insurance	135000	135000	135000	135000	135000	135000	135000
On electricity	7000	7000	7000	7000	7000	7000	7000
On depreciation							
-Building	41250	37125	33413	30071	27064	24358	21922
-Equipment	11250	9563	8128	6909	5873	4992	4243
On interest	329100	263280	197460	131640	65820	0	0
Total Expenditure	**2005288**	**2190843**	**2119876**	**2049495**	**1979632**	**1910224**	**1871040**

PROFIT AND LOSS STATEMENT

Particulars	**I year**	**II year**	**III year**	**IV year**	**V year**	**VI year**	**VII year**
Expenditure							
Total Expenditure	2005288	2190843	2119876	2049495	1979632	1910224	1871040

Net Expenditure (TE- Dep &Int)	1623688	1880875	1880875	1880875	1880875	1880875	1844875

Income							
Total Income (TI)	5575000	7135000	7135000	7135000	7135000	6775000	6775000
Net Profit(TI-NE)	3951313	5254125	5254125	5254125	5254125	4894125	4930125

CASH FLOW STATEMENT

Particulars	I year	II year	III year	IV year	V year	VI year	VII year
Income							
From Sale of milk	5400000	6960000	6960000	6960000	6960000	6600000	6600000
From sale of manure & gunny bags	12500	12500	12500	12500	12500	12500	12500
From sale of heifer calves	125000	125000	125000	125000	125000	125000	125000
From sale of bull calves	37500	37500	37500	37500	37500	37500	37500
Total Cash Inflow	**5575000**	**7135000**	**7135000**	**7135000**	**7135000**	**6775000**	**6775000**

Outflow

On concentrate feed	1030500	1353000	1353000	1353000	1353000	1353000	1317000
On green fodder	250000	150000	150000	150000	150000	150000	150000

On dry fodder	102187.5	136875	136875	136875	136875	136875	136875
On veterinary aid	15000	15000	15000	15000	15000	15000	15000
On labour	84000	84000	84000	84000	84000	84000	84000
On insurance	135000	135000	135000	135000	135000	135000	135000
On electricity	7000	7000	7000	7000	7000	7000	7000
Total Outflow	**1623688**	**1880875**	**1880875**	**1880875**	**1880875**	**1880875**	**1844875**
Net Cash Inflow	**3951313**	**5254125**	**5254125**	**5254125**	**5254125**	**4894125**	**4930125**

FINANCIAL ANALYSIS OF THE PROJECT

Particulars	**I year**	**II year**	**III year**	**IV year**	**V year**	**VI year**	**VII year**
Capital Investment	3873000						
Working Capital	1623688	1880875	1880875	1880875	1880875	1880875	1844875
Total Cost	5496688	1880875	1880875	1880875	1880875	1880875	1844875
Total Benefit	**5575000**	**7135000**	**7135000**	**7135000**	**7135000**	**6775000**	**6775000**
Net Cash Flow	**78312.5**	**5254125**	**5254125**	**5254125**	**5254125**	**4894125**	**4930125**
DCF at 20%	0.833	0.694	0.579	0.482	0.402	0.335	0.279
Disc. Benefit	4645833	4954861	4129051	3440876	2867396	2268934	1890778
Disc.cost	4580573	1306163	1088469	907058	755881	629901	514871
NPV at 20% DCF	**65260**	**3648698**	**3040582**	**2533818**	**2111515**	**1639033**	**1375907**
DCF at 25%	0.800	0.640	0.512	0.410	0.328	0.262	0.210
Disc. Benefit	4460000	4566400	3653120	2922496	2337997	1776026	1420820

Disc.cost	4397350	1203760	963008	770406	616325	493060	386898
NVP at 25% DCV	**62650**	**3362640**	**2690112**	**2152090**	**1721672**	**1282966**	**1033922**
NPV at 20%	**14414813**			**B:C ratio at 20%**		**2.473**	
NPV at 25%	**12306051**			**B:C ratio at 25%**		**2.394**	

Short Answer Type Questions

1. Explain dairy economics

2. Explain capital expenditure

3. What is meant by gross cost and gross income

4. Calculation of cost of milk production per litre

5. Expand NDDB and NABARD

6. Expand DRDA and ITDA

Long Answer Type Questions

1. Explain the manage mental practices involved to increase the profit in dairying

2. Write about the cost of milk production and measures to reduce the cost of milk production.

3. Write about the estimation of costs and returns in dairying

4. Explain briefly about the various financial institutions supporting dairy development programmes.

5. Write the procedure for the preparation of a project report for a two animal dairy unit.

UNIT 2

Milk Procurement

Structure

2.1 Systems of milk collection

2.2 System of milk pricing

2.3 Principles involved in pricing of milk products

2.4 Planning for milk collection and transportation routes

2.5 Measures to increase milk collection during lean season

2.1 Systems of milk collection/ procurement

The success of any dairy project depends on a well planned organized system of milk procurement. In the case where procurement system is not well established, dairy plants remain under utilized and on the other hand, if system is well planned the following advantages can be obtained.

1. An assured market round the year to the milk producers.
2. Increase in the milk production through inputs at reasonable cost.
3. Planning and scheduling of milk procurement.

4. Full capacity utilization of the dairy plant

The following aspects should be considered

1.Policy decisions at top management level

2.Scheduling the actions for smooth running

1. Policy decisions at top management level: The following decisions should be taken before starting milk procurement.

i) Price to be paid for raw milk in different seasons

ii) The system and frequency of payment for milk- Daily, weekly, fortnightly or monthly.

iii) Reserve funds required to carry milk procurement to avoid hard ships.

iv) Material, equipment, chemicals and stationary required for collection centres.

v) Transportation of milk – hiring of transporting vehicles is considered to be better rather than owning the vehicle.

vi) Technical inputs i.e. Veterinary aid, A.I, feed and fodder to be given in advance to the producers to get the advantage of favour.

vii) Man power required and their training a with regard to milk procurement.

2. Scheduling the actions: The milk procurement activities are planned after the above policy decisions are taken. Village societies are formed after preliminary and detailed survey of villages. Society staff is recruited and necessary training in the fields related to milk collection, testing, maintenance of records, bank transactions bye-laws etc is given. Transport time table for milk cans and (or) unloading of empty cans is drawn. All the members of the society will be informed about the time of milk collection at the collection centres. Depending upon the quantity of milk collected, indent for extra cans or information about the quantity of milk to be procured in future should be reported promptly to the concerned authorities by the society organizers.

2.2 Systems of milk pricing: The pricing of any commodity is always based on its cost price and the price paid by the consumer. Pricing system followed should be aimed at

1. Remunerative price to the producers.
2. Competitive to the local market prices.
3. Discourage adulteration and promote quality consciousness based on milk constituents i.e. Fat and SNF.

Methods of milk pricing

Un organised sector i.e milk vendors practice volume and weight basis. The volume basis will encourage the adulteration of milk with water. Quantity of milk will be affected with formation of foam. The weight system will not be effected by foam it also encourages adulteration of milk. The various other milk pricing systems are

1. Pricing on pro-rata fat basis: The price of milk is fixed proportional to the fat content of milk in this system. It will assign practically zero value for S.N.F content.

The advantages of this method are easy to calculate the milk price and easy to adopt as it requires only fat estimation. Farmer will easily understand the system and it can be adopted to any type of milk.

The disadvantages are it encourages adulteration of milk with water, as there is no check on S.N.F. This system will encourage buffalo milk as it contains more fat per cent and do not provide remunerative price for cow milk.

2. Pricing on two axis basis: This method is used in pricing cow as well as buffalo milk as both fat and solids-not-fat (SNF) contents are taken into accounts. It is called as "two axis pricing" as the system is based on both fat and SNF. The prices of fat and SNF are fixed depending-upon the market price of Ghee and skim milk powder. Normally the price of fat will be declared by the union for different seasons and the price of SNF will be 2/3 price of the fat. The price is calculated using the following formulae.

Example: Price of 100 kg milk=kg fat rate x Fat percentage + kg SNF rate x SNF%

If the price of kg fat is Rs. 100 then price of 9% SNF be 100 x 2/ 3 = Rs. 66.60

Then the cost of 100kg of milk testing 6% fat and 9% SNF = (100x6) + (66.6x9) = 600+599= 1199 i.e. Rs. 11.99 per kg.

The advantage of this system is there is no discrimination against cow or buffalo milk as cow milk is reasonably priced due to consideration of SNF content, which is well comparable to that of buffalo milk.

3. Pricing on Equivalent Fat unit basis: In this method, the SNF units are converted into equivalent fat unit in proportion to the relative market prices of fat and SNF. The SNF value is at 2/3 unit of fat. For example if the buffalo milk testing 6% fat and 9% SNF, then

The total number of Fat units = 6 + 9 x 2 / 3 = 6 + 6 = 12

If the fat price is Rs. 100/- then the cost of 100 kg of milk =100x 12 = 1200

or Rs. 12 per kg of milk.

This method will give the same advantage of two axis pricing system.

2.3 Principles involved in pricing of milk products

The following six steps are to be practiced while finalizing the price for milk products.

1. **Selecting the pricing objectives:** Whether the pricing objectives are profit oriented or service oriented. Normally, the government agencies, voluntary organizations or cooperative bodies are service oriented with minimum profit,

where as private agencies will aim at maximum profits. Aiming at reasonable profit will have many advantages to have in market for longer period with maximum percentage of market share.

2. **Determining the demand:** The market demand for individual product can be assessed by making market surveys. The heavy demand product should be prepared. The price of heavy demand product will be naturally high.
3. **Estimating the cost:** The cost of the products normally at which it can be marketed can be calculated as follows.
   a) Cost of raw materials used for the preparation of the product i.e. milk, sugar, spices, salt etc.
   b) Cost of processing the product: Normally the processing costs will be around 20% of cost of raw packing cost.
   c) Depreciation on the cost of raw material.
   d) Distribution cost (i.e. transportation)
   e) Distribution margin (whole sellers margin)
   f) Retailers margin.

The total of the above gives actual price for the products. For that add profit margin which may be 10-15% depending upon the demand.

4. Analysis of competitor's price and offer : The price of products should be competitive and attractive compared to competitor's product. Some times extra quality of products is offered with the same price (Add 100 gms with 500 gms of products) by competitors. That should also be taken into account.

5. Other factors influencing the product price fixation

i) Season: During summer, demand for flavoured milk, butter milk cream, kulfi will enormously increase. So the price of fast moving products in summer can be increased.

ii) Area of marketing: When the income of people is high, there will be more sale of product. There is more demand for milk and milk products in cities followed by towns.

2.4 Planning for milk collection and transportation routes

Milk collection centre should be located in a convenient place in a village by the side of a main road. It should have sufficient place for milk collection, testing, storage of milk collection equipment, records and technical inputs. It should have electricity and sufficient water for cleaning milk cans and other equipment.

Correct timing for milk procurement to each milk collection centre should be fixed and it should be intimated to all the milk producers. Milk procurement time should not be changed frequently.

Producers having vested interest some will try to influence the staff and undesirable things are done to save their personal interest. This should not occur. Some persons will supply adulterated or substandard milk. This should be discouraged.

Some farmers due to many reasons will supply evening milk in the next morning and morning milk in the evening which may cause curdling of milk and loss to the quality of milk causing problem in processing of milk. This can be explained to the farmer that milk of morning and evening should not be mixed, as it may lead to loss to all producers.

Some staff member will not follow the timings for milk collection, so milk procurement, will get delayed, and that the producers will have to wait for hours together and lose their interest in society. Maintenance of the time by the staff is also essential for improving the milk procurement.

Transportation of milk to the processing centre or chilling centre will be undertaken by the Union. Usually hired vehicles are used for transportation of milk. Circular milk routes are proffered to save time and to cover more villages. Some societies will not have proper routes, it‘s the responsibility of the society to transport the milk from the collection centre to the nearby village.

At union level different routes are planned to get the milk from different places to the processing plant. Each route will be planned in such a manner that it will go through all the society villages or at least nearer to the societies. The routes are so planned that if any damage to the road or traffic occurs, an alternative road is available to the processing centre. The, route map should be supplied in advance to all the societies so that they can plan for amicable pick-up points. The length of the road should be such that from the starting point of the milk collection, it reaches the processing or chilling centre within reasonable time so that the milk may not get spoiled and fit for processing.

The transport vehicles will deliver the empty cans for next collection and lift the can with milk. In case of any breakdown to the transporting vehicles an alternative vehicle or at least the other route vehicle may be diverted.

Modes of milk transportation in India: Under Indian conditions , milk has to be regularly collected and transported twice a day(morning and evening). Modes of transport depend upon the carrying load, the distance of collection and local conditions. The particulars are given below.

Mode of transport	Optimum load (kg)	Optimum distance (km)	Remarks
Head load	15-25	3-8	It is practiced for small loads and distances. Important in hilly areas.
Shoulder sling	Upto 40	3-6	Meant for heavier loads but for short distances than head load.
Pack animal	Upto 80	6-10	Ponies, horses and donkeys usually employed.
Bullock cart	300-400	10-12	Rather slow
Tonga	250-300	10-12	Faster than head load, pack animal and bullock cart.
Bicycle	40	15	Quick and handy, easily accessible to milk producer
Cycle-rickshaw	150-200	10 or more	More carrying capacity than bicycle.
Boat	40-200	2-8	When rivers are to be crossed.
Auto-rickshaw	250-500	15 or more	Greater carrying capacity and faster than cycle- rickshaw
Motor truck	1-3 tonnes	15 or more	Commonly used for heavy loads.
Railway wagon	11tonnes or more	80 or more	Cheaper than road over a long distance.
Tanker(road or rail)	5 tonnes or more	80 or more	Great scope in future for long distance transport.

2.5 Measures to enhance milk collection during lean season.

During rainy or winter season, there will be more availability of green roughages which will increase the milk production, where as in summer most of the fields including grazing lands become dry and insufficient green fodder adversely affects the milk production. Moreover, no farmer will plan for calving during summer as it adversely affects lactation milk yield. Most of the cows will be in dry or late lactation or late lactation with pregnancy. Hence, summer season is called lean season for milk procurement and rainy and winter season is called as flush season.

The milk production during flush season will be surplus and the collection centres are unable to collect full quantity due to various reasons. The processers should regularly collect full quantities of milk from the producers during flush season. The producers also remember the collection centres, who have helped them during flush season. Some processors even declare milk holidays once in a week, or so during flush season in some areas. It will cause economical loss to the producers. When famers are tackled well during flush season, they will supply the entire quantity of milk during lean season.

Fixing of high price or giving bonus or extra payments for the milk supplied during lean season will also improve the milk collection. As the level of production drops during summer and also most of the dairy animals in dry / pregnant conditions, the cost of the milk production will generally high during summer season, the processers should enhance the purchase price of milk to compensate this high cost of milk production.

Advance payment/prompt and regular payments for the purchased milk by the collection centre will definitely improve the milk collection during summer. Supply of inputs like concentrate feeds, fodder seeds, fertilizers, A. I facilities to the producers in advance and adjusting the cost for the price of milk collected. Milk collection centres can make advance payments during festival occasions to attract the producers to supply milk during lean season.

The collection centre person should respect customs of the local people and they should participate in various social and cultural activities of the village so that the farmers think that these are one among them and definitely they sell milk to them only.

Out of their profits, the processors / milk collection centre persons should spend certain portion for social activities in the village, i.e. laying or repair of roads, construction of school buildings, maintenance of parks, donation to temples, or donation to any religious/other function will have effect on milk collection. Milk competitions, bull competitions, calf rallies and other groups of animal competition regularly in the village will also increase the loyalty in the villagers.

In addition to the above encouragement points, the processors/collection centre people should not do these things i.e cheating the producers by taking extra quantity by manipulating the weights and measures, showing less readings of fat and SNF levels in the milk, wrong calculation in the price fixation of milk, utilization of money for personal use and delaying the payments to the producers, not paying the bonus after the year, not bothering about the collection of milk during flush season and not attending to the problems of animals.

Short Answer Type Questions

1. What is meant by pricing of milk on two axis basis.
2. What is lean and flush season in milk collection
3. Which is the best method of milk pricing
4. List the methods of milk pricing
5. What are the reasons for low milk procurement during lean season
6. What are the reasons for surplus milk procurement during lushseason
7. Location of milk collection centre in a village

Long Answer Type Questions

1. Explain briefly about milk procurement systems.
2. Write in detail about various pricing policies of milk.
3. What are the principles involved in pricing of milk products
4. How do you plan for milk collection and transportation routes
5. Write about the various modes of transportation of milk in India.
6. Explain the measures to increase milk collection during lean season

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UNIT 3

Dairy Development Programs

Structure

3.1 Various dairy development programmes operated in India

3.2 Operation flood - Aim and Achievements

3.3 National Technology Mission for Dairy Development

Milk has emerged as the single largest agricultural commodity surpassing paddy in terms of its value. India ranked first in the world in milk production with 165 million tonnes because of implementation of several dairy development programmes in India.

3.1 Various Dairy development programmes operated in India: Some important bovine and dairy development programmes implemented in India are given below.

1. Key Village Scheme (KVS): It was initiated in 1952 as a part of the First Five-Year Plan at the government cattle breeding farms in their breeding tracts to produce stud bulls of recognised breeds. Each key village block was envisaged initially to cover 5,000 breed able cows and buffaloes and later on expanded to cover 10,000 breedable cows and buffaloes to produce quality bulls for upgrading non-descript population in other areas. During the Third Plan, 600Key Village Blocks were established to cover 6million breedable population.

The main activities were production of purebred bulls for upgrading non-descript population in other areas. Initially, natural service was practiced but later on artificial insemination (AI) was introduced at most of the key village centres. Mass castration of scrub bulls, fodder production, better feeding, health cover and milk recording and extension activities like cattle shows and calf rallies were included in the programme.

2. Intensive Cattle Development Project (ICDP): By the end of the Third Plan, ICDP was started in 1965 to replace Key Village Scheme. The ICDPs were started in the milk-sheds of dairy projects with the following activities.

1. Each ICDP should cover one lakh breedable cows and buffaloes.
2. It should be located in breeding tracts of indigenous breeds of cattle in milk shed areas.
3. It should be linked up either with fluid milk marketing schemes or milk products manufacturing projects.
4. The projects should be located in areas where good potential conditions existed to ensure satisfactory response to cattle improvement and milk production enhancement efforts**.**
5. Exitic cattle breeding farms were established throughout the country to provide bulls for production of semen to support this scheme. Cross breeding program with exotic bulls of Holstein –Friesian, Jersey and Brown Swiss was started through A.I in these project areas.
6. Fodder production programmes and feed mixing plants were taken up for better feeding of dairy animals apart from heath cover of dairy animals. Milk recording, calf subsidy, cattle shows, calf rallies, fodder competitions etc. were also included in the project.
7. The project is linked with the dairy plant with assured milk marketing and a remunerative price.
8. The multi-national brands introduced new milk products.
9. To overcome the economic barriers, toned milk with less fat and at comparatively the cheaper price, was formulated.

Besides above contributions, some negative effects were also observed as listed below.

1. Modernization and planning of dairy industry was consumer oriented.
2. The package of inputs required for enhancing milk production was left in the hands of state Animal Husbandry Department without any correlation with milk industry. Those inputs hardly reached the producers as they were to bear entire burden of maintaining the milch animal.
3. NDDB and Operation Flood: The NDDB was created in 1965 to take up dairy development programmes in the country on Anand model by replicating the pattern in other parts of the country. The dairy development programmes are being implemented through a network of milk co-operatives organized on the model existing in Gujarat state namely ANAND pattern i.e 3 tier Programme structure i.e Forming village level primary milk co-operative producer's societies, District level milk producers co-operative unions and Apex level federation of district co-operative milk producers unions.

Operation Flood was launched in 1970 and implemented in 3 phases from 1970 to March 1996. The main objectives are to assure remunerative price for the milk produced by the milk producers through a stable, steady and well organized market support and distribution of milk and milk products at reasonable price to consumers. It comprises Anand pattern 3-tier milk producers cooperative societies. The major impact of the project is increase in milk production by providing technical inputs and services to the milk producers. It also provided assured market and remunerative price to the milk producers in the rural areas. It created effective processing ,marketing system of milk and milk products. It created effective participation of milk producers in milk production, procurement and marketing. It also provided social services like schools and hospital to the families of milk producers.

4. Milk and Milk Products Order (MMPO)

This programme has been started by the Government of India during 1992 under the liberalization policies. It empowers those dairy plants exceeding its utilization of 10,000 liters per day must register with Government for its modernization, product manufacturing and collect milk in specified area.

5. Integrated Dairy Development Project in Non-operation Flood, Hilly & Backward areas: After the successful implementation of Operation Flood , it was launched during 1993-94 on 100% grant in aid with the following objectives:

1. Development of milch cattle/buffaloes and increasing milk production in non-Operation Flood , hilly & backward areas.

2. Procurement, processing and marketing of milk in a cost effective manner.

3. Ensuring remunerative prices to the milk producers and generating additional employment opportunities

4. Improving social, nutritional and economic status of residents of hilly and backward areas.

6. Other dairy and livestock development programmes: The following programmes also played important role in dairy and livestock development.

a. Livestock Insurance Scheme for high yielding animals

b. National programme for bovine breeding and Dairy development (NPBB&DD)

c .Rashtriya Gokul Mission(RGM)

d. National Kamadhenu Breeding Centre (NKBC)

d. National Dairy Plan

e. National Livestock Mission (NLM)

d. National Livestock Policy

g. Rastriya Krishi Vikas Yojana (RKVY)

h. National Rural Livelihood Mission (NRLM)

3.2 Operation flood - Aim and achievements

Operation Flood is a project designed by the National Dairy Development Board (NDDB) in three phases. i.e. Operation Flood-I, Operation Flood-II and Operation Flood-II

Operation Flood-I (1970 - March 1981)

Objectives

- Expansion of dairies in four major metropolitan cities namely Mumbai, Calcutta, Delhi and Chennai (Madras).
- Organization of milk cooperatives in 18milk sheds in 10 states.
- Skim milk powder and butter oil were received from the Untied Nations world flood programme and F.A.O. The funds generated amounting to over Rs. 100 crores by selling the recombined milk were to be spent towards technical input for milk production.
- The target of milk production by 1984 -85 was 38 million tones.
- The Co-operative structure under this programme would provide fair price to the farmers for their milk produce. Supply good quality milk at reasonable price to the Consumer in urban areas and stimulate enhancement in milk production.

Operation Flood – II (April 1981 to March1985)

Objectives

- To extend dairy co-operative structure to cover some 10 millions rural milk producer's families.
- To develop 16 millions cross bred cows and up graded buffaloes by mid 1985 to form the national milk grid by building up the infrastructure for breeding programme.
- To link all urban centers, 1148 cities and towns with a populations of over 1 lakhs into a national milk grid.
- To augment dairy processing capacities.
- The per capita availability of milk is expected to increase to 144 grams by end of OF-II.

Operation Flood –III (1985 April to 1996)

O.F – III being implemented during the 7th five years plan seeks primarily to consolidate the extensive milk procurement and marketing base built during the earlier two phases.

Remunerative prices and marketing opportunities created under O.F have enabled small dairy farmers to look after their milch animals and use them as a major resource for increasing income.

Operation Flood Phase – III would endeavour to develop strong farmer's organization in 136 milk sheds built during 2nd phase. These organizations controlled by member of producers through their elected representatives at all the 3 tiers (village milk co-operative societies district milk Co-operative unions, State Diary Development Co-operative Federation) and manage their milk procurement, processing, and marketing and inputs supply functions.

The Objectives of O.F-III are as follows

OF –III aims at increasing rural milk procurement to peak of 18.3 million liters from over 8 million milk producer families by 1990. Over 12 million liters are proposed to be sold as fluid milk through urban market.

It is visualized an increase in milk procurement by about 132% and milk marketing by about 148%.

To achieve, the above targets a rational pricing policy was evolved at both farm and urban market level.

Much greater emphasis was placed on the marketing of fluid milk.

Expanding marketing infrastructure in all major linking them to milk sheds through the National milk Grid (NMG) to ensure year round stable milk supply in these markets.

National Milk Grid ensures improved available price to the consumer and a remunerative price to the milk producer by balancing without regions and seasonal imbalances in supply and demand.

Provision has made in OF-III to establish 10 cattle feed plants each with a capacity of 100 tons/ day. Provisions are also made to extend the capacity of the selected existing cattle feed plant.

3.3 National Technology Mission for Dairy Development (TMDD)

The government of India has formed a body "Technology mission" to coordinate the activities of various institutes concerned with dairy development such as NDDB, IVRI, Agricultural universities, state government department working for dairy development with the ultimate objective to promote dairying on "Operation Flood" model for the welfare of millions of milk producers in the country. Most of the above institutions are working piece meal and in isolation. This body was established in 1988 to 1994 (7 years programme) with headquarters at Anand in Gujarat State. The main objectives are

1. Under the Technology mission the milk production in the country is expected to go up from 44 million tonnes in 1987 to 61 MMT by 1995.
2. To increase the per capital availability of milk from 158 to 186 gr / head/ day.
3. The average lactation yield of the cow is expected to be increased from 390 to 640 lit. and in buffaloes from 900 to 1010 lit per lactation.
4. Number of districts covered by dairying would go up from 242 to 270.
5. Number of village milk co-operatives to increase from about 49000 to 50000. These include about 21,000 additional village cooperatives planned under of phase III.
6. Milk marketing facilities will go up along with processing capacity.

7. Various government Departments associated with the mission are Indian council of Agricultural research (ICAR), Central Scientific and industrial Research(CSIR),Agriculture universities and NDDB will be involved with the mission.

8. The mission plants to set up large energy efficient dairies and lacto peroxidise system to preserve milk quality.

3.3.1 White revolution: Green revolution is intended for overall increase in agricultural produce, whereas white revolution is intended for increasing the milk production tremendously in India so that sufficient quantity of milk is available for all the people at affordable price. Most of the dairy cattle are native breeds, in which majority are poor yielders of milk. It is not economical to raise the animals with 2-3 litters of milk production.

The milk potential of animals can be improved to achieve the white revolution by implementing the following practices

- **Introduction of Exotic cattle:** Exotic breeds like jersey, Holstein Friesian, Brownswiss etc. are excellent milk producers. These breeds can be introduced to some extent throughout the country to increase the milk production.

- **Cross breeding programme:** The semen of exotic breeds can be utilized on native breeds and non-descript animals to produce superior off springs. With little investment, the future herd will be crossbreds having good milk production capacity. Massive cross breeding programme should be undertaken. Now a days trained personal are involved in door step Artificial Insemination. Rural unemployed people will undergo short duration training on Artificial Insemination and they will do door step A.I on payment.
- **Selective breeding of Indian dairy breeds:** There are some Indian breeds i.e Sahiwal, RedSindhi, Tharparkar and Gir which are yielding optimum milk

production. These breeds can be maintained by maintaining pure breeding programme.

- **Up grading the non- descript buffaloes** with high yielding Murrah buffalo breed. Slowly the future stock will become high yielding graded Murrah buffaloes.
- **Animals Husbandry activities :** Veterinary doctor should be there in and around- at least within a reasonable distance, who will take care of the animals in the following activities.
   To treat and maintain the health of diseased animal.

   To inseminate the animals and confirming pregnancy diagnosis, attending dystocia and maintaining reproductive health.

- Advising balanced nutrition and managemental tips
- **Improving the fodder prouction :** The fodder crops development in India is not favorable. Most of the farmers are opting for commercial crops, not leaving any land for fodder crops. Green fodder is necessary to increases the milk production economically and also maintains good health and reproductive status. dairy farmers should allot some land for fodder production. High yielding fodder crops like Napier Bajra, para grass, leucerne, cowpea, berseem, and other grasses can be grown whose yield is more and also give multi cuttings. The grazing lands can be improved by sowing with high yielding pasture grass varieties.
- **Establishing of feed plants:** The availability of good quality of concentrate feeds in India is not satisfying the needs. Modern feed plants, should be established especially under cooperative system, to produce well balanced ration for high milk production and also to keep the price of concentrate feed at minimum affordable level. As the human beings are competing for the most of the feed ingredients, much emphasis should be given for use of unconventional feed ingredients. To avoid wastage of feed in dust form, it is better to go for pelletization process. Molasses can be used both as sweetening as well as energy supplement.

- **Formation of Cooperative on three tier system**: The development of milk production under government has not given boost. It is proved in our country in Gujarat, that only cooperatives will perform better to boost up milk production cooperatives system. Advantage is the milk producers will manage all the activities i.e. milk production, collection, disposal and providing basic requirements. Anand pattern of three tier system is successful system. In this, in a village all the milk producer will form village cooperative society. In a district, all the village cooperative societies will form district milk producers union. All the district union in the state will form state Federation, which is the apex body to take policy decision. Village societies will collect the milk and send to district union where milk is processed and milk products are prepared. Liquid milk and products are marketed by the district union. In all the villages village milk producer‘s cooperative societies should be formed to enhance the milk production.
- **Providing technical inputs and services to the milk producers :** The district union should provide the input like artificial insemination facilities, supply of balance concentrate feeds, fodder seeds on subsidized rates, and arranging for loans for purchase of dairy animals. Training programmes should be conducted to milk producers periodically in the subject of dairying, so that the farmers will get sufficient knowledge in the breeding, feeding and management of dairy animals for increasing milk production economically.
- **Improving the rural Transport:** The roads are in very poor condition in the rural areas. The milk collected at rural cooperative societies needs to be transported to huge distances for chilling and processing by road. Hence proper road facilities are very much essential.
- **Processing centre/ product factories:** The milk processing centre/ products factories should have the sufficient capacities and sufficient number to deal with surplus milk during flush season. The surplus milk should be converted into products. If the processing centres are at long distance from collection

points, chilling centres can be established in which the milk is chilled and transported to processing centre by refrigerated thermo packed road tankers.

- **Marketing facilities:** For the sale of liquid milk and milk products, marketing infrastructure should be developed. i.e. C & F agents, distributors, whole sale retailers, mobile quality checking teams should be provided to check the quality on the spot, if any complaint comes, to get consumer‘s satisfaction. A poor marketing structure will easily damage the business.

Short Answer Type Questions

1. What are the main activities of key village scheme
2. What are the main activities of ICDP
3. Define intensive cattle development project
4. What do you mean by White revolution
5. What is the main objective of technology mission for dairy development
6. Expand RGM, NKBC, NLM and RKVY

Long Answer Type Questions

1. Explain briefly about any four dairy development programme started in India.
2. Write briefly about the practices to be implemented to achieve white revolution.
3. Explain briefly about the various phases of Operation Flood programme.
4. Explain about technology mission for dairy development.

UNIT 4

Dairy Cooperatives

Structure

4.1 Cooperatives-Importance of Cooperatives-Principles of Cooperation

4.2 Milk cooperatives – Anand pattern

4.3 Functioning of village milk cooperative society

4.4 Structure and activities of district Milk Union

4.5 Role of state milk cooperative Federations

4.6 Records and registration in a milk society

4.7 Insurance of dairy animals

Cooperation means working together; ‘Co’ means together and ‘ Operation’ means working. Cooperation is a voluntary concept with equitable participation and control among all involved in any business activity or enterprise. According to H.Calvert (1879), it is a form of organisation where persons voluntarily associate together on the basis of equality for the promotion of their own social and economic interests.

4.1 Cooperatives-Importance of Cooperatives-Principles of Cooperation

Most of the Indian farmers have small land holding. Use of production enhancement inputs went on increasing. Thus the input-output ratio started getting imbalanced. The need of cash was more felt to purchase inputs. To meet these needs, farmers had to borrow money at a very high rate of interest. Money lenders exploited the farmers who were poor and in debt.

At this juncture, the Government realized the need of cooperative movement therefore, appointed a committee under the chairmanship of Edward Law to make suitable proposals for enacting a separate legislature Act.

Importance of Cooperatives:

(a) Social objectives:

i) To develop democratic leadership.

ii) To motivate people for voluntary participation and group action.

(b) Economic objectives:

i) To bring welfare of the society through availability of credit and for better prices to farm produce.

ii) To avoid exploitation by middlemen.

iii) To provide employment opportunities and distribution of essential commodities.

(c) Essential objectives:

i) To bring working knowledge among the members.

ii) To develop responsibility and honesty among the members.

Principles of Cooperation

The Cooperative principle is not something which is only a way of managing credit or marketing. It is a way of life. The principles of cooperation are as follows.

- **Rochadale principle :** The modern formal cooperative movement dates to 1844 ,when 28 poor weavers came together with capital to open a small retail shop. They adopted a set of rules which were later known as Rochadale principles which today effectively guide the philosophy and conduct of cooperative societies all over the world.
- **Voluntary membership:** Membership of a cooperative society should be voluntary to any person possessing the requisite qualification for being a member.
- Democratic control
- Limited interest on share capital
- Patronage divided
- Promotion of education
- Mutuality
- Association of person
- It is an understanding
- The basis is equality
- It is a socio economic movement

4.2 Milk cooperatives – Anand Pattern

The foundation of Anand pattern of milk cooperative was laid with the organisation of the kaira dist. Co-operative Milk Producer’s Union limited at Anand. In this pattern, all the functions of dairying – milk production, procurement, processing and marketing are controlled by the milk producers themselves. In addition to this, all the facility related to milk production and procurement are provided at farmer door steps. The Anand Pattern in three tier system i.e. village Cooperatives, District Union and state Federation were formed. The basic unit in the Anand Pattern is the 'Village milk producers co-operative-a voluntary association of milk producers in a village, who wish to market their milk collectively. All the village milk producers cooperatives in a district are member of their district Co-operative milk producer's Union.

Every milk producer can become a member of society. At a general meeting of members, representatives are elected to form a managing committee. It manages the day-to-day affairs of milk collection, it's testing for fat content, sale of cattle feed and other technical inputs etc. Each society also provides technical services i.e Artificial Insemination and veterinary aid to the dairy animals of society members.

A key element in the Anand pattern of dairy co-operative is that all registered village milk societies are members of a district co-operative milk producer's Union which enable them jointly to own a dairy processing factory and a cattle feed plant. In order to become members of the Union, a registered society must purchase at least one share of Rs. 100/-and Pay Rs. 5/- as entrance fee.

The District Dairy Cooperative Unions became member of a cooperative milk marketing Federation by Subscribing to it at Rs. 20,000 each as share capital. The federation is responsible for all member Union, liquid milk and milk products, deciding the product - price mix, 'cooperative provision of joint services (AI, breeding) and cooperatives 'marketing of technical inputs to members.

4.3 Functioning of Village Milk Cooperative Society

The supervisor/ officer from the union organizes Gramsabha after the completion of survey of the village about milk production and related items. If the villagers decides to form society, an organizer is selected from amongst them. The organizer is authorized to collect the share money @ Rs. 101 each for share subscription and Rs.1/- for share. All the milk producers interested in society will be registered with Dept of Cooperative. One member will be elected as chairman and he appoints secretary who will look after day to day work.

Functions and activities of the society

The basic unit of An and Pattern structure is village milk producer cooperative society. The Functions of society can be classified into

A) **Managerial functions:** All the members of the society form the general body of the society which has supreme power, the society and this number of staff depends upon the size of the business. One third members of the committee retire every year by rotation. The rotation retirement helps bringing new faces and continuity in the management. The chairman is elected every year in the management committee meeting. The committee decides policy matters and frames guide line for efficient running of the society. The committee holds its monthly meeting to discuss issues pertaining to society, producers as per guidelines provided by the union etc.

B) Operational functions : It can be classified into two groups i.e milk trading and input services.

Milk Trading: It involves the following works

1. Reception of milk: Milk is received from the producer both morning and evening. Sample of milk is collected for testing.

2. Testing of milk: The individual samples are tested for fat and SNF and recorded sample from pooled milk is drawn and tested.

3. Dispatch of milk: All milk cans are covered tightly by lids. Filled milk cans are loaded on the hired /own truck and empty cans are unloaded for society use for next milk collection.

4. Payment for the milk: The price of milk remains uniform throughout the district irrespective of village, district union or head quarters. Both quality and quantity form the basis for the payment. Price chart will be supplied by the union. The society pay the producer's morning milk price evening and evening milk price next day morning.

5. Accounting : Separate account books are maintained for different transactions and the relevant postings are made on the same day of operation. A person from the same village is appointed as internal auditor to check the account.

6. Distribution of profits : The society, from its profits distribute bonus to the producers in proportion to the value of milk supplied be undertaken.

7. Other duties : like sample milk disposal, local sales of milk, standardization of testing equipment and chemicals etc., will all be undertaken.

Input services:

1. Providing Artificial Insemination services and veterinary first aid.

2. Society purchase cattle feed from the union and supplied at cost or subsidized rate.

3. Provides quality fodder seeds to the producers at cost or subsidized rate.

4. Provides news letters and educational material. It will conduct meetings and tours to dairy plant, cattle feed plant etc.

5. It will also help in cattle insurance and some strong societies will give subsidy on insurance of cattle.

4 .4 Structure and activities of District Milk Union

Once sizeable number of societies (40-50) are organized and registered in a milk shed, the district level milk union can be started. The chairman's of all village milk cooperative societies formed are the members of the district milk producers unions. In order to become members of the district milk producers unions a registered society must purchase at least one share of Rs. 100/- and 5/- as an entrance fee. They hold the meeting and resolves the formation of District Cooperative Milk Producers Union.

The union will be registered with the cooperative department. They elect the Board of Directors who will in turn elect chairman. One third of elected board members retire every year by rotation. Each district union is professionally managed by a Managing Director, who reports to the elected chairman and board of Directors. The number of board of directors will be sixteen to seventeen of the village societies. The remaining five comprise managing director as a member secretary, one or two representatives of the financing institutions, a representative of the registrar of cooperative societies and representatives of the Federation. These five numbers are not eligible for contesting to the post of chairman. The general policy for the union is framed by the board. The board employees the Managing Director/ General Manager, but his removal will be done by only generally body. The board determines the number, type and scale of the posts and Managing Director/ General Manager makes appointment.

Functions and activities of the District Milk Producers Union

1. **Procurement of milk:** Milk will be collected from all the member societies of union by engaging hired vehicle. Different routes are formed to cover the societies so as to enable the milk to reach the union plant within reasonable time.
2. **Processing and marketing of milk and milk products:** The milk is processed and liquid milk products are produced and kept in sale through own shed area. Different milk products are produced and kept in sale through own or distribution outlets.

3. **Providing Technical inputs:** The union appoints veterinarians who will provide Artificial Insemination service, treatment of diseases etc. on free cost or charging subsidized rates. Emergency services will be provided. Liquid nitrogen will be supplied regularly to field AI centres. Supply of feed and fodder seeds to village societies on cost or subsidized rate is taken up. Establishment of the dairy and fodder demonstration farms is also taken up.

4. **Strengthening of milk cooperative movement:** The union will formulate the strategies for strengthening of cooperative in dairy industry.

5. **Organization of extension activities and rural development service:** Field visits will be arranged for milk producers to dairy plant, cattle feed plant, semen production stations etc. so that producers will know some scientific knowledge and profitable method in milk production. Milk yield competition will be organized to build competition among the producers. Screening of different educational films related to dairying will be undertaken.

In addition to the above Union carries other promotional activities for over all benefit of farmers. The union owns and operative's dairy plant, cattle feed plant, fodder and bull mother farms, semen collection station, headquarters centre for animal husbandry activities.

On the net profit earned by the union, 25% is carried to its reserve funds and not exceeding 12% per annum is paid to the member societies as dividend on their paid up share capital and small contribution is made to education funds. Out of the remaining profits, bonus is paid to the members up to 80%.

4.5 Role of state milk cooperative federations.

The district Dairy cooperative union become members of a cooperative milk marketing federation. Each union should subscribe at least Rs. 20,000/- as share capital. The Federation is responsible for evolving and implementation of policies on cooperative marketing of liquid milk and milk products.

The Federation Board consists mainly of the elected Chairman's of the entire district Unions and the federation Managing Director. Other members are of representatives of Registrar of Cooperative societies; from representative of financing agency, nominee of NDDB and one nominee union of the State Government (Dairy Development Department). The members elect the chairman of the board.

The Federation Board is advised by its managing committee, which is composed of each member unions chief executive, chief quality control officer and one more non voting coopted technical representatives of NDDB. The Federation Managing Director will be the committee chairman. The committee meets once in a month and is also responsible for day to day implementation of the board's policies and plans.

Out of the total profit earned by the Federation, 25% goes to reserve fund, not exceeding 12% as dividend, remaining as bonus to member union and little to education fund and Research and Development.

4.6 Records and registration in a milk society

Records to be maintained

The society shall maintain and update a number of records.

(a)Organizational Records:1. Membership record 2. Share ledger and Proceedings

(One for general body meetings and other for Managing Committee meetings).

(b) Financial Records: 1. General Ledger 2.Cash Book

(c) Procurement Records: 1.Milk Purchase register 2.Milk test record 3.Dairy register 4.Sample milk sales record

In the following pages, the format of each form and instructions for filling them up are given.

Name of the Society

Proceeding Book for general body / Managing Committee	
Date	**Proceeding**

Membership record: It is maintained to record the membership details of each member of the Primary Milk Producer's Cooperative Society, originating from Secretary of the society and authorised by the Registrar, cooperative Societies or the Managing Committee of the Society.

One copy is to be retained at the society

Frequency of recording of the updates: Initially at the start of the society, subsequently whenever a member joins the society or leaves the society.

Information details: Name and Address of member with father‘s name, Age of the member, Occupation of member, Heirs/Nominee‘s name and address, Age and relation of heir, Date of joining as member, Date of paying entrance fee, Member‘s signature or thumb impression, Date of leaving membership etc.,

Share Ledger : It is maintained to record the detail of share purchased by each member of ten primary milk procedure's cooperative society.

- Originating from the secretary of the society
- Authorized by the Register cooperative department / managing committee of society

Members Details

S.No	Date of joining as member	Entrance fee paid	Name & address	Occupation	Age	Nominee Relation	Member signature	Date of sig. or leaving thumb membership impression	Remarks

3. Distribution

One copy to be retained at the society

4. Frequency of Recording

Each time a share is purchased/ returned / transferred by a member, it is recorded as record for each member.

Information Details

Name of the society

Name of the share holder

Date of purchase / return transfer of share

Cash book folio no.

The no. of shares issued to member along with serial number of share certificates.

The number of share returned or transferred by the member along with serial number of share certificate returned / transferred.

Balance number of shares held.

Balance (Rs) deposited as share money.

Amount returned / transferred to member.

Remarks.

7. Processing details

Information recorded here is used in completing individual records.

Name of the Society

Share Holder :

Name of the share holder : **Address :**

Sl.no	Cash Book Folio No	Shares		Balance shares held (Nos)[pos]	Share money				Remarks
		Issued to members	Returned/ transferred By whom transferred		Debited Rs. Ps	Returned Rs. Ps	Transferred Rs. Ps	Balance Rs. Ps	

Bonus and Dividend Registers

1. Purpose

Detail of business transacted by an individual producer member over period of one year.

2. Originating from

The managing Committee of the society

3. Authorized by

The. Managing Committee of the society

4. Distribution

One copy to be retained by the society.

5. Frequency of Recording

At the end of every month for one year. One record of each member.

6. Information Details

Name of producer member and address

Period of accounting – from (data and month) to (date and month)

Quantity of milk supplied and its value (Ref. No. Col. 4&6 of purchase register). The total for the accounting period to be recorded here

Rate of bonus declared.

Bonus payable.

No. of share held by the producer (Ref. Co. VII of share letter)

Dividend payable: Amount payable is worked out according to the number of shares held by the producer.

Signature of the secretary.

Signature of receiver on receipt of amount.

7. Processing details

Bonus amount and dividend amount payable: milk supplied and number of shares held by all members may be added while preparing financial statements and the annual report of the working society.

Bonus and Dividend Registers

Name **Address**

A/c	Milk	Rateof	Bonus	No. of	Rate of	Total	Signa-	Sig. of
pe-	Sup	Bonus	pay-	shares	Dividen	amt.	ture of	mem-
		Declare						
riod	Plied	d	able	held	de-	payable	secre-	ber
				value	Clared		tary	

Cash Book: It is maintained to record the daily financial business transactions of the society. It is originated from the Secretary of the society and authorized by the Registrar Cooperative department/ Managing Committee of the society. One copy is to be retained at society. Frequency of recording is daily.

This book will have both pages of the register (left and right) for one entry. The page on left will have entries for the income (credit side) whereas, the right side will have the entries for the expenditure (debit side).

Every day the first entry on the left side with opening balance and with closing balance on the right side with cash in hand, is recorded. The cash in hand on the close of the particular day should tally with the opening balance of the next day and the total income (total of all credit entries) and total of the expenditures and cash in hand should tally.

For any withdrawal or receipt through cheque, the cheque no. and the date is to be entered.

Page no

Date and month of transaction.

Ledger folio no. of the head of account.

Head of account and particulars of transaction.

Receipt no.

Amount of money spent or received.

Total processing details. Bears a cross reference to the general ledger

Cash Book

Date and Month	Ledger Folio No. Particulars	Receipt No.	Amount Rs. Ps	Total Rs. Ps

Dairy Register: Dairy register helps the management of the society in finding out, on shift to shift basis the economics of the operations of the milk business. The faulty working of the society results in excessive profits. Low and sour age or-curdling of milk can be immediately traced and remedial measures can be taken.

As the economics is worked out a day –today and shift loss or abnormally large profits due to excess or underpayment suppliers can be immediately checked and the operating profits kept.

It is originated from the secretary of the society and authorized by the managing committee. One record is kept by society. Update twice daily separately for morning and evening shifts.

Information details

Column No.	Information
	Name of the society-month, year. **Date :** One page is for used for 10 days. dates are given as 1/10,12/11 etc. During fortnight, strike out dates, 10,11 etc., and second fort night strike out dates 1,2,etc. **Shift :** 'M=Morning, E=Evening Number: Number of member suppliers who poured milk. **Quantity :** Liters of milk poured by member supplier. **Amount :** Amount in Rs.. & Ps. Paid to member supplier. **Number:** Number of non-members supplying milk. **Quality:** Liters of milk poured by non-member. **Amount:** Amount of Rs. & Ps. Paid' to non member supplier. **Quantity:** Liters of milk poured by member supplier. **Amount :** Amount in Rs. & Ps. Paid to members supplying milk. **Number:** Number of non-members supplying milk. **Quantity:** Liters of milk poured by non-members. **Amount :** Amount of Rs. & Ps. Paid' to non members. **Quantity:** Total of columns(4)and(7) **Amount :** Total of columns(5)and (6) **Fat%:** General fat test of the sample drawn from total milk poured. **CLR:** Corrected Lactometer Reading of the sample drawn from total milk poured. **Price payable per litres:** Price from ready reckoner based on fat and CLR recorded in columns 11and 12.

Column No.	Information
	Total amount payable on general test : Price payable in column 13 X total quantity recorded in column. **Sasti :** If amount in column 14 is more than amount in column 10, record the difference in sasti column. **Mahangi :** If amount in column 14 is less than amount in column 10, record the difference in mahangi column. **Quantity :** Litres of milk sold locally. **Amount :** Amount in Rs. & Ps. realised from local sale. Quantity of milk send to plant in litres. **Good milk quantity :** Quantity of good milk received by the union. **Fat% :** Of the sample of good milk received by the union from the society. **CLR :** Corrected Lactometer Reading of the good milk. **Kg. Fat :** Amount of fat in the total quantity of good milk received by the union = Fat% /100 x Litres of milk. **Rate per kg. Fat or / litres :** Rate payable by the Union to society for one kilo of fat or one litre of milk containing fat, record in column 21 and CLR recorded in column 22. **Amount :** Rate per kg. In column 24xkg. fat (column 23) or rate per litre in column 24xqty (col. 20). Information recorded in column 20-25 for good milk is repeated for sour milk, if any received by the union from society. **Quantity :** Total quality of milk received by the union = total of columns 20+26+32. **Amount :** Total amount payable by the,union to society = total of column 25+31+37. Quantity of sample milk sold.

Date	Shift	Procurement								
		Members supply			Non Member Suppy			Total General Supply		Test
		No.	Qty Ltr	Amt(Rs)	No	Qty	Amt	Qty Ltr	Amt(Rs)	CLR
1	2	3	4	5	6	7	8	9	10	11
1	M C									
	M B									
	E C									
	E B									
2	M C									
	M B									
	E C									
	E B									

4.7 Insurance of Dairy Animals

Cattle insurance has gained importance in recent years. The country is heading for white revolution with introduction of massive cross breeding programme and high milk yielding buffaloes to increases the productivity of the animals. The value of the livestock is also very high.

The financial institutions are pressing for security for loans for the purchased animals. The land less labourers does not possess the necessary property to offer as security. The insurance of animals which are hypothecated to the financial institution is the only security, which encourages livestock loans.

In spite of its importance in national economy, cattle insurance has not gained momentum in the country. The various causes for this are

1.Enormous Cattle, population in India
2. Cattle ownership is widely dispersed among millions of farmers.
3.Low productivity of animals
4.Acute shortage of feed and fodders
5.Lack of effective disease control measures
6.Lack of awareness

However due to cross breeding, scientific dairy farming, and demand created by lending policy of financial agencies has resulted in cattle insurance popularization. The following four subsidiaries of General, insurance corporation are providing cattle insurance.

1. National Insurance Company 2. New India Assurance Company

3. Oriental Insurance company 4.United India Insurance company

The premium for cattle insurance is about 4% of the cost of animal insured. It may vary from time to time.

Type of Cattle Covered: Milch cows and buffaloes, calves/heifers, stud bulls, bullocks and castrated male buffaloes.

Age-group covered

Milch cows: 2 years (or age at 1st calving) to 12 years

Milch buffaloes: 3 years to 12 years.

Stud bulls: 2 years to 8 years.

Bullocks: 2 years to 8 years.

Indigenes Cross bred/Exotic female calves heifers from 4 months up on the date 1st calving.

Scope of Cover: Policy provides indemnity in the event of death of insured cattle

due to:

Accident (Inclusive of fire, lightning, flood, cyclone, famine)

Surgical operations.

Strikes, Riots, Civil commotion.

Diseases (inclusive of anthrax, Black quarter, Foot and Mouth disease, hemorrhage Septicemia, Rinderpest, and Thelariasli,s), contracting or occurring during the period of policy, and shall be subject to exclusion as under.

Theft and clandestine sale

Partial disability

Premium rate depends on cattle owned by individuals / institution / Bank financed, Bullocks and male buffaloes, for all dairies operating under NDDB all over India.

Claims: After the death of animal, the insured has to furnish duly, completed claim form and certificate of death given by qualified veterinarian for animals covered under market agreement scheme. In case of IRDP project cattle, claimant has to furnish information in following forms.

1. Duly completed claim form.

2.Certificate of death given jointly by any two of the following:

-Sarpanch of village.

-President or any other officer of co-operative credit society.

-Official of milk collection centre.

-Supervisor / inspector of Central co-operative bank.

3. Post mortem report, if conducted.

Short Answer Type Questions

1. What is meant by cooperation
2. What are the economic objectives of cooperatives
3. What are the principles of cooperation
4. Explain Anand pattern of milk cooperatives.
5. Explain village milk producer's Cooperative Society.
6. What are the technical inputs and technical services
7. What is the importance of livestock insurance

Long Answer Type Questions

1. Briefly explain the different principles of cooperation.
2. Explain about the functions and activities of village milk producer coop. society and District milk producer union.
3. What are the records to be maintained in a milk society
4. Write about the insurance of dairy animals

Ψ

UNIT 5

Marketing

Structure

5.1 Marketing of dairy animals

5.2 Marketing plans for liquid milks

5.3 Strategy for marketing of milk products

5.4 Role of advertisement for market promotion

5.5Role of salesmen and marketing personalities in marketing of dairy products

Market means a social institution, which performs activities and provides facilities for exchanging commodities and buyers, sellers in free interaction with one another.

A market exists when buyer's wishes to exchange the money for goods or service are in contact with sellers, who are willing to exchange goods or services for money.

5.1 Marketing of dairy animals

Marketing of dairy animals is entirely different from marketing of any other product or items. Animals will be purchased from the popular dairy farms, individual farmers. The price of dairy animals depends upon the individual animal. No common price will be there for all animals.

Animal markets are organized on specified days at important places. The dairy animal owners will bring their animals to these markets which are popularly known as "sandies" or "santha". The animal purchasers will come to the market and they will select the animals. The record about the animals, ancestry particulars, production and other particulars are maintained to get good price for the dairy animals. The animals displayed in the market for sale should be washed and prepared so that it will give good look and appearance. The entire body should be washed to remove dung or dust using light detergent solution. Hair may be clipped when the hair is lengthy on the body. Horns are trimmed. Blanketing: i.e. Rubbing the body with blanket or cloth for better appearance is done. Trimming of tail hair is practiced when hair is long.

Determination of the value of the animal

The value of the dairy animals will depend on the following factors.

Breed
Age
Number of lactations completed
Past production history and Ancestry

Present milk production

Stage of pregnancy
Type and body conformation
Type of breed, good capacious udder, wedge shaped body, good size, chest and barrel, well developed and balanced quarters.
Soundness: Sound body, free from excess fat, dairy type, graceful look.
Condition : Good flesh prior to calving in cow's, good growth and development in young animals.

Disposition and other-Quite docile, good temperament, easy milker, Free from vices, teats functioning, free from mastits. Expected producing ability- should be high

Calving time: Winter, rainy or summer. The time of calving, which buyer needs gives more price.

The seller should furnish data of the animal i.e Breed, Date of birth No. of lactations Current lactation number Health condition.

Lactation yield

While comparing the production of different animals with different fat percentages, the milk yield should be converted in to 4% or 3.5%. Fat corrected milk by the following formula.

4% FCM=0.4 x milk production in the lactation +15x amount of butterfat in the lactation.

3.5% FCM = 0.4324 x milk production + 16.21.8 x amount of butter fat in the lactation.

The average rate of the animal is generally calculated as follows.

Cow Value = Average Amount of milk yield per day x 2000

Buffalo value = Average Yield of milk / day x2500.

In big dairy farms/ research stations, once or twice in a year open auction will be conducted in their own campus. The price of the animals will depend on the competitive bidders.

Average calving interval
Peak yield and day recorded
Total butter fat yield in a lactation

Temperament of the animal
Vices in the animal
Physical defects and abnormalities.
Average service period.
Average no. of services / conception.

Age of first calving

Body weight at first calving

Major diseases affected so far.

Before purchase of any dairy animal, its health, and reproductive status, pregnancy should be properly checked by a veterinarian. If the animal is suffering from any reproductive disorders, the animal may not conceive, if at all conceives, it may lead to abortion.

5.2 Marketing plans for liquid milks

Some factors which help in deciding the mode of distribution of milk are

Keeping quality and kind of milk

Perishable nature of milk and its products.

Possible contamination

Proper supervision and control in distribution

Cost of distribution / delivery of milk

Distribution of pasteurized milk

The deterioration of quality of pasteurized milk is mainly due to post pasteurization contamination. The pattern of its distribution to public is affected by the following factors.

Building density in particular locality

Topography of the area.

Number of customers.

Distance of the area from dairy plant.

Temperature of milk at delivery.

Type of delivery vehicles,

Shop distribution vs. home delivery.

Containers for milk distributions : Milk is distributed in sealed cans, bottles and polythene bags or tetra packs

System of distribution of milk

Sound system of milk distribution is essential for efficient well organized retail marketing of milk. It should be simple, convenient for both farmer and customer. There are three types of distribution or disposal of milk.

i) Cash and carry system : The customers are required to pay the cost of milk to vendors at the time of delivery of milk.

Merits

1. Maintenance of account of sale proceeds of milk is easy.
2. Commission of vendors can be calculated easily and promptly
3. Account of each calendar month can be closed in time.
4. No extra cost involved in printing coupons / cards.

Demerits

1. Handling of huge amount of coins and currency is a problem.
2. Daily counting of money is cumbersome.
3. Risk of embezzlement of money by vendors, chances of loss of money due to theft or pick-pocketing.
4. Non availability of coins, difficulty for willing customers in purchase of milk.

ii) Coupon system: In this system, a set of coupons are issued to the customers on advance payment. Customers receive milk in exchange of coupons and purchases new booklet of coupons, when they run short of it on advance payment.

Merits

1. Chances of loss of money are eliminated.
2. Money on dairy farm is received much in advance which can be profitably utilized.

3.Sale of milk in uniform even at the end of month.

4. Counting of coupons is not cumbersome.

Demerits

1. Value of unredeemed coupons cannot be ascertained easily.

2. Account of sale proceeds of milk at the close of calendar month cannot be as clear as of cash and carry system.

3. Chances of recirculation of redeemed coupons.

4. Forged printing of similar coupons is eminent.

Sample of the coupons

Front cover

Book No. .... Sl. No. ....
... Liter of Milk
The .... Dairy Farm
Sold to Shri ....
.... Dairy Officer

Leaf of the Coupon

Book No. .... Sl. No. ....
The ....
Will exchange the couponFor .... Litres the coupon
... Dairy officer

iii) Card system: Milk cards are printed and sold to customers on advance payment. Validity of milk cards is limited to a month. Date of issue is not fixed but expiry of all sold cards is fixed. Customers who could not take milk for a day or days together are liable to get the cost of milk refunded. Immediately after supply of milk is made, the quantity of milk is noticed at the back of card on each date.

Card can be issued from the dairy office. One day time is allowed for customer to register. At the time of issue of card, timings of milk delivery are notified. Usually yellow cards are issued for cow‘s milk and blue cards for buffalo milk.

Merits

1. Cost of milk is received in advance which can be utilized advantageously.
2. Trouble of daily counting of money / coupons eliminated
3. Market for milk is assured.
4. Chances of loss of money eliminated.

Demerits

1. Refunds for non supply of milk causes great inconvenience to both customers and organization.
2. Monthly accounts of actual sale proceeds of milk cannot be closed on account of refund.
3. Vendors and booth men may sell out milk to non-bonafide customers other than card holders.
4. Printing and issue of cards and refund involves a good deal of labour and time.

Customers have to pick up milk only from assigned places.

iv) Push button mini dairy : This is designed or installed on NDDB designed coin (TOKEN) operated milk vending machine, popularly known as "push button mini dairy". The milk holding capacity of these machines varies from 1000 to 3000 lit large enough to hold the milk required by him /her. It is also called as bulk vending machines.

For marketing of liquid milk, a market survey should be conducted about total liquid milk demand, complaints about the competitive product, type of milk, the consumer preference, i.e. Toned milk, Double toned milk, standardized milk, whole milk, low fat milk etc., income details of the consumers, selling points which will be more convenient to maximum people and trustworthiness on the seller.

After getting the survey results, the areas are divided into number of zones. Milk distribution/ selling points are located in each zone.

Points to be considered in marketing of liquid milk.

- Type of milk should be prepared depending upon the income of consumers.
- Depending upon the need, the size of packet i.e.200ml, 500ml, 1 liter etc should be prepared.
- The pick up / selling points should be convenient.
- Twenty four hours availability of milk, will definitely increases the sales.
- Receiving complaints about leakages, quality, availability, price, timings should be taken care and necessary prompt action may be taken.

5.3 Strategy for marketing of milk products: The following steps are followed for marketing of any product

(I) Market survey: Marketing of any product requires market survey to produce a product. The market survey for the marketing of milk products should be based on the following points.

- Economic status of the people in the area.
- Purchase power of the people for the milk products.
- Present consumption of different milk products.
- Packing size required.
- The competitors in the market.
- The price and offers of the competitors.
- No. of dealers / retailers required.
- Details of already established distributors / retailers.
- Consumer‘s growth.

Marketing survey people will be appointed or survey work may be given to some firm to get the information about the above points.

(II) Market measurement: By analyzing the above, demand and supply can be analyzed as follows.

1. Present demand and supply of the product and price existing.
2. No. of consumers with quantity required in each area.
3. Packing size required in area / consumer wise.
4. Effective distribution channels / sellers.
5. Weakness in competitors' products.
6. Service given by competitor / service required.

(III) Selection of product. : After making survey and analyzing the data of product which are in demand are selected. The availability of raw materials (milk) and price of collection will be surveyed and if these are favourable manufacturing of the products will be started.

(IV). Price of the products: Price of the product will directly influence the marketing of any product. The price of the product will be calculated as follows.

Calculating the cost of production of the product
Distribution cost /Transportation cost (1-2% of the product)

Distribution margin (2-3% of the cost of product)
Retailer margin (5-8% of the cost of product)

Marketing expenses (sales personel) (1% of cost of products)

Advertisement expenses (2-5% of the cost of the products)

% of profit desired (Generally at 10%).

While estimating for profit, it should be reasonable. The reason for aiming a reasonable profit are.

It will prevent entry of competitors into the market.

It will project a favourable public image/ brand name image.

It will restrict the trade union demands.

It will maintain relation with customers.

Goods will be available at reasonable quality at reasonable price by giving service facilities.

After calculating the production cost (including marketing advertisement) the following price method is followed. i.e, 0 market method which is the price of the cost for production or competitors price or market + in which price is fixed above the production cost or competitors price or market – less than production cost competitor price.

For a new firm, to compete in the competition the products should be sold at market – ve price to get market share. After entering into market slowly switch over to market 0 and afterwards to market + price.

(V) Market forecasting and target fixation : Forecast the sales volume of the product in the market depending on the preliminary market survey and fix the target.

(VI) Marketing strategies to achieve target: The marketing strategies are

1. Appointing sales officers/ marketing people to promote sales.

2. Advertisements in the form of pamphlets, wall posters, holding and even in electronic media.
3. Offering discounts/ offers.
4. Attending the complaints or any service required.

The marketing expenses will be high in the initial stage. One should not bother about initial marketing expenses. It is very difficult to enter in competitive market. Once the product is entered into the market, growing in market share will not be a problem.

(VII) Review of policies

After entering into the market and gaining customer faith about the quality and services, the prices may be slowly increased and it should be comparable with the competitor's price.

(VIII) Social activities

To gain confidence of the customers, some programme in the localities of the people may be sponsored like cultural programmes, games and sports, offering scholarships to meritorious students, maintaining parks, roads, school etc. For these functions company logo can be utilized for sponsoring which will help in increasing the sales, meeting expenditure from promotional budget.

Marketing systems.

I. Producer- Consumer

The producers directly sell the products to the consumer. No middle man in the marketing. In this any problem will be immediately tackled.

II. Producer- Retailer- Consumer

The producer will supply the products directly to the retailer, who will in turn, will sell the products to the consumers. If the business terms between the producers and retailers fail, he will take lead role in marketing. If any sales promotion benefits in the form of gifts, cash etc., will give boost to the retailer to improve the marketing.

5.4 Role of advertisement for market promotion

In modern marketing system, there is stiff competition for any item in the market. To compete in the market with competitors, advertisement is the main instrument. It is not uncommon in market, that many of the manufacturers spending lot of money on the advertisement. Even, the excellent quality product cannot enter in to the competitive market, without advertisement.

The various means of advertising for promotion of sales are given below

Pamphlets, bulletins etc: Pamphlets of different sizes, attractive colors are printed for distribution to the customers. The matter is so framed highlighting the worth of the product compared to other brands of competitors. A comparative statement can be prepared containing extra quality in the product, keeping quality, effect on health, and under lining the cost comparing with other products in the market. Directly the competitors name or brand should not be mentioned, but only mentioning the other product containing 'x' composition, colours or any specific or separate qualities.

In the pamphlet figures, cartoons etc can be printed which will give impression about the product. The running matter should be very less and only highlights should be mentioned. The matter should be in regional or popular language on one side national/international language and other side regional language. These pamphlets can be distributed to all the houses through newspapers, or appointing boys. The pamphlets can be made available in popular shops.

Posters : A poster is designed to make a public announcement of a special idea. It includes only a few words with an illustration. To catch the attention of the viewers and to pass a simple message at a glance, it should be attractive, brief and clear. If the poster is attractive, then people will look it for a longer time. It should have caption which should be as small as possible. It should be printed in bold letters. If necessary include the picture which can give eye catching to the people. Use attractive bright color. Do not use-more than three colors. Normally the back ground colors mostly preferred are yellow, green, light blue and dark blue. Plenty of space between letters, words, lines and illustrations must be given. The layout of the poster should be well balanced so that viewer's eye can smoothly travel. The style of giving message should be dependent on the type of customers.

Holdings: Holders are permanent boards made of iron and place on elevated heights with the help of strong stands or located on top of the buildings. The advertising material is painted or poster is pasted to the board. These holders are placed in important junctions or on highly ways or busy centers. Lighting facility wil be there to facilitate at night times. The matter / figures will be almost the same as guidelines followed for posters. The holders are easily eye catching type and give wide publicity about the product.

News Papers, periodicals and Magazines : Newspapers, periodicals and magazines are good media for advertising about the product. Most of the people will read newspaper. If not all most of the people will read magazines and periodicals. If advertisements about the products are given in newspapers and periodicals, people will go through this information and definitely increase the sales. There, advertisements should be captioned with interesting caption and the information about the product with photograph should give good opinion about the product over competitor's products.

Cut outs and Banners : Big size cut outs with product information can be kept at important places. Banners made of cloth or plastic materials containing the information about the products may be arranged facing main roads. These cut outs and banners will improve the sales.

Railways and Transport Vehicles : Railway bogies, Buses, Lorries and other commercial vehicles can be painted with the information about the product. When the people are waiting for buses and trains, will definitely see the matter and will have some effect on the sales.

Slides in Cinema halls: Slides can be prepared with the information about the products, which can be displayed in cinema halls at the beginning and interval timings.

Electronic Media : In modern era electronic media plays an effective role in advertising among the various electronic medias.

Radio : Advertisements can be played on radio during break time, before and after any programme. The advertisement programme prepared for radio should be preferably in songs style of popular songs or talk style of very important persons. The radio anchors should have clear and melodious voice.

Television : Advertisement films can be prepared and the advertisement material can be displayed with athletes or any other important people. These advertisements will have more impact on the people as it is seen in films. The famous personalities will be delivering the matter as they are using that product with good results. These Television advertisement can be displayed either in Doordarshan or any local channels. The rates for these advertisement depends on the time of display, the programme in which it is displayed.

Electronic Display boards : Electronic display boards can be displayed in the railway platforms, bus station, important junctions, stadiums, parks and public places. The features of the product will be displayed as running matter.

In electronic media, audio- visuals are more effective than only audio or video separately.

Sign boards on the road-dividers or traffic islands: Sign boards can be placed in the place of roads dividers. These boards will be painted with the information.

Appointing advertisement persons : Appointing advertisement people both men, women who will explain about good qualities of the product, at door step. They will wear dresses and caps containing information about the product, which will definitely attract the customers. Friendly walk, run on the main roads wearing logos of the company and product will definitely have the impact on sales.

5.5 Role of salesman and marketing personalities in marketing of dairy products

Any person who is employed to sell the product is known as Sales man. Now a days the art and profitability of business mainly depends upon the marketing. Any body can prepare any product, but the profitability and survivability depends upon effective marketing. For effective marketing, sales-people are necessary. Depending upon the organization and level of working they are named as salesman, Sales representatives, marketing manager, sales coordinator etc. The art of selling is termed as Salesman ship.

Activities of Salesman

He will be in touch with distributors/ Whole Saler/retailers regularly to know about the movement of the stock.

Sales people will approach the important and active people, who will influence others in purchase of particular brand of the product he will explain with them, about all the good qualities of the product comparing other similar products.

Sales people will approach the individual customers, and explain the advantages of their product over other products available in the market.

After sales service is an important item in the marketing. The sales people will highlighted about the after sales services by their company, which is not attempted by others or giving inferior services.

He should speak good language without any breaks. His talk should be very impressive and people should be attracted to hear his speech.

Directly he should not introduce the product to the consumers. He should give his introduction by using the company name.

He should wish the customers in local language and traditional types and he should enquire the welfare of the family members so that at end the customers are satisfied.

Sales people will take samples of the product with them and they give the live demonstration before them which have much effect on the customers

They will carry other company's product with them and compare the qualities before customers.

Sales people will try to impress the customers by enquiring children education and giving best medical facilities available if any family member is sick. Then they will talk about their products.

Skills of a Sales Man

Any sales person should have the following skills to improve the sales of the product.

The sales man should wear well fitted and attractive dress and he will use tie and look trim so that he will look active and pleasing personality.

First he should start about the necessity of particular product and then he should introduce his company product which is superior than any other similar products available in the market.

He should patiently and interestingly hear what the customers are feeling and he should not directly involve in controversy over their feeling. He should support their feeling and then slowly tell them that use of his company product will improve the condition or facilitates further.

If the customer offers any hospitality, he should agree for that and he should appreciate hospitality repeatedly, so they show same inclination towards his products.

He should tell some interesting examples in the beginnings or about the famous personalities or jokes or any other interesting topics so that the customers will attract to salesman talks, depending on condition.

He should give a sample of the product to the customers and he can challenge about the good qualities of their product.

Sales people may attend the family functions, religions and cultural functions so that the customers are impressed by sales people.

Short Answer TypeQuestions

1. Define market .

2. What is marketing ?

3. What is FCM ?

4. Give formula for 4% FCM.

5. Give formula for 3.5% FCM.

6. What is coupon system ?

7. Mention various system of milk distribution.

8. Define Salesman.

9. What is Salesmanship

10. Define advertisement.

Long Answer Type Questions

1. Explain marketing of dairy animals.

2. Briefly write about marketing of liquid milk.

3. Discuss in detail about marketing of milk products.

4. What are the ways and means of advertising for promotion of sales?

5. Briefly explain about activities and skills of a salesman

Ψ

UNIT 6

Extension

Structure

6.1 Role of extension in livestock development

6.2 Livestock Extension Methods

6.3 Role of audio visual in Extension.

6.4 Training- different types of training-evaluation of training

6.5 Adoption process-stage of adoption-rate of adoption

6.6 Constraints to extension services

6.7 Role of Information technology in Livestock Extension

6.1 Role of extension in livestock development

Livestock/ animal husbandry extension deals with the people through education procedures, in improving livestock farming and / or dairy industry methods and techniques, increasing the milk/animal production and / or processing and efficiency, increasing the income and stepping up the level of living and elevating the social and educational standards of rural life.

Importance of livestock Extension

The majority of the livestock industry is with illiterate people. They have dairying and other livestock as subsidiary to the agriculture. The knowledge in livestock rearing to the rural farmer is very less and the production of milk, meat and eggs is very low. To improve the livestock production, the extension or transfer of technology plays a vital role. The extension will help the rural farmers in the field of livestock production in the following areas.

1. Selection of good dairy animals, sheep, goat, swine and poultry
2. Construction of comfortable and economical livestock housing
3. Economical feeding systems for all categories of livestock
4. Cultivation of Fodders and conservation
5. Improving the milk, meat and egg production with better management
6. Management techniques to combat the effects during different seasons
7. Formulation of feed with locally availability ingredients for various livestock
8. Good milking techniques in dairy animals
9. Prevention of diseases in livestock and poultry
10. Breed improvement programmes
11. Marketing of milk and other livestock products
12. Preparation of indigenous milk products

6.2 Livestock Extensions Methods

The various Extension methods are classified into 3 groups as individual contact methods, group contact methods and mass contact methods.

A. Individual contact method: It is a face to face type of individual contact by the extension worker with an individual (farm, farm women, youth etc) or the members of the family for a special purpose. The various individual contact methods are

1. Farm and home visit

It is a face to face type of individual contact by the extension worker with the farmer and or the members of his family on the latter's farms or at home one or more specific purposes. It is intended to give first hand information to the farmer relating to the development of farm and house, and identify the local leaders.

Advantages

i. Extension worker develop good rapport with farmer

ii. Extension workers gets first-hand information on rural problems

iii. Help in locating local leaders and cooperation

iv. Percentage of adoption is high

v. He develops confidence when his ideas are accepted by the farmers.

Disadvantages

i. Limited contacts of farmers

ii. Sometimes vision may not be opportunistic to the farmers

iii. Chance for favouritism

2. Office call

It is a call made by a farmer or a group on the extension worker at his office for obtaining information and for inputs or other farm help needed or making acquaintance with him. The volume of office calls is related to the degree of public interest in the program of the extension worker and their villages and accessibility of his office to rural people.

Advantages

i. Economic use of extension worker and energy.

ii. The farmer is in receptive stage of mind and ready to follow or put the new idea in practice.

iii. It is sign of confidence that, the farmer has in the extension worker and respect for ability.

iv. A careful record of office calls provides a basis for follow up activity.

Disadvantages

i. It is not possible to get detailed first hand knowledge of the farmer's problems and activities.

ii. Limited contact with farmers.

iii. Waiting for visitors who are not turning up is wasted time

iv. Unbusiness like handling of office call with result in unconcerned person, using the office as longing place.

3. Personal letter

It is a personal and individual letter written by extension worker to a farmer in connection with extension work. In practice, letters are used to answer enquiry from farmers regarding specific problem.

Advantages

i. Cheap and useful to educate farmer.

ii. Best method to reach farmers who could not be reached by above two methods.

iii. Percentage of adoption is high and extension worker get first-hand information about rural problems.

iv. To develop good relations and confidence, this is one of the best method.

Disadvantages

i. It is time consuming method

ii. Since majority of the farmers are illiterates, this method has limited usage.

iii. It is difficult for extension worker to write to each and every individual problems.

iv. Only few members can be contacted.

4. Phone Calls

It is a direct contact between the extension worker and farmer over the telephone for one or more specific purpose.

Advantages

i. Although face to face contact is missing, they have the advantage that they may be initiated by either the farmer or the extension worker.
ii. They are useful in society and giving specific information such as first- aid-treatment of animals before arrival of veterinarian, control of lice infection, stress medication in poultry farms etc.
iii. They provide a mean of follow up and evaluation of the effectiveness of radio broadcasts or television telecasts.
iv. It is necessary to employ special telephone number and tape recordings to answer the flood of inquiries after especially interesting programme or announcements.

Disadvantages

i. Use of telephone is very limited in our country.
ii. The extension worker cannot see the farmers face and his farm.

5. Result Demonstration

Result Demonstration is a demonstration conducted by farmer or other under direct supervision of an extension worker to prove the worthiness of a recommended practice or combination of practices.

Advantages

i. It appears to the eye and effectively reaches the farmers.
ii. Increases his confidence and also more number of people will understand.

iii. Useful for introducing new technologies
iv. Contributes to discover the local leader and help in developing local leadership.

Disadvantages

i. Requires lot of time and costly method
ii. Difficult to find good demonstrator who will help perfect records
iii. Unfavourable weather and other factors may destroy the value.
iv. Unsuccessful demonstration may create strong unfavorable conditions

(B) Group Contact Methods

A group is a body of individuals drawn together around a common interest. The various group methods are.

1. Method Demonstration: It is relatively short time demonstration given before a group to show how to carry out an entirely new practice or old practice in a better way.

Advantages:

i. It is very effective in teaching new skill
ii. It stimulates action and build confidence
iii. It introduces a change of practices at low cost
iv. Saves publicity purposes.

Disadvantages

i. Suited only to the Skill involving technologies.
ii. Transporting the materials and equipments to the demonstration site is difficult.
iii. It causes a setback of whole programme if improperly coordinated

2. Field trip and tours: A group of interested farmers, accompanied and guided by extension worker goes on tour to see and gain firsthand knowledge of improved practices in their natural setting i.e.. research farms, demonstration plots, farmer and institution.

Advantages

i. Participants gain first-hand knowledge of improved practices and are stimulated to action.
ii. Best suited to the 'show me' type of people
iii. Widens the vision of farmers and adoption
iv. It has entertainment and site seeing values

Disadvantages

i. Most expensive method and involves time, transport and number of preparations.

ii. It is difficult to fix season and time suitable to all.

iii. Recreational aspect may mask the educational aspect

iv. Frustration may result if the tour is badly conducted.

3. Meeting: Meetings are one of the oldest and most important group methods of extension teaching. The various types of meetings are general meeting, lecture meeting, extension talk, and discussion meeting etc.

Advantages

i. Large number of people can be reached.
ii. Group psychology can be used in promoting the programme.
iii. Reaction of the people to a programme can be assessed.
iv. Adoption of practices can be accomplished at low cost.

Disadvantages

i. Handling the topic becomes difficult because of mixed composition of audience.
ii. Circumstances beyond control like factions and weather might reduce the attendance.

iii. Difficult to avoid unrelated persons attendance.

iv. Traditional leaders who are not functional come in the way of group activities.

(C) Mass Contact Method

Individuals, face to face methods and group methods cannot read every one who needs information. So mass methods like exhibition, Radio talk, TV talk, motion pictures, printed method (Eg : Leaflets , folders, pamphlets booklets etc.) makes large number of farmers aware of new ideas and technologies. The above mass contact methods can be used singly or in combination.

Exhibition is a systematically display of models, specimens, charts, and poster etc in sequence participant members. Radio talks are prepared subject wise and transmitted. TV talks are prepared just like radio talks, with an advantage of seeing. Motion pictures on latest technologies are being prepared. Printed media like leaflet, folder, pamphlets, bulletin, booklets, news- articles, wall news paper, circular letter, feature stories are prepared on different topics necessary to the farmers Photographs are also printed to give more impression.

Advantages

i. Suitable for mass scale adoption of an improved practice in the shortest time possible.

ii. Provide clean information of the technologies.

iii. Easy for retention and recall.

iv. Promotes literacy and awareness.

Disadvantages

i. It will lose its significance if it is not fully prepared and used.

ii. Requires much preparation and investment.

iii. Not suitable for individual problems.

iv. Less useful in low literacy areas.

6.3 Role of Audio visuals in Extension

Audio visual aids are the instruction devices, in which by audio aids the learners can only hear the information, by visual aids the learners can only see the information, by audio visual aids the information can be heard and as well as seen.

Importance of A.V aids in livestock development

Research and experience have shown that, audio visual techniques can significantly increase and reinforce learning. All dairy development activities to increase milk production can be prepared into programs and the programmers can be disseminated to the farmers using different audio-visuals at frequent intervals. The farmers will learn the new techniques through various audio visual aids and by following the new techniques will improve the milk production in quantity as well as quality.

The various audio visual aids are classified into three group i.e... Audio aids, visual aids, audio visual aids.

Audio aids

The various audio aids used in extension are

(a). Public address system: It is used to enable the extension workers to be in more than one place at a time. It can be used for recording radio play and other group discussions and meeting. Films and still projections can be synchronized with sound. Public address system consists of mike, amplifier and speaker. Mike and speakers are connected to amplifier using wire.

Fig 6.1 Loudspeaker

(b) Tape recorder: The messages can be recorded in cassettes and played before farmers. Tape recorders will work on both A.C & D.C. For inserting cassettes press the eject button and insert the cassette and it is ready and turn over the cassette and insert it. Recording can also be done with microphone after pressing the record button and when the recording is over, press stop button. Recording of cassette can be done by pressing rewind button.

Other audio aids are. Telephone, Radio and Gramophone record.

Fig 6.2 Telephone

Visual Aids

Visual aids are of two types i.e. projected and non- projected / display aid. Few important projected visual aids are

(a) Overhead projector

It projects the image over the head of an instructor. Matter is written on transparency and placed on glass stage of over head projector with the bottom of the image and the words can be seen. Raising or lowering the image on the screen may be accomplished either by filling the front surface mirror by means of leaves. To get clear image, focusing is done by tuning.

Fig6.3 Overhead Projector

(b) Slide projector

Slide is a small piece of film or other transparent material containing matter or figure. Manually operated and automatic slide projectors are available. Hand slides can be prepared using positive film. If not available negative film can be utilized which can be transferred to positive film afterwards.

Fig 6.4 Slide Projector

(c) Opaque projector

This is based on reflection projection rather than transmitting light through it. The matter on opaque materials like newspapers, text books etc., can be projected. Operation is very simple. First, open the stage properly, place the materials and close the stage and operate.

Fig 6.5 Opaque Projector

(d) Film projectors

Film projectors are classified as 70 mm, 35 mm, 16 mm and 8 mm and in class room teaching 16 mm and 8 mm projector is commonly used.

Fig 6.6 Film Projector

(e) Computers

The computer message can also be projected by using special equipment to the computer. Lessons are prepared and incorporated in the floppies.

Fig 6.7 Computer with projector

Under non projected visuals examples are –poster, flash cards, bulleting board, photographs, models, exhibits and display charts, flannel graphs, specimens, real object etc.

Flannel board or felt board consists of stiff board covered with felt material on one side. Flannel strips in a graphic or written strip which is backed with rough texture so that they adhere to the flannel board. Any message or picture in strips is used.

Bulletin boards are boards made up of soft wood, ply board covered with cloth. The materials like booklets, circular letters, bulletins, cartoons, maps, charts, newspaper clippings etc can be fixed in order with the help of push pins, thorns, tape or glue.

Various types of charts used are flip charts, sliding chart, pull chart, window chart, spiral chart, slit chart, bar chat, pie chart, tree chart, flow chart, etc.

Flash cards are the series of illustrated cards flashed before the learners in proper sequence. Photographs, models (replicas of real object) specimens (real objects) and real objects will also be used as visual aids.

Films are projected on the screen with background of sounds.

Television is an important audiovisual aid used for mass communication. The program is telecasted into air by converting the audio and video waves into electromagnetic waves, which are then received in the TV set. Recorded program as well as live telecast can be done through TV.

The term video is used to denote picture which have been converted into electronic signal. The video produced can be telecasted. Video cameras are utilized to record the program in video cassettes which can be played by using video player.

Computer multimedia is computer based teaching method, in which the lessons are prepared with computers, stored and displayed before learners.

6.4 Training- Different types of training-evaluation of training

6.4.1 Training

Training means to educate a person so as to be fitted, qualified and proficient in doing some job.

While, the education is primarily concerned with opening out world to the students, so that he can choose his interests and career. Training is primarily concerned with preparing the participant for certain lines of action which are delineated by technology and by the organization in which he works and which also improves his performance in it. Education deals mostly with knowledge and understanding whereas training deals mostly with understanding and skill.

According to Collins, training must include the instruction, and other learning experience, which purport to fit the worker into the service so the he competently meets the demands of his job, as determined by the changing needs of people.

Need for Training

Training improves a person's skill, his power of intelligence and develops in him the desired attitudes and values required for his work.

Training helps the new entrant to acquire occupational work-skill and the latest knowledge in agriculture, Animal husbandry, home science, health and sanitation.

Types of Training

Training of extension workers can be classified as:

Pre-service Training:' Education at high school, college namely agriculture college, veterinary college etc.

In-Service training : This is to keep a worker to know about the latest knowledge or giving him special training in a new job. This may be

a. Orientation training: Where a new entrant is oriented to the organization setup, the philosophy, code of conduct etc.

b. Induction Training: Where workers can be given the knowledge of the working and organization of the community development and extension service, his place of work and his place in the work team.

c. Short range training: Training of certain period in the field of agriculture or animal husbandry in a concerned college i.e agriculture college or veterinary. College.

d. Job Training: Special job work may be imported by sending the person to a specially designated centres. Eg : ,I.L.R.I, Hyderabad.

e. Periodical Meetings & conferences: Rabi & kharif meetings and workshops, Conferences, Refresher training and programmes, ORTS, at fixed intervals/ season where review orientation and problem solving / technical sessions will be conducted.

6.4.2 Training process

Principles of training

-Create a feeling of need or want in the trainee.

-Desire for security

-Desire for new experience

-Desire for affection and response

- Desire for recognition

-Clearly defined and specific objectives.
-Must accomplish educational changes in the subject matter learnt.
Change in knowledge, skills, and attitudes of understanding.
-Effective learning situation, comprising of teacher, learner.
-Subject Matter- environment class room etc.,

-Teaching aids and physical facilities should be effective

-Should provide effective learning experience to the trainees.
-Should provide a combination of techniques – by engaging maximum number of ranges – such as oral, visual, audio visual and doing things.
-Training should be challenging and satisfying.
-Requires careful evaluation of results
-Assessment of Training needs is a requisite for organizing a training programme.

For farmers training, the following points are to be kept in mind.

i. Time of holding the training: Lean season, free from rush of agriculture operations.
ii. Duration of Course: 2-3 days on a topic like plant protection, poultry-chick care, Dairy calf management or up to 1 week on crop management, soil conservation, Animal feeding and management etc.
iii. Venue of Course: realistic venue – field or shed to provide practical exposure.
iv. Production – cum – demonstration and group discussion: Front Line Demonstration plot in village before each main season.

6.4.3 Evaluation of training programme

Evaluation or appraisal of training programmers is to ascertain whether the programme has achieved its objectives and whether these objectives could have been achieved more effectively in some other way.

Objectives

Assessment of progress and impact
Ascertain the merits and demerits
Measuring the success or failure in implementation
Analysing the reasons for success or failure
Deriving lessons for improvement in the formulation and execution of programme.

Types of Evaluations

The various types of evaluation are

I. Formal and informal evaluation: It contains five point content of degrees of evaluation i.e.. Casual, every day evaluation, self checking evaluation, do it yourself, extending evaluation, studies and scientific research.

II. Formative and summative evaluation: Formative attempt to assess the demerits of the programs during implementation stage and summative evaluation assesses the worth of the final results of a program. Earlier more importance was given to summative and now to correct mistake, more emphasis was given to formative evaluation.

III. Ongoing and Ex- post facto evaluation: Ongoing evaluation is an action oriented analysis of a project's effects and impacts compared to anticipations, to be carried out during implementation. Ex-post facto evaluation would resume the effect several years after completion of the investment, to review comprehensively the experience and impact of a project as a basis for future policy formulations and project designs.

Steps in Evaluation

1. Plan for evaluation: It indicates what should be done, why it need to be done, how it will be done, who should. Planning helps to collect data for evaluating with in limitations.

2. Purpose of Evaluation: The purpose of the evaluation, will determine which data have to be collected for evaluating any programme.

3. The reason for evaluation: The reasons for evaluation which may appraises progress and impact, to judge the methods and devices, to improve ongoing programme and to have basis for future programme. The evaluation should fix priority for the above.

4. Respondents to Evaluation: Respondents are the audience consisting of farmers and his families, local leaders, NGOs authorities etc. The evaluator should select the primary respondents according to the reasons for evaluation.

5. Standards for evaluation: Standards are the yard sticks or criteria applied to measure the impact of a programme.

6. Levels of evaluation: In early stage we can evaluate how the programme was planned, and after completion of programme, the impact on the farming community.

7. Evidence for evaluation: Evidence means information about a standard or criteria. To finalize which type of evidence to use, adjustments must be made between what is the best to use and what is possible to obtain.

8. Designs for evaluation: The survey is the most commonly used design for evaluation. In this sampling is done first. Questionnaire, interviews and observation techniques are applied to collect data. The other designs like case study design, experimental design etc, are rarely used.

9. Conduct evaluation: It has three steps analyzing, reporting and applying. After collecting the data it is analyzed properly using device like value scales, opinion polls etc. The findings of evaluation need to be presented either by talk or written form. The implications, and recommendations drawn from evaluation needs to be presented either by talk or written from. The implications and recommendations drawn from evaluation should be used to improve the ongoing or in planning future programmes.

6.5 Adoption process-Stage of adoption –Rate of Adoption

Adoption is a decision to make full use of an innovation as the best course of action available. Adoption process is a mental process through which an individual passes from first hearing about an innovation to final adoption. Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas.

Adoption is essentially a decision making process. According to Johnson and Haver (1955), decision making involves the following steps.

i. Observing the problem
ii. Making analysis of it
iii. Deciding the available courses of action
iv. Taking one course
v. Accepting the consequences of the decision.

The North central Rural sociology subcommittee for the study of diffusion farm practices (1955), identified five stages of adoption process, which received world-wide attention. They are

i. Awareness stage
ii. Interest stage
iii. Evaluation stage
iv. Trial stage
v. Adoption stage

Rate of Adoption is the relative speed with which an innovation is adopted by the members of a social system. It is generally measured as the number of individuals who adopt a new idea in a specified period , such as each year.

6.6 Constraints to extension services

Many of the constraints affecting livestock extension apply equally to the overall extension service. To highlight some of these issues like

i. Lack of sufficient trained extension personnel.
ii. Lack of funding and logistical support.
iii. Lack of resources and infrastructure.
Eg: Availability of concentrate feed, fodder seeds, slips etc.
iv. Lack of appropriate technical and extension message.
v. Lack of programme planning.
vi. Lack of communication
vii. Multiple duties to the extension personnel.

6.7 Role of Information technology in Livestock Extension

Information communication technology (ICT) is an umbrella term that refers to all information and communication systems and technologies including the digital formats such as the internet or the world wide web, but also interfaces with radio, cable and wireless television, cellular phone and print media; as well as the various services and applications associated with them, such as video conferencing and distance learning.

ICT can be defined as the basket of technologies which assist or support in storage, processing of data or information or in dissemination of data/information or both. ICT are those technologies that can be used to interlink information technology devices such as personal computers (PCs) with communication technologies such as telephones and their telecommunication networks. Through ICTs the transfer of technology in livestock is very fast and very effective. Some of the examples of ICT devices used in livestock extension are the PC/Laptop With email and internet, IT Kiosks, teleconferencing, video conferencing, kisan call center etc.

Short Answer Type Questions

1. Explain importance of livestock extension.
2. What are the groups of extension methods
3. List various individual contact methods of extension.
4. Mention various group contact methods
5. What are the mass contact methods of extension.
6. What are the advantages of result demonstration method
7. What are the advantages of method demonstration method
8. Mention various audio and visual aids used in extension
9. What are the non-projected visual aids used in extension
10. What are the stages of adoption process
11. What are the ICT devices used in livestock extension

Long Answer Type Questions

1. Write briefly about group and mass contact methods of extension
2. Explain various audio and visual aids used in extension activities
3. Explain about the method and result demonstrations in extension programmes
4. What are the various types of training and steps in evaluation of training
5. Explain about adoption process in transfer of technology

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UNIT 7

COMPOSITION OF MILK

Structure

7.1 Definition of milk, PFA designated milks
7.2 Composition of milk of different species
7.3 Detailed composition of milk –Nutritive value of milk
7.4 Factor affecting the composition of milk

7.1 DEFINITION OF MILK, PFA DESIGNATED MILKS

Chemical definition: Milk is heterogeneous colloidal product in which fat and protein are dispersed in water and other substances like Sugar, Minerals are held in solution form where the water is dispersion medium for dispersed phase and solvent for other soluble constituents.

Physical definition: Milk is white coloured colloidal substance in which fat and protein are dispersed in water and is produced by mammary glands of mammalian.

P.F.A definition: Milk is normal mammary glands secretion derived from completely milking of healthy milch animal without either addition there to or extraction there from it shall be free from colostrums.

PFA Designated milks:

According to the Prevention of Food Adulteration (PFA) Rules, 1976, the standards for different classes and designations of milk in India are given in the Table 7.1

Class of milk	Designation	Locality	Minimum	
			Fat%	SNF%
Buffalo milk	Raw, pasteurized, Boiled, flavoured and sterilized	Andhra Pradesh	5.0	9.0

Cow milk	- Do --	Andhra Pradesh	3.5	8.5
Goat or sheep	--Do--	Andhra Pradesh	3.0	9.0
Standardized milk		All India	4.5	8.5
Recombined milk		All India	3.0	8.5
Toned milk		All India	3.0	8.5
Double toned milk		All India	1.5	9.0
Skim milk		All India	Not more than 0.5	8.7

7.2 COMPOSITION OF MILK OF DIFFERENT SPECIES

The average chemical composition of milk of different species of livestock is given below (Table7.1). It varies in different animals because of genetic factor which can not be changed by management of the animals.

Name of the species	Water%	Fat%	Protein%	Lactose%	Ash%
Cow	86.6	4.6	3.4	4.9	0.7
Buffalo	84.2	6.6	3.9	5.2	0.8
Ewe	79.4	8.6	6.7	4.3	1.0
Goat	86.5	4.5	3.5	4.7	0.8
Sow	89.6	4.8	1.3	3.4	0.9
Mare	89.1	1.6	2.7	6.1	0.5
Dog	75.4	9.6	11.2	3.1	0.7
Cat	84.6	3.8	9.1	4.9	0.6
Human	87.7	3.6	1.8	6.8	0.1

The average chemical composition of milk of few breeds of Indian cows and Murray buffalo is given below.

Table 7.2 Chemical composition of milk of Indian breeds

Breed of cow/buffalo	Percentage composition				
	Water	Fat	Protein	Lactose	Ash
Sindhi	86.07	4.90	3.42	4.91	0.70
Gir	86.44	4.73	3.32	4.85	0.66
Tarparkar	86.58	4.55	3.36	4.83	0.68
Sahiwal	86.42	4.55	3.33	5.04	0.66
Murrah	83.63	6.56	3.88	5.23	0.70

The average chemical composition of milk of some exotic breeds of cows is given in Table 7.3

Table 7.3 Chemical composition of cow milk of exotic breeds

Breed	Percentage composition				
	Water	Fat	Protein	Lactose	Ash
Holstein	87.74	3.40	3.22	4.87	0.68
Shorthorn	87.19	3.94	3.32	4.99	0.70
Ayrshire	87.10	4.00	3.58	4.67	0.68
Brown Swiss	86.59	4.01	3.61	5.04	0.73
Guernsey	85.39	4.95	3.91	4.93	0.74
Jersey	85.09	5.37	3.92	4.93	0.71

7.3 DETAILED COMPOSITION OF MILK- NUTRITIVE VALUE OF MILK

MILK COMPOSITION:

Milk is natural secretion with very complex composition. The constituents present in milk are broadly categorized into major and minor constituents.

MAJOR MILK CONSTITUENTS:

a. **Water:** constitutes the medium in which the other milk constituents are either dissolved or suspended. Most of it is 'free' and very small portion is in the 'bound' form, being firmly bound by milk proteins, phospholipids, etc.

b. **Milk fat:** The fat in the milk exists in the form of small globules of 2 to 5 microns in size (range 0.1 to 22 microns).This is an oil-in-water type emulsion. The surface of the fat globules is coated with fat globule membrane. The membrane contains phospholipids and proteins in the form of complex, and stabilizes fat emulsion.

c. **Milk proteins:** These are composed of number of amino acids, some 'essential' and others 'non-essential'. The proteins of milk consist mainly of casein, β-lactoglobulin, α-lactalbumin etc. Casein exists only in the milk and is found in the form of a calcium caseinate-phosphate complex. It is present in the colloidal state. It forms more than 8 per cent of the total protein in the milk.

d. **Milk sugar or lactose:** It is also called as brain sugar as it helps in brain development. It is in true solution in the milk serum. On crystallization in water it forms hard gritty crystals. It is one-sixth as sweet as sucrose. Lactose is responsible for the defect known as 'sandiness in ice-creams and sweetened condensed milk under certain conditions. Chemically lactose is composed of glucose and galactose.

e. **Mineral matter or ash:** The mineral matter or salts of milk exert considerable influence on the physico-chemical properties and nutritive value of milk. The major salts those present in appreciable quantities include potassium, sodium, magnesium, calcium, phosphate, citrate, chloride, sulphate and bicarbonates.

Although milk is acidic, ash is distinctive basic. Part of the minerals occur in true solution, while a part are in the colloidal state.

MINOR MILK CONSTITUENTS:

a) **Phospholipids:** There are three types of phospholipids; viz. Lecithin, cephalin and spingomylin are present in the milk. Lecithin is the important constituent of fat globule membrane which contributes to the 'richness' of flavour of milk and other dairy products. Phospholipids are excellent emulsifying agents and stabilize the milk fat emulsion.

b) **Cholesterol:** It is present in true solution in the fat, as part of fat globule membrane complex and in complex formation with protein in the non-fat fraction of milk.

c) **Pigments:** These are fat soluble and water-soluble. Carotene and xanthophyll are fat soluble and riboflavin is water-soluble pigment. Carotene which is reddish brown colour in its pure form is responsible for yellow colour of milk, cream, butter, ghee and other fat rich products. Carotene also acts as anti-oxidant and as a precursor of vitamin A. Cows in general and some breeds in particular such as Guernsey and Jersey can transfer more carotene from their feed to the milk fat than buffaloes, who do not possess the capacity. Riboflavin is a greenish yellow pigment which gives the characteristic colour to whey. Earlier the term 'lactochrome' and 'lactoflavin' were used instead of riboflavin.

d) **Enzymes:** The important milk enzymes and their specific actions are as follows: (i) Analase (diastase) – starch splitting (ii) Lipase-fat splitting, leading to rancid flavour,(iii) Phosphate – capable of splitting certain sphosphoric acid esters which is a basis of phosphatase test for checking pasteurization efficiency.(iv) Protease – protein splitting,(v) Peroxidase and Catalase – decomposes hydrogen peroxide.

e) **Vitamins:** The vitamins found in milk are fat soluble vitamins A,D,E and K; and water-soluble vitamins of the 'B-complex' group (such as thiamine or B_1,riboflavin or B_2,pantothenic acid, niacin, pyridoxine or B_6,biotin,B_{12},folic acid etc.) and vitamin C (ascorbic acid).

NUTRITIVE VALUE OF MILK:

Milk is an almost ideal food. It has high nutritive value. It supplies body building proteins, bone forming minerals and health- giving vitamins and furnishes energy giving lactose and milk fat. All these properties make milk an important food for pregnant mothers, growing children, adolescents, adults, invalids, convalescents and patients alike.

a) **Proteins:** Milk proteins are complete proteins of high quality that is they contain all essential amino acids in fairly large quantities.

b) **Minerals:** Milk is an excellent source of calcium and phosphorus, both of which, together with vitamin D are essential for bone formation. Milk is low in iron, copper and iodine.

c) **Vitamins:** Milk is good source of Vitamin A, Vitamin D, thiamine, riboflavin etc. However milk is deficient in vitamin C.

d) **Fat:** It is rich source of energy. It contains significant amounts of essential fatty acids like linoleic and arachidonic acids. It plays the most distinctive role in contributing flavour to the dairy products which is not duplicated by any other type of fat. In addition to flavour, milk fat imparts a softy body, smooth texture and rich taste to the dairy products.

e) **Lactose:** The principal function of lactose is to supply energy. It also helps to establish a mildly acidic reaction in the intestine and facilitates assimilation.

f) **Energy value:** The energy giving milk constituents and their individual contributions are as follows:

Milk fat : 9.3 C/g

Milk protein: 4.1C/g

Milk sugar : 4.1 C/g

Where 1C(Food Calorie) = 1000 c (small calorie)

The energy value of milk will vary with it composition. On an average, cow milk furnishes 75 C/100 g and buffalo milk 100 C/100g.

g) **Effect of processing:** Pasteurization has no effect on vitamin A, carotene, riboflavin and a number of remaining vitamins B, and vitamin D. In this process a 10 per cent loss of thiamine and 20 per cent loss of ascorbic acid may be expected. Sterilization increases the loss of thiamine and ascorbic acid to 30-50 per cent and 50 per cent respectively.

7.4 FACTORS AFFECTING THE COMPOSITION OF MILK.

All milk contains the same kind of constituents, but in varying amounts. In general, milk fat per cent shows the greatest daily variation.

The following factors affecting the composition of milk

- **Species:** The milk from various species of animals have different composition. Eg: Buffalo milk contains more fat and SNF than cow and goat milk. The average chemical composition of milk of different species of livestock is given inTable7.1
- **Breed:** Generally, the milk of Indian cows contains more fat percent than that in exotic cows. Milk composition also varies from breed to breed. The average chemical composition of milk of few breeds of Indian cows and Murrah buffalo is given in Table 7.2.
- **Individuality:** Milk composition varies from animal to animal within the breed.
- **Age:** The fat per cent in milk declines slightly as cow grows older.
- **Stage of lactation:** The first secretion after parturition is called as colostrums. The composition of colostrums is entirely different from milk. Colostrums contains more protein (16%) and more total solids (28%). Colostrums will become normal milk within 4 or 5 days after calving. In early lactation, the fat% is low. Fat% is gradually increased 2-3 months after calving. The fat percent will be higher at the end of lactation.
- **Interval of milking:** In general, a longer milking interval is associated with more milk yield with a lower fat per cent.
- **Completeness of milking:** If the cow is completely milked, the fat percent is normal. When the animal is not completely milked, both milk yield and fat per cent will be decreased.

- **Stage of milking or Portion of milking:** Fore milk is low in fat content(less than 1 per cent), while strippings are highest (8to 10 per cent). The other milk constituents are only slightly affected on a fat –free basis.
- **Feeding:** Minimum 17% crude fiber is required in the ration to maintain normal fat per cent in milk. When fiber content is decreased in the ration, fat% will be decreased in the milk. Feeding of very fine chaffing of succulent fodder and fine grinding of feed ingredients will decrease the fat% in milk. Fedding of grinded cotton seed or cotton seed cake increases fat% in milk. Protected fat also increases fat% in milk.

- **Disease and abnormal conditions:** These tend to alter the composition of milk, especially when they result in a fall in yield. Mastitis disease decreases fat and lactose % in milk but chloride content is increased.

- **Season:** Milk fat and protein per cent will be increased during winter. It will be decreased during the spring and summer.

Short Answer Type Questions

1. Write the definition of milk
2. Write the PFA standards of cow and buffalo milk.
3. Write the PFA standards of recombined and toned milk
4. Write the PFA standards of double toned and skim milk
5. Write the chemical composition of cow milk
6. Write the chemical composition of buffalo milk

Long Answer Type Questions

1. Write about the composition of milk
2. Explain the nutritive value of milk
3. Write about the factors affecting the composition of milk
4. Write in detail about PFA standards of different types of milk

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UNIT 8

PHYSICO-CHEMICAL PROPERTIES

Structure:

8.1 Colour and flavour

8.2 pH and acidity

8.3 Specific gravity, freezing and boiling of milk

8.4 Viscosity and surface tension

8.5 Off- flavours

8.1 COLOUR AND FLAVOUR:

The colour of milk produced by the colloidal casein particles and the dispersed fat globules, both of which scatter light and the carotene which imparts a yellowish tint. Milk ranges in colour from yellowish creamy white (cow milk) to creamy white (buffalo milk). The intensity of yellow colour of cow milk depends up on various factors such as breed, feeds, size of fat globules, fat per cent of milk etc. The greater the intake of green feed the deeper yellow the colour of cow milk. The larger the fat globules and the higher the fat per cent, the greater the intensity of yellow colour. Skim milk has a bluish, and whey greenish yellow colour which is masked by other constituents present in the milk.

The flavour of milk is blend of the sweet taste of lactose and salty taste of minerals, both of which are damped down by proteins. The phospholipids, fatty acids and fat of milk also contribute to the flavour.

Changes in the flavour of milk occur due to type of feed, season, stage of lactation, condition of udder, sanitation during milking and subsequent handling of milk during storage. The sulfydryl compounds significantly contribute to the cooked flavour of heated milk. The sources of abnormal flavour of milk may be due to bacterial growth, feed, absorbed, chemical composition, processing and handling, chemical changes, addition of foreign material.

8.2 PH AND ACIDITY

a) **pH:** The pH of normal, fresh, sweet milk usually varies from 6.4 to 6.6 for cow milk and 6.7 to 6.8 for buffalo milk. Higher pH values for fresh milk indicate udder infection and lower values indicates bacterial action.

b) **Acidity:** Freshly drawn milk is amphoteric in nature. It shows a certain acidity as determined by titration with an alkali(sodium hydroxide) in the presence of an indicator(phenolphthalein).This acidity is also called Titratable Acidity (T.A).It is known as 'natural' or 'apparent' acidity and is caused by presence of casein, acid – phosphates, citrates etc., in the milk. The natural acidity of individual milk depending up on species, breed, individuality, stage of lactation, physiological condition of the udder, etc., The higher the solids-not fat content in the milk, the higher the natural acidity(N.A) and vice versa. The titratable acidity of cow milk varies from 0.13 to 0.14 per cent and buffalo milk from 0.14 to 0.15 per cent. 'Developed' or 'real' acidity is due to lactic acid formed as a result of bacterial action on lactose in milk. Hence the titratable acidity of stored milk is equal to the sum of natural acidity and developed acidity. The titratable acidity is usually expressed as 'percentage of lactic acid'.

8.3 SPECIFIC GRAVITY, FREEZING AND BOILING OF MILK

a) The specific gravity of milk is usually expressed at 60 °F (15.6 °C). The specific gravity of milk is determined by lactometer. The common lactometers are Zeal, Quevenne, etc. The average specific gravity of cow milk ranges from 1.028 to 1.030 at 60 °F, 1.030 to 1.032 for buffalo milk and 1.035 to 1.037 for skim milk. The specific gravity of milk is influenced by the proportion of its constituents. Each of which has a different specific gravity approximately as follows: water – 1.000; fat – 0.93; protein – 1.346; lactose - 1.666; and salts -4.12 (Solids –not- fat – 1.616).

As milk fat is lightest constituent, the more the fat content in milk the lower the specific gravity will be and vice versa. Buffalo milk contains more fat than cow milk but higher in specific gravity because of presence of more solids-not-fat than cow milk. The specific gravity of milk is lowered by addition of water and cream and increased by addition of skim milk or removal of fat. The specific gravity of milk should not be determined for at least one hour after its drawn from the animal; else a lower than the normal value will be obtained due to the *Recknagel phenomenon*.

b) Milk freezes at temperatures slightly lower than water due to the presence of soluble constituents such as lactose, soluble salts, etc., which lower the freezing point. The average freezing point depression of Indian cow milk may be taken as 0.547 °C (31.02°F) and buffalo milk 0.549°C (31.01°F).Most bulk milk samples have a freezing point depression of 0.530 °C (31.05 °F). A freezing point depression lower than this value indicates added water. Mastitis milk shows a normal freezing point. The freezing point test of milk is a highly sensitive and even up to 3 per cent of watering can be detected.

The freezing point is employed mainly for detection of adulteration of milk with water, souring results in lowering of the freezing point due to increase in the amount of soluble molecules. Hence the freezing point should be determined on un-soured samples for greatest accuracy. Boiling and sterilization increase the value of freezing point depression but pasteurization has no effect. The fat and protein contents of milk have no effect on the freezing point of milk.

c) Boiling point of any liquid is the temperature at which at the given pressure the material is in equilibrium both as a liquid and as a gas. This is the temperature at which the liquid phase will vaporize and the gas phase condense or liquefy according to the heat supply.

Water boils at 100 °C under normal atmospheric temperature and pressure. The presence of dissolved substances increases the boiling point of a solution. Since milk contains several dissolved substances, it has higher boiling temperature than that of water. Because there is variation in the dissolved substances, the boiling point of milk also varies between 100.15-100.17 ° C [100.2-101.02].

8.4 VISCOSITY AND SURFACE TENSION

VISCOSITY: The viscosity of normal milk is -2.2 to -2.5 m Pa at 20 °C. It depends on metabolism and state of nutrition of individual cow. It depends up on temperature, concentration of casein micelles and fat globules. The viscosity of whole milk is -1.9 cP, the viscosity of skim milk is -1.5 cP and the viscosity of whey is -1.2 cP. Homogenization increases the viscosity of milk and cream. Casein micelle contributes more to viscosity of milk. Temperature decreases the viscosity of milk. For example at 20°C milk is about half as viscous as at 0°C and at 40 °C the viscosity is $1/3^{rd}$ of value at 0°C.

SURFACE TENSION (ST): Surface tension is defined as the work required to increase the surface area of a solution and expressed as dynes/cm. Surface tension of milk is approximately 70% of that of water which is 72 dynes/cm. Surface tension of cow milk is 50-52 dynes/cm, Surface tension of skimmed milk is 55 -60 dynes/cm and surface tension of cream is 46 -47 dynes/cm. Casein along with its proteolytic products proteose, peptones are responsible for surface tension. Heating, sterilization and homogenization increase the surfacetension.

8.5 OFF-FLAVOURS

CHARACTERISTICS OF MILK OFF-FLAVORS

1. **Typical Milk:** No criticism. Very little distinct odour, pleasantly sweet and clean with no aftertaste.
2. **Acid:** Basic taste sensation. Sour, tart, may cause tingling sensation on tongue. "Cultured milk" or "sour" odour may be present.

   Cause - Growth of lactic acid producing organisms such as *Lactococcus lactis*, due to poor refrigeration, especially when temperatures exceed 70°F (21°C). "Malty" milks may be acid also.
3. **Astringent:** Peculiar mouth-feel, tongue & mouth lining feel shrivelled, puckered, chalky (e.g., cranberry juice).

   Cause - Associated with denatured proteins due to high heat treatments or with staleness (e.g., milk powder). May be more pronounced in skim milks and in Ultra High Temperature (UHT) or Ultra-Pasteurized (UP) products. Occasionally occurs with slight rancid, bitter or acid milk.
4. **Barny:** Unpleasant odour and taste of a poorly maintained barn or unpleasant feed. May be perceived as "unclean." "Cowy" or "cow's-breath" may present a similar defect but generally with an unpleasant medicinal or chemical (i.e., acetone) aftertaste.

   Cause - absorbed, transmitted odour/flavour due to cow inhaling barn odours associated with poor ventilation and unclean barn conditions. Similar defect may be due to ketosis in cows, but with more of a medicinal or chemical after taste (see cowy).

5. **Bitter:** Basic taste sensation. Pure bitter has no odour. Taste sensation is detected on the tongue after expectoration (delayed) and tends to persist. (e.g., hops in beer, coffee may be bitter)

   Cause - enzymatic breakdown (microbial or milk enzymes) of milk proteins to short bitter peptides. Certain weeds ingested by cows may also cause bitterness although this is rare.

6. **Cooked:** Note odour and flavour. Varies in intensity from sweet, pleasant, with slight sulphurous or custard notes, to caramelized or cabbage-like, which may be objectionable. Flavour usually becomes less intense over time but may persist depending on packaging material.

   Cause - Higher pasteurization temperatures and/or longer holding times. Intensity depends on the severity of heat treatment. Cooked flavours tend to be more pronounced in batch-pasteurized than HTST milk; most pronounced in Ultra High Temperature (UHT) or Ultra Pasteurized (UP) products.

7. **Cowy:** Unpleasant odour & flavour; “acetone” or “cow's-breath”; unpleasant medicinal or chemical aftertaste.

   Cause – metabolic disorder in cows such as acetonemia or ketosis. Similar defect may be transmitted/absorbed odours of poor barn conditions (i.e., barny).

8. **Feed:** Odor & flavor is characteristic of associated feed; silage, hay, grassy, etc. Can be slightly sweet, generally not unpleasant, although could be unclean when strong or feed quality is poor. Most feed flavors clear up readily after milk is discharged from mouth. Common, though most often slight.

   Cause - cows consume particular feed or inhale feedy odors prior to milking; transmitted to the milk. Feeding should be done after milking when practical, barns should be well ventilated.

9. **Flat:** No odor. Lacks mouth-feel, flavor fullness, and/or sweetness of fresh milk. Watery characteristic.

   Cause - adulteration with water or low milk solids content. Older milk may be “flat.”

10. **Foreign:** Milk may have odor and/or flavor that is not commonly associated with milk. Often “chemical” in nature. Depends on causative agent; sanitizers, detergents,

exhaust fumes, cow medications, citrus fruits, etc. Chloro-phenol compounds may give “medicinal” or “bandage-like” flavor.

Cause - Contamination of milk with foreign substance. It may be direct contamination of the milk (e.g., udder ointment/chemical sanitizers, phenols/chlorine); may be transmitted through the cow or absorbed during raw storage or through retail packages in plant, store or home refrigerators.

11. **Fruity/ Fermented** Odor and flavor is usually pronounced, similar (*not exact*) to pineapple, apple, strawberry or other fruit (*fruity*); may have more of a sauerkraut or vinegar-like odor or flavor (*fermented*).

    Cause - growth of psychrotrophic spoilage bacteria, especially certain psychrotrophic *Pseudomonas* species or some of the spore-forming organisms (e.g., *Bacillus*, *Paenibacillus*).

12. **Garlic/Onion:** Characteristic pungent odor and flavor. Highly objectionable.

    Cause - Animals ingesting wild onion or garlic weed. It may also be absorbed through packaging during refrigeration storage with onion or garlic containing foods.

13. **Lacks Freshness:** Lacks fine, pleasing flavor. Mild off-flavor that lacks specific characteristic to make identification easy. May be “stale” or less sweet (e.g., “flat”). Generally not intense enough to fail product.

    Cause - Usually due to age, staleness, residual milk enzymes or initial stage of microbial spoilage (e.g., psychrotrophic bacterial off-flavors such as unclean, bitter and rancid).

14. **Malty:** Malt-like aroma or taste (like malted milk or Grape-Nuts®). It may be similar to feed or cooked odors, but is considered a severe defect as microbial spoilage. Milk often is acid as well.

    Cause - Growth of *Lactococcus lactis* var. *maltigenes* (or possibly other organisms) due to poor refrigeration. It may be followed by “acid” or “unclean” flavors.

15. **Oxidized / Light-Induced:** Odor and taste of burnt-protein, burnt-feathers, or medicinal or plastic-like taste. It may progress to metallic or lipid oxidized type flavor due to fat oxidation.

    Cause - exposure of milk to sunlight or fluorescent lights resulting in protein degradation and/or lipid oxidation. Milk in unprotected or transparent milk jugs/bottles is more susceptible although this defect may occur in paper packaging if the light is intense and exposure time is sufficient.

16. **Metallic- Oxidized:** Wet cardboard, oily, tallowy, chalky, or fishy flavor. Odor (old veg. oil) is pronounced when defect is intense. May have a lingering greasy or puckery mouth-feel. Sensation comes quickly.

    Cause - milk fat oxidation catalyzed by copper or certain other metals contacting milk (e.g., copper pipe, white metal, metallic water supply). It may be associated with raw milk of cows fed high fat feeds (e.g., soybeans) and/or lack of antioxidants (e.g., vitamin E). Sometimes occurs spontaneously. Raw or cream-line milk is more susceptible than pasteurized homogenized.

17. **Carton/ Paperboard:** Plastic-like or wet paper flavor. Subtle, rarely pronounced unless there is evidence of carton burning during the sealing process.

    Cause – associated with paper-board packaging with heat used to seal HDPE polymer coating. Generally more apparent in half-pints due to increased package surface area to volume ratio.

18. **Rancid:** Pungent odor when extreme. Taste soapy, unclean, bitter, blue cheese-like or "baby vomit." Provolone cheese has a rancid flavor profile. Pronounced lingering aftertaste. Sensitivity varies.

    Cause - free fatty acids (e.g., butyric acid) released from milkfat by natural or microbial enzymes (lipase). In raw milk it's associated with excessive agitation, temperature abuse or cow factors (e.g., poor health and/or nutrition). Pasteurization destroys natural enzyme (lipase), but spoilage microorganism may have similar enzymes that cause rancidity.

19. **Salty:** Basic taste sensation. No odor. Generally easily detected. Clean mouth-feel.

    Cause - associated with late lactation or mastitis cows.

20. **Unclean:** Unpleasant odor and taste. Mouth fails to clean up after expectorated. Suggestive of mustiness, putrid, "dirty dish-rag" or other "unclean" flavors.

    Cause - generally due to growth of spoilage microorganisms in milk or on excessively dirty equipment. It can occur due to milk absorbing odors from dirty coolers or environment.

Short Answer Type Questions

1. What is the pH and acidity in milk
2. What is the normal freezing and boiling point of milk
3. What is the normal specific gravity and viscosity of milk
4. Give a list of any ten of the off flavours in milk
5. What is the normal colour and flavour of cow and buffalo milk

Long Answer Type Questions

1. Write about the pH, acidity, specific gravity, viscosity and freezing point of milk
2. Write briefly about important characteristics off flavours in milk

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UNIT 9

ADULTERANTS AND PRESERVATIVES

Structure:

9.1 Common adulterant in milk & their detection

9.2 Common preservatives in milk &their detection

9.3 Adulteration of buffalo milk with cow milk – Hamsa test

9.4 Effects of adulterants and preservatives on human health

9.1 COMMON ADULTRANTS IN MILK - THEIR DETECTION

Adulteration of milk may be defined as addition of any material to the milk, or removal of any constituent of milk. As per PFA, adulteration of milk is not allowed and it is punishable with fine and imprisonment. The common adulterants in milk are

1. Addition of water
2. Removal of fat
3. Addition of cane sugar
4. Addition of starch / cereal flour
5. Addition of skim milk powder
6. Addition of gelatine
7. Addition of urea
8. Addition of Ammonium sulphate
9. Addition of glucose

The common adulteration of milk is addition of water. By water adulteration of milk constituents are diluted (Fat and SNF). The water adulterated milk tests less lactometer reading and less SNF content. To mask this other compounds listed above are added so that milk shows required lactometer reading. The water adulterated milk will be thin and non viscous. To mark this also the various substances are added, so that the adulterated (Water) milk will have normal consistency.

1. **Detection of Addition of Cane sugar in Milk**

- Take 10 ml milk in the test tube.
- Add 1ml of conc. Hydrochloric acid and mix thoroughly.
- Add 0.1 gm resorcinol powder and mix the content thoroughly.
- Place the tube in a boiling water bath for 5 min. and observe the colour.
- Observe if there is any development of red colour.

Development of red colour indicates that cane sugar is added in milk.

2. Detection of Addition of Starch in Milk

- Take about 3 ml of well mixed milk in a test tube.
- Boil the milk over a burner.
- Cool and add on drop of 1 % iodine solution and observe the colour.

Presence of blue or bluish violet colours indicates the presence of starch / cereal flours added in milk.

3. Detection of Addition of Skim milk powder in Milk

- **Take 50 ml of milk in centrifuge tube and place it in a centrifuge and balance the centrifuge.**
- **Centrifuge at 3000rpm for 30 min.**
- **Decant the supernatant fluid carefully.**
- **Dissolve the residue in 2.5ml of concentrated nitric oxide.**
- **Dilute the solution with 5ml of water.**
- **Add 2.5ml of Ammonium hydroxide and observe the color.**

Presence of orange colour indicates the presence of skim milk powder.

4. Detection of Added Water

- Determine the lactometer reading of the milk sample.
- Determine the fat percentage of the milk sample by Gerber method.
- Calculate the SNF using Modified Richmond formula.

- Calculate the specific gravity of milk sample.
- The PFA standards (fat and SNF) for cow and buffalo milk are3.5&8.5 and 5.0&9.0 respectively
- Formula for calculating the percentage of added water

$$\% \text{ Added water} = \frac{100(\text{Standard SNF} - \text{Sample SNF})}{\text{Standard SNF}}$$

9.2 COMMON PRESERVATIVES IN MILK – THEIR DETECTION

1. Detection of boric acid and borates

- Take 5 ml of milk in a test tube.
- Add 1 ml of concentrated hydrochloric acid and mix well.
- Dip a strip of turmeric paper in the acidified milk.
- Dry the filter paper immediately and note the change in colour.

Turmeric paper turns red if boric acid or its salts are present.

2. Detection of Formalin: There are two tests

a) Hehners Test

- Take 10 ml of milk in a test tube
- Add 0.5 ml of 1% ferric chloride solution.
- Add carefully about 5 ml of concentrated sulphuric acid down the side of the test tube in such a way that it forms a separate layer at the bottom without mixing with milk.
- Observe the colour of the ring formed at the junction of the two liquids.

b) Leech Test

- Take 5 ml of milk in a test tube
- Add to it equal volume of concentrate hydrochloric acid containing 1 ml
- of 10% ferric chloride solution to each 500 ml of the acid.
- Heat over a flame for 5 minutes.
- Rotate the tube to break up the curd and observe the colour.

Violet colour indicates presence of formaldehyde.

3. Detection of Hydrogen Peroxide

Principle: Paraphenylenc diamine hydrochloride gives blue color eith Hydrogen peroxide.

- Take 10ml of sample in a test tube add 2 drops of paraphenylene diamine hydrochloride solution. Mix the contents and observe the colour. Intense blue colour will indicate presence of Hydrogen peroxide.

9.3 ADULTERATION OF BUFFALO MILK WITH COW MILK-HAMSA TEST

Buffalo milk is richer than cow milk in almost all the constituents. Hence watered buffalo milk is used as an adulterant of cow milk. Hamsa test is used to detect this type of adulteration.

Procedure:

- In two test tubes place 9 ml each of tap water.
- In one tube, market 'C' add one ml of pure cow milk and mix well.
- In another test, mark 'B' add one ml of pure buffalo milk and mix well.
- Place one drop of diluted cow milk from tube 'C' and one drop from tube 'B' separately on a glass slide.
- Now place one drop of Hamsa test serum on each of these drops and mix well with tooth pick.
- Start a stop watch. At the end of 30 seconds, observe big coagulated and like particles in B while C will remain milky.
- If the unknown sample is tested, if curd particles appear, the sample is contaminated with buffalo milk. If it is milky and opaque, no buffalo milk is added.
- This test is affected by any preservatives added to the milk in normal concentrations. The hamsa test serum is effective, if it is stored at 3 – 5^{O} C at all times.

9.4 EFFECTS OF ADULTERANTS AND PRESERVATIVES ON HUMAN HEALTH.

Milk is most commonly diluted with water - this not only reduces its nutritional value, but contaminated water can also cause additional health problems. The other adulterants used are mainly starch, sodium hydroxide (caustic soda), sugar, urea, hydrated lime, sodium carbonate, formalin, and ammonium sulfate.

The Indian Council of Medical Research has reported that "milk adulterants have hazardous health effects. The detergent in milk can cause food poisoning and other gastrointestinal complications. Its high alkaline level can also damage body tissue and destroy proteins. Other synthetic components can cause impairments, heart problems, cancer or even death. While the immediate effect of drinking milk adulterated with urea, caustic soda and formalin is gastro enteritis, the long-term effects are far more serious."

Urea can lead to vomiting, nausea and gastritis. Urea is particularly harmful for the kidneys, and caustic soda can be dangerous for people suffering from hypertension and heart ailments.

Formalin can cause more severe damage to the body like liver damage. The health impact of drinking milk adulterated with these chemicals is worse for children. Caustic soda harms the mucosa of the food pipe, especially in kids. The chemical which contains sodium, can act as slow poison for those suffering from hypertension and heart ailments.

To avoid these dangers, it is the best to buy milk from a renowned source. Buying milk sold by reputed companies in tetra packs is also a good option.

Short Answer Type Questions

1. What is adulteration of milk
2. Write the formula for calculating the per cent of added water in milk
3. Explain the importance of Hamsa test for milk
4. Write the list of common adulterants in milk
5. Write the list of common preservatives in milk

Long Answer Type Questions

1. Explain about the adulteration and effect of adulteration on human health
2. Write briefly about detection of common adulterants in milk
3. Write briefly about detection of common preservatives in milk

Ψ

UNIT 10
Microbiology of milk

Structure:

10.1Types of microorganisms present in milk
10.2Milk borne diseases
10.3Microbial standards of raw and pasteurized milk

10.1 TYPES OF MICROORGANISMS PRESENT IN MILK.

Genus streptococcus organisms are Gram positive, spherical or ovoid and non motile. Carbohydrate fermentation is homo fermentative with lactic acid as the dominant end product.

All streptococci are fastidious with respect to their nutritional requirement as they require a number of B vitamins and amino acids for growth. Streptococci are divided into four groups viz., pyogenic group, viridians group, entrococcus group and lactic group. All streptococci except viridians group possess a serologically active, group specific 'C' substance (polysaccharide).

Lactobacillus Group

These are gram positive rods typically, non-motile, non sporulating and non acid fast. Lactobacilli are aerobic and facultative anaerobic, catalase negative, and grow best at pH 6.0. The carbohydrates and poly alcohols are changed by homo fermentation to lactic acids or by hetero fermentation to lactic and acetic acids, alcohols and carbon dioxide. Surface growth is enhanced on enriched media and under anaerobic conditions with added Co_2 (5 – 10%). The genus lactobacillus is subdivided into three groups. i.e. Thermo bacterium, Strep to bacterium and Beta Bacterium.

Leuconostoc Group

The genus consists of gram positive cocci in pairs or short chains which are micro aerophillic and hetero fermentative i.e. glucose is fermented with production of D (-) lactic acid, ethanol and Co_2. Certain types grow with a characteristic slime production in sucrose media. They generally grow on ordinary culture media, but growth is enhanced by the addition of yeast. Tomato or other vegetable extracts. These species are generally found in milk and plants juices.

GENUS ESCHERICHIA

The presence of this organism in food is of considerable public health significance, as the occurrence indicates faecal contamination. Escherichia coli are rods occur singly, in pairs and in short chains. Ferments glucose, lactose, manitol and xyloze and do not ferment sucrose, salicin and glycerol. Citric acid and salts of citric acid are not utilized by this organism. The optimum growth is at 30 – 37°C, but also grows at 10°C and 45°C as well. The Imvic test (Indole production, methyl red, voges proskar and citrate utilization) is + ++ - - . The selective media used for isolation is Eosin-Methylene blue (EMB) agar or violet red Bile agar (VBRA).

Genus Enterobacter

These are non faecal origin. There are two species i.e. Enterbacter Aerogenes and Enterobacter cloacae. The Imvic test is - - + + . All other characters are just like escherichia.

Genus Shigella

These are extreme lypathogenic type and causes acute food borne illness like desentry. The organisms are Shigella dysenterae, sh. Flesneri ad sh. + Sonnei. These are gram negativerods.

Genus Salmonella

These organisms will cause a variety of food- infections and illnesses. These are gram negative rod, motile by peritrichous flagella, unable to liquify gelatin and hydrolyse urea, Indole negative, methyl red positive and voges proskauer negative. The various organisms are Salmonella typhosa, paratyphi, S.typhimurium, S. Enteridis, S.Schottmuellri, S.Hirschfeidii.

Genus Yersinia

The various organisms are Yersinia enterocolitica, Y. pestis, Y.pseudo tuberculosis

Genus Klebsiella

Gram negative rods which are plump with rounded ends and are non motile. These are encapsulated in mucoid stage. The organism is Klebsiella pneumonia and causes pneumonia. The optimum temperature for growth is 37° C.

Genus Proteus

Straight rods which are motile. The species are proteus mirabilis and P. Valgaris which produce amoeboid colonies that show a swarming phenomenon on solid media. /urea is hydrolyzed and glucose and other carbohydrates are fermented with production of acid and gas.

Genus Pseudomonas

These organisms develop florescent, diffusible pigments of greenish, bluish, violet, lilac, yellow or other colour. The important pathogenic species is pseudomonas aeruginosa which forms greenish blue pigment (pyocyanin). The other species are ps. Fluorescence, ps. Fragi, ps, putida, ps. Putrefaciens are associated with certain defects in milk and milk products.

Genus Vibrio

These are curved, comma shaped rods, which do not attack cellulose. They grow well and rapidly on the surfaces of standard culture media and are heterotrophic organisms. Vibrio cholera is invariably associated with cholera.

Genus Brucella

The important species are Brucella abortus, B. Melitensis and Brucella suis. These are aerobic, Gram negative, non motile rods. Gas is not produced from carbohydrates and gelatin is not liquified. They grow at 37^{o}C. the agar colonies are small, circular and convex.

Genus Staphylococci

These are spherical cells occurring singly in pairs, in tetrads and in irregular clusters. The cocci are rather smaller than the micro cocci. They are non motile. The species are staphylococcus aureus, staph, Epidermis. These are Gram positive cocci occurring singe. Pairs or short chain, non motile.

Genus Bacillus

These are saprophytes and found in soil and widely distributed in nature. The important species are Bacillus cereus and B. anthracis causes milk borne illness. Other organisms are B, Stear other mophillus. B.Megaterium which causes spoilage or some changes in milk. These are gram positive rods and spore formers. Optimum temperature of growth in around 30 – 35^{o} C except B.Stearo thermophilus which grows between 55 – 65 ^{o}C.

Genus Clostridium

These are mostly found in soil and the intestinal tract of man and other animals. These are anaerobic spore formers and cause problem in canned milk products. The important organisms are clostridium butycricum and CI. Tyrobutyricum. These are thermophiles. These two organisms may cause late blowing in cheese. Other organisms like CI. Botulinum, CI- perfringens are classical food pathogens causing gastro intestinal disturbances and neurological disorders. These are gram positive, non, motile and the spores are produced located centrally or eccentrically giving bulging appearance to the cells. These are also responsible for butyric and saccharolytic fermentations.

Genus Mycobacterium

These are acid fast, slender rods, straight or slightly curved, classical test for these organisms is demonstration of acid fastness by carbol fuchsin or zeil neelsen method. Cells are non motile but aerobic. The organisms are M. tuberculosis, and M. Bovis, the former is human bacilli and the latter is bovine bacilli. These are gram positive and optimum growth at 37^{o}C ranging from 20-40^{o}C. These are pathogenic and cause tuberculosis disease.

Yeasts and Moulds

Yeasts

Yeasts are gram positive, unicellular, non motile, ovoid or elliptical cells, whose size is bigger than bacteria. The growth temperature ranges from 25 – 40^{o} C. They can tolerate high acidities (pH 3.5) and are fermentative or oxidative in their metabolism of carbohydrates. Few species are lipolytic in nature. The yeasts commonly associated with milk and milk products are given below.

1. **Saccharomyces species / kluyveromyces species**

The common species are Saccharomyces cerevisae, S. fragilis, S.Lactis, S. delbrueckii etc. S.fragilis and L. Lactis are also known as Kluyveromyces fragilis and kluyveromyces lactis.

S. cerevisae is generally used in brewing and baking industries. Asco spores are formed. It ferments glucose but it is unable to ferment lactose. Kluyveromyces fragilis is an ovoid to elongated organism and forms white glistening colonies on malt extract agar. It occurs singly, in pairs, or in short chains. Lactose is fermented to alcohol and carbon dioxide which forms the bases of its use in the manufacture of kumiss and kefir. The optimum temperature of growth is 37^{o}C and does not grow at 5^{o} or 43^{o}C. Kluyveromyces lactis forms spherical, cylindrical cells in single, pairs or clusters. It is capable of fermenting galactose and lactose. It has been isolated from cheese and milk.

1. Candida Species

Different species of candida have been isolated from butter, margarine, cheese, kefir and sweetened condensed milk. Some of the species cause yeasty or gassy cream with a high acidity, foaming and yeasty odour. The important species are C. pseudotropocalis, c. Lipolytica, C. mycoderma, C.kefir etc.

Moulds

The important moulds in dairy industry are**.**

1. **The Penicillium Species**

The penicillium species usually form blue-green spreading colonies eg. P. roqueforte, which is used in the manufacture of Roqueforte cheese and blue veined cheese. It is mainly responsible for characteristic flavour and appearance of these cheeses. Another species namely p. camemberti is used in the manufacture of camembert and bric cheeses.

Rhizophus species are present in food stuffs like bread and dairy products. Sporangia are white at first which changes to black on ripening. R. stolenifieris one of the common species.

2. **Aspergillus Species**

Some species (A. Flavus, A. parasiticus) are able to produce aflotoxins (G1, G2, B1 and B20) in dairy products. The aflotoxins are elaborated in animal feed as well which consequently get secreted as M1 and M2 in milk.

10.2 MILK BORNE DISEASES

A variety of micro organisms may gain access into milk and milk products from different sources and causes different types of food borne illnesses.

Common milk borne infection, intoxications and toxic infections

A) Milk Borne Infections

1. **Salmonellosis:** The causative organisms are

Salmonella typhi	:Typhoid
Salmonella paratyphi	:Paratyphoid
Salmonella Enteritidis	:Food poisoning
Salmonella weltiverdin	: Food poisoning

The sources of salmonella organisms into the milk are water, milk handlers, and suffering animals. Typhoid and paratyphoid are non pathogenic to animals.

The main symptoms of typhoid are

- Continued fever

- Inflammation of intestine, and formation of intestinal ulcers
- Enlargement of spleen
- Characteristic rose spot eruptions on the abdomen and toxanemia.

Symptoms of paratyphoid are

- Resembles typhoid but it is milder.

Salmonella food poisoning symptoms are

- Nausea, vomiting, abdominal pain
- Diarrhoea, chills, head ache,
- Prostration, muscular weakness, drowsiness
- Moderate fever, restlessness

Incubation period varies from 7-14 days for typhoid and 1 – 7 days for paratyphoid. The specific diagnostic test for Salmonellosis is Widal test for typhoid fever.

Prevention and Control

- Adequate treatment of water supply
- Infected individual should not be allowed to handle milk.
- Hygienic conditions during production, processing and all stages.
- Pasteurization of milk.

2. Bacillary dysentery (Shigellosis)

The causative organisms are Shigella dysenteries, Sh. Sonnei, sh. Flexneri. Sources of organism are through contamination with infected materials like utensils, water flies and milk handlers.

Important Symptoms are

- Diarrhoea with blood, pus or mucous.
- Fever, abdominal cramps and tenesmus.

Prevention and Control measures: Rigid sanitary discipline and Control of flies.

3. Streptococcal infections : Causative agents are

- Streptococcus pyogenes- Scarlet fever, septic sore throat, tonsillitis, septicemia
- Str. Agalactiae – Mastitis in animals (non pathogenic to human)
- Group D streptococci (enterococci): Food poisoning.

Sources of infection are

- Animals infected with S. Agalactiae
- Persons concerning care and milking of animal and Milking machines
- Human carriers of S. pyogenes

Symptoms

- Septic sore throat – high and irregular fever, and sudden onset of fever
- Inflammation and swelling of lymphnodes of throat and sometimes absess around tonsils.
- Scarlet fever – Acute febrile disease of throat accompanied by scarlet rash.
- Scarlet rash is due to release of toxin

4. Food poisoning: Resembles staphylococcal food poisoning syndrome which will be milder.

Prevention and Control:

- Adequate heat treatment of milk
- Regular health check of dairy worker.
- Avoiding faecal contamination of milk.

B)Milk borne milk intoxications

1. Staphylococcal poisoning : It is caused by Staphylococcus aureus which elaborates different types of toxins like

- Haemolysin (alpha, beta, gamma and delta)
- Leucocidin
- Necrotizing factor
- Enterotoxin
- Coagulase

Among all the above toxins the important toxin in entero toxin, this is heat stable and not destroyed even after boiling for 15 minutes. Sources of organisms are milch animals and human handlers. Symptoms are

- Nausea, Vomiting, abdominal cramps.
- Diarrhoea, sweating , headache and prostration

Prevention and Control:

- Adequate heating of milk destroys only organisms but not entertoxin.
- So heating immediately after production before toxin production is necessary.

- Post pasteurization contamination should be avoided.
- Infected handlers should not be allowed to handle milk. Mastitis animals should be isolated.

2.Botulism

The botulism poisoning is the severest of all food poisoning as it is affects the nervous system and is often extremely fatal. The causative organism is clostridium botulinum. Several types of toxins are produced i.e. A to G but A, B, E and F affect the human being. The sources of organisms is soil and water.

Symptoms

- Nausea, Vomiting, fatigue, dizziness
- Head ache, dryness of skin, mouth and throat.
- As it acts on central nervous system, it leads to paralysis of muscles, double vision and respiratory failure resulting finally into death.

Prevention and control

- Adequate heating of milk and milk products
- Hygienic milk production
- Chilling of milk immediately after production.

3. COLI POISONING

Escherichia coli is known to be associated with Enteritis in infants and adults as well as travellers diarrhoea and food poisoning. It produces two types of toxins i.e. heat labile at and heat stable(ST).

Source of disease

- Water supplies, contaminated with faecal matter
- Unhygienic practices by the handlers and Infected animals.

Symptoms

- Symptoms resembles cholera by ingestion of LT toxin. Massive watery diarrhoea.
- In ST type of toxin diarrhoea with and without vomiting which is non bloody. Fever in children and not in adults.

Prevention and control: Control of Sources.

4.Cholera

This is one of the acute diarrheal diseases caused by vibrio cholerae. It occurs as massive epidemics and unhygienic practices appears to be chiefly responsible for outbreak. This is mainly water borne illness. Adulteration of milk with water may be one of the causes for this disease.

Symptoms

- Diarrhoea, Vomiting
- Rice water stools, abdominal pain
- Thirst, dehydrationsymptom
- Death even within 12 hours after the appearance of symptoms

Prevention and Control

- Proper pasteurization of milk
- Sanitary disposal of human excreta
- Isolation of patient and carrier.

5. Fungal Intoxication

Aflotoxicosis : Produced by common mould Aspergellus flavus and A- parasiticus. The toxin is known as Aflotoxin. The toxins B1, B2 and B2a and G1, G2 and G2a. These toxins are heat stable and also carcinogenic.

Symptoms are – Liver hyperplasia, Tissue hemorrhage, Anorexia, hepatitis, finally death.

C) Other Milk Borne Disorders

Proteus infection: caused by Proteus vulgaris causes summer diarrhoea. It is easily destroyed by pasteurization.

1.Acromonas Infection: Acromonas hydrophilia causes food poisoning through contaminated water supplies.

2.Klebsiella infection: Causes gastro intestinal illness.

3.Pseudomonas infection: Organisms are Ps. Putrefaciens, Ps. Fragi, P.viscose and P. æruginosa. Of these P. æruginosa causes food poisoning and also causes urinary tract infection, eye infection, ear infections, abscess meningitis and enteritis in human beings.

New Emerging Pathogens

1. **Listeriosis:** It is caused by Listeria monocytogenes. The heat resistance is more and sometimes it survives pasteurization, as these organisms are ingested by leucocytes and gives protection.

Symptoms: Acute meningitis, with or without septicaemia. Parenchymal pulmonary infiltration Cough, fever, fatigue, loss of weight.

Prevention and Control

- Handlers and animals infected should be screened.
- Proper heat treatment of milk
- Avoid overcrowding of animals
- Avoid infected persons in handling of milk.

2. **Brucellosis**

Organisms are B. melitensis (goats) B. abortus (Cattle) B. suis (pigs). All these species can infect human beings.

Sources: Diseased animals secrete organism in milk. Persons handling the milk. It causes undulant fever in humans.

3. **Diphtheria :** Causative organism is Corynebacterium diphtheriae. Sources of infections are milk handlers and infected animals.

Symptoms : Febrile infection of nose, throat and tonsils followed by inflammation of throat. Diphtheria toxin affects kidney, heart muscles resulting death.

4. Anthrax : It is caused by Bacillus antharacis. Sources of infection are infected animal and environment. It causes carbuncle disease in human (contagious type). Pulmonary type causes pneumonia which may be fatal.

5. (Q) Fever: Organism is Coxiella burneti which is more heat resistant organism. It survives sometimes pasteurization temperature also.

Symptoms: High fever, head ache, weakness, malaise, severe, sweating and pneumonia.

Viral Diseases

1.Enteroviruses : Causative viruses are a group of viruses causing severe epidemic summer diarrhoea in infants and children.

Symptoms: Gastroenteritis, Headache, fever, muscle stiffness and paralysis.

2.Infectious hepatitis: It causes jaundice, which is one of the serious diseases in human beings through contaminated water. Sources are contaminated water, milk handlers and environment.

Symptoms: Nausea, vomiting, lethargy, abdominal pain, diarrhea fever anorexia, sore throat, bile in urine and jaundice.

3.Foot and Mouth disease: It causes fever and difficulty in swallowing in human beings.

10.3 MICROBIAL STANDARDS OF RAW AND PASTEURIZED MILK

The different national and international organizations have given various standards to milk and milk products.

Raw Milk

I.S.I. (BIS) Standards

a. Direct Microscopic Count (DMC)

Count per ml	**bacteriological grade**
< 5, 00,000	Good
5 Lakhs – 4 millions	Fair
4 – 20 millions	Poor
>20 millions	Very poor

b. Standard Plate Count (SPC)

Count per ml	**Quality / Grade**
<2, 00,000	Very Good
2 Lakhs – 1 million	Good
1 – 5 millions	Fair
>5 millions	Poor

c. Methylene blue Reduction time

(MBRT) MBRT hours	**Quality**
5 and Above	Very Good
3 to 4	Good
1 or 2	Poor
½ and below	Very poor

d. One hour Resazurin Test (RRT)

Disc No.	**Quality / grade**
4 and above	Good
3 ½ - 1	Fair
½ and 0	Poor

e. 10 mts Resazurin rest (RRT)

Disc No.	Quality/grade
4 - 5	Satisfactory
3 ½ -1	Doubtful
½ and 0	Unsatisfactory

f. Thermoduric Count

Count /ml	Quality /grade
<10,000	Good
10,000 – 30,000	Fair
>30,000	Poor

g. Coliforms

Absent in 0.001 ml – Satisfactory

h. Leucocyte Count

Count per ml	Quality / grade
<5,00,000	Normal Milk
>5,00,000	Mastitis or early or late lactation milk.

USDA/FDA Standards

	(SPC) (max) ml)	(Coliform (max) ml)
Raw Milk (pick up)	1,00,000	-
Raw milk (Co- mingled)	3,00,000	-

Military Federal Purchases Standards Raw Milk

DMC : 5,00,000 to 30,00,000/ ml

Fresh milk SPC: 20,000/ ml and Coliform 10 ml

Suggested Standards

Total Bacterial count	<2,50,000 /ml
Coliform	<100 /ml
E.coli (Faecal type)	Absent 1 in 0.01 ml

Thermoduric	< 1000 / ml
Spores	< 10 / ml
B. Cereus spores	< 1 / ml
Staphylococcus aueus	< 100 / ml
MBRT (at 37°C)	Not < 5 hours
RRT	Not < 3 hours
Somatic Cell count	< 7,50,000 / ml

1. Pasteurized Milk

(a) SPC count/ ml	**Quality /grade**
< 30,000	Satisfactory

Coliforms. Absent in 1 : 10 Dilution

satisfactory USPHS Standards (United State Public Health Society)

(a) SPC – Grade 'A' milk not more than 20,000/ ml

Certified milk not more than 500 /ml

(b) Coliform

Grade A > 10

ml Certified milk > 1 / ml

Suggested Standards

Total bacterial count < 50,000 / ml

3) Sterilized milk

BIS standards

Spore count: max. 5/ ml

Turbidity test: negative

Short Answer Type Questions

1. Write a list of common milk born bacterial infections
2. Write a list of common milk born milk intoxications
3. Write a list of common milk born viral infections
4. What are the milk born brucella organisms infect human beings
5. What are the toxins of Staphylo coccal poisioning with milk

Long Answer Type Questions

1. Write about Salmonellosis, Bacillary dysentery and Strepto coccal milk born infections
2. Write about Staphylo coccal, Coli poisoning and Cholera milk born infections
3. Write about brucellosis, listeriosis and fungal intoxication milk born infections
4. Write about microbial standards of raw and pasteurized milk.

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UNIT 11

ESTIMATION OF MICROBES IN MILK

Structure:

11.1 MBRT and RRT tests
11.2 Direct microscopic count
11.3 Standard plate count
11.4 Coliform count
11.5 Yeast and mould count

11.1 MBRT AND RRT TESTS

Methylene Blue Reduction Test:

The test is useful in assessing the bacteriological quality of milk by determination of the time taken for the reduction of methylene blue indicated by its colour change. The greater is the number of microorganisms in milk, the greater the metabolic activity and the faster is the reduction of methylene blue and vice-versa.

Procedure:

1. The samples of the milk are mixed thoroughly. If the milk is in a bottle/ sachet it shall be inverted at least 25 times by a rapid rotary movement of the wrist in order to mix the fat uniformly with the milk.
2. Pour the milk into a sterile beaker and transfer 10 ml of milk into a test tube with the help of a pipette.
3. To the contents in the test tube add 1ml of standard methylene blue solution and close the test tube with sterile rubber bungs.
4. Invert the test tubes twice to mix the milk and methylene blue solution.
5. Place the test tubes in the thermostatically maintained water bath at 37ºC±0.5ºC and note down the time of incubation.

6. Observe the test tubes after 30 minutes for reduction of dye (decolourization). If there is no de colurization the tubes are inverted once and transferred to water bath for further incubation.
7. After 30 minutes, at an interval of every one-hour continue to observe for the reduction of dye. The milk shall be regarded as decolorized when the complete column of milk is completely decolorized or is decolorized up to within 5mm of the surface.
8. Record the time of de colorization and tabulate the results as follows.

Sample no.	Time of starting	Time of decolourization	MBR time	Inference
1.				
2.				
3.				

Interpretation:

The quality of raw milk is judged by using the following specification

MBR Time(Hrs)	**Quality of raw milk**
5 and above	Very good
3 and 4	Good
1and 2	Fair
½ and below	Poor

Resazurin Reduction Test:

The principle of this test is same as that of methylene blue reduction test. However, unlike methylene blue, the resazurin dye undergoes reduction through a series of colour shades viz., blue, purple and lavender, pink before completely getting reduced to colourless. The reduction of the dye to a particular shade of colour is dependent upon the extent of depletion of oxygen by the metabolic activity of microorganisms. The colour change is measured with the help of a Levibond comparator and a standard colour disc.

Procedure:

1. The samples of the milk are mixed thoroughly. If the milk is in a bottle/sachet it shall be inverted at least 25 times by a rapid rotatory movement of the wrist in order to mix the fat uniformly with the milk.
2. Pour the milk into a sterile beaker and transfer 10ml of milk into each of two test tubes with the help of a pipette.
3. Add 1ml of working solution of resazurin to the contents of one of the test tubes and close the test tube with sterile rubber bungs. Resazurin is not added to the contents of second milk test tube, which is to serve as control.
4. Invert the test tubes twice to mix the milk and resazurin solution.
5. Place the test tubes in a thermostatically maintained water bath at 37ºC±0.5ºC and note down the time of incubation.
6. At the end of one hour of incubation, the test tubes are removed from water bath and color of contents is read with the help of Levibond comparator fitted with a standard resazurin disc. Place the control milk test tube in the left slot of the comparator and the milk tube with resazurin in right slot of the comparator. The control tube is used to compensate for the natural colour of milk.
7. Revolve the resazurin disc to match the colour of the milk in tube with one of the color standars of resazurin disc and record the disc number and tabulate the results as follows.

Sample no.	Time of starting	Resazurin disc number (after one hr of incubation)	Inference
1.			
2.			
3.			

Interpretation: the milk samples are graded by using following specifications:

Resazurin disc no	**Quality of raw milk**
4 or higher	Good
31/2 to 1	Fair
½ and below	Poor

11.2 DIRECT MICROSCOPIC COUNT

Direct microscopic count test is based on the microscopic examination of stained film of a measured volume of milk spread over a specified area on glass slides. The method is useful for a rapid estimation of the total bacterial population (both live and dead cells) of a sample of milk and also in giving useful information for tracing the sources of contamination of milk with bacteria.

In this test, milk smear is prepared on one square centimetre area and it is stained with a special stain called Newman's stain and examined under microscope. Each microscopic field examined represents a quantitative aliquot of the milk sample. The number of microscopic fields occurring in one square centimetre area of the milk smear will vary as the diameter of the microscopic field varies with each microscope. This necessitates the calculation of microscopic factor.

Procedure:

a) Determination of Microscopic Factor (MF):

1. Place the stage micrometer on the stage of the microscope and observe for the one mm scale on the stage micrometer with the low power objective.
2. Turn to the oil immersion objective after placing after placing a drop of oil on the scale of the stage micrometer without disturbing the focus area
3. Move the stage micrometer until one end of the scale is at the edge of the microscopic field.
4. Count the number of small divisions of 0.01mm present in the total diameter area of the microscopic field.
5. The area of the microscopic field is given by πr^2 where r is the radius of the microscopic field.

6. **Microscopic Factor(MF)** is calculated as follows:

$$MF = \frac{\text{Area of the smear (1sq.cm) X 1}}{\text{Area of microscopic field } (\pi r^2) \text{ X volume of milk}}$$

$$= \frac{100\text{sq.cm x } 1}{\pi r^2 \text{ x } 0.01}$$

$$= \frac{10000}{\pi r^2}$$

Preparation of milk film or smear:

1. Thoroughly mix the sample of milk by shaking and with the help of a sterile Breed's pipette draw milk to above graduation mark of the pipette.
2. Wipe the exterior of the pipette with a clean blotting paper and adjust the volume of milk exactly to0.01ml mark.
3. Toughing the tip of the pipette to the centre of the one sq.cm marked area on the slide, dispense the entire volume of milk on to the slide.
4. Spread the milk sample uniformly over the entire one sq.cm area on the slide with a sterilized platinum needle.
5. Allow the milk smear to air dry completely.

Fixing and staining the film:

1. Immerse the slide in Newman's stain (in a staining jar) for ½ to 1 minute. The slides may be washed gently with distilled water to remove excess stain. Allow drying of the smear in air or keeping the slide in an incubator.

Microscopic examination of stained film:

1. Place the slide with stained milk smear on the stage of the microscope and place a drop of immersion oil on the smear and examine under oil immersion.
2. Count the number of organisms (individual cells or clumps of cells) in a number of fields of film by examining under the oil immersion objective. The field for counting bacterial cells is selected at random.
3. The number of microscopic field occurring in one square centimetre area of the smear will be very high. So only a representative number of fields depending on the concentration of bacterial cells in a microscopic field are chosen for counting the bacterial cells.

4. The total number of field is counted as follows:

Number of clumps in a field	Number of fields to be counted
<0.5	50
0.5 to 1	25
1.0 to 10.0	10
10.0 to 30.0	5
>30	Dilute the sample of milk and repeat the test

5. Calculate the average number of clumps per field and multiply by microscopic factor to get the direct microscopic count per ml of milk.
6. Record the results and grade the milk by following the prescribed standard. Note down the type of organisms, arrangement of cells number of leucocytes in the milk smear for knowing the source of contamination.

Interpretation: the following standards are followed for assessing the bacteriological quality of milk samples.

Direct microscopic counts per ml	Bacteriological quality of milk
Less than 5,00,000	Very good
5,00,000 to 40,00,000	Good
40,00,000v to 2,00,00,000	Fair
Over 2,00,00,000	Poor

The examination of the smear also will be helpful in giving the information regarding the sources of contamination of milk.

Type of organisms	Source of contamination
1. Many cocci and rods in clumps and patches	Improperly cleaned milk utensils
2. Excessive number of rod shaped bacteria and spores	Exposure of milk to dust and dirt
3. Large number of cocci in pairs and short chains	Improper cooling of milk
4. Large number of leucocytes cells(over 500,000/ml) together with long chains of cocci	Mastitis infection

11.3 STANDARD PLATE COUNT

The standard plate count method is also called as pour plate technique or colony count test. It is useful in the estimation of viable micro organisms in the given sample of milk. The test employs the serial dilution technique for easy quantification of the organisms in view of a wide range of bacterial population that may occur in milk. The appropriate dilutions of the milk sample are mixed with a sterile nutrient medium that can support the growth of the organisms when incubated at suitable temperatures. Each bacterial colony that develops on the plate is presumed to have grown from one bacterium in the inoculums. The total number of colonies counted on the plates multiplied by the dilution factor is taken to represent number of viable organisms present in the sample.

This method has been widely used with satisfactory results and is particularly suitable where low bacterial population is expected. This method is especially useful for pasteurized milk and for line testing at various stages of processing and for detecting the sources of contamination.

Procedure:

a) **Preparation of dilutions of the milk sample:**

1. Mix the milk sample thoroughly and aseptically transfer 1ml of the sample with a sterile pipette to 9ml of dilution blank (1st dilution), which will make 1 in 10 dilution of the milk sample.
2. Take 1ml from 1st dilution and transfer to second 9ml dilution blank to get 1in 100 dilution. Mix thoroughly and transfer 1 ml from second dilution to third dilution blank to make 1 in 1000 dilution and so on till a series of required dilutions of the sample are ready. Use a fresh pipette for each successive dilution.

b) **Plating the sample and preparation of plates:**

1. Use a fresh pipette and transfer 1 ml of each required dilution into sterile Petri dish. Always plate the samples in duplicate.
2. To each Petri dish add 15 to 20 ml of sterilized plate count agar, which was previously melted and cooled to 45ºC.
3. Mix the contents of the plate thoroughly while the medium is still liquid, by gently rotating and tilting Petri dishes and allow the agar to cool and set.
4. Invert the plates and incubate at 37ºC for 48 hours.

c) Selection of plates and counting the colonies:

1. Select such plates of the dilution that would contain between 30 to 300 colonies.
2. Count the number of colonies with the aid of a colony counter and tally counter.
3. Determine the average of the counts in the two plates and multiply this by the dilution factor.
4. Express the results as standard plate count per ml of milk.
5. Record and tabulate the results in the following manner.

Sample dilution	**Counts in plates**		**Average**	**SPC/ml**	**Inference**
	Plate 1	**Plate 2**			

Interpretation: Raw milk is graded based on the following specifications

SPC/ ml	**Grade**
Not exceeding 2,00,000	Very good
2,00,000 to 10,00,000	Good
10,00,000v to 50,00,000	Fair
Over 50,00,000	Poor

11.4 Coliform count

Coli forms are gram negative, oxidase negative, non-spore forming rods which can grow aerobically or facultative in presence of bile salts or surface active agents with similar growth inhibitory properties and are able to ferment lactose with the production of acid and gas with in 48 hours at 37ºC. Their presence in milk or milk products is indicative of possible faecal contamination and is found especially when they are handled under unsanitary conditions. The presence of these organisms is considered un desirable because they produce acid, gas and objectionable taints in the milk products. Generally coliform organisms are destroyed during pasteurization. Their presence in pasteurized milk indicates post pasteurization contamination.

The test is chiefly based on the principle that the members of these group are capable of producing acid and gas from lactose in the presence of bile salts. Presence of typical coliform colonies in Petri plates is taken as evidence of Coliform contamination.

Procedure:

1. Prepare the serial dilutions of milk sample using aseptic method. Usually 1:10and 1:100 dilutions of raw milk and 1:10 dilutions of pasteurized milk.
2. Pour 1ml of appropriate dilutions into previously labelled sterile Petri dishes (in duplicates). Prepare separate sets of Petri dishes both for raw and pasteurized milk.
3. Pour about 15 to 20 ml of sterile Mac Conkey's agar into the Petri dishes and mix the contents.
4. Allow the agar to solidify and pour additional layer of media (3 to 4ml) to completely cover the surface of solidified medium in order to inhibit the surface colony formation.
5. Invert the plates and incubate at 37ºC for 48 hours.
6. Examine the plates for typical colonies of coloiforms. Dark red colonies measuring atleast0.5mm in diameter constitute a positive coliform test. Count these colonies and express as total coliform count per ml of milk.
7. Record results as follows:

Sample	**Dilution**	**No. of colonies**		**Average coliform count/ml**	**Inference**
		Plate 1	**Plate 2**		
1					
2					

Inference:

Absence of coliforms in 1:100 dilution (less than 100 per ml) in raw milk and in 1:10 dilution (less than 10 per ml) of pasteurized milk is accepted as criterion of satisfactory quality.

11.5 Yeast and mould count

Procedure:

a) **Preparation of dilutions of the milk sample:**

1. Mix the milk sample thoroughly and aseptically transfer 1ml of the sample with a sterile pipette to 9ml of dilution blank (1st dilution), which will make 1 in 10 dilution of the milk sample.
2. Take 1ml from 1st dilution and transfer to second 9ml dilution blank to get 1in 100 dilution. Mix thoroughly and transfer 1 ml from second dilution to third diution blank to make 1 in 1000 dilution and so on till a series of required dilutions of the sample are ready. Use a fresh pipette for each successive dilution.

b) **Plating the sample and preparation of plates:**

1. Use a fresh pipette and transfer 1 ml of each required dilution into sterile Petri dish. Always plate the samples in duplicate.
2. To each Petri dish add 15 to 20 ml of sterilized Potato dextrose agar, which was previously melted and cooled to 45ºC.
3. Mix the contents of the plate thoroughly while the medium is still liquid, by gently rotating and tilting Petri dishes and allow the agar to cool and set.
4. Invert the plates and incubate at 21 to 25ºC for 48hours.

c) **Selection of plates and counting the colonies:**

1. Select such plates of the dilution that would contain between 20 to 200 colonies.
2. Count the number of colonies with the aid of a colony counter and tally counter.
3. Determine the average of the counts in the two plates and multiply this by the dilution factor.
4. Express the results as standard plate count per ml of milk.
5. Record and tabulate the results in the following manner.

Sample dilution	Counts in plates		Average	Y&M/ml	Inference
	Plate 1	Plate 2			

Interpretation: Raw milk is graded based on the following specifications

Yeast&Mould/ml	Grade
1 to 20	Good
21 to 50	Fair
51 to 100	Poor
Above 100	Very poor

Short Answer Type Questions

1. What is the use of MBRT test
2. What is the use of Direct Microscopic Count test
3. What is the purpose of Standard Plate Count
4. What is the purpose of Coliform count
5. What is the purpose of the RRT test

Long Answer Type Questions

1. Write the procedure of MBRT test
2. Write the procedure of Standard Plate Count
3. Write the procedure of Coliform Count
4. Write the procedure of Direct Microscopic Count test

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LIVESTOCK MANAGEMENT AND DAIRYING

Paper – III

Paper III : Milk Processing & Milk Products

INDEX

Unit 1 :	**Milk Reception**	**310**
Unit 2:	**Filtration and Cream separation**	**319**
Unit 3:	**Heat Treatment to milk**	**326**
Unit 4:	**Cleaning and Sanitization**	**336**
Unit 5:	**Liquid Milks**	**343**
Unit 6:	**Fat rich milk products**	**348**
\ Unit 7:	**Ice cream**	**365**
Unit 8:	**Fermented milk products**	**379**
Unit 9:	**Concentrated and Dried milks**	**405**
Unit 10:	**Indigenous milk products**	**428**
Unit 11:	**Packing and storage of milk products**	**442**

UNIT 1

Milk Reception

Structure:

1.1 Milk collection and transportation

1.2 Methods of Milk preservation

1.3 Milk Reception at Dock (Unloading, weighing, sampling, grading, dumping)

1.4 Milk chilling methods and storage

1.1 Milk collection and Transportation

Collection of milk: Milk production is confined to rural areas while market demand is more in urban and city areas. Hence, milk is collected from rural milk producers in the milk shed area and transported to processing and distribution points in towns and cities.

A milk shed are is the geographical area from which a city dairy receives its fluid milk supply.

A) The common systems for collection of milk are as follows:

1. By co-operative organizations formed by individual or collective milking societies. This is suitable to the milk producers because no profit making middlemen are involved in this system.
2. By contractors: Less return to producers.
3. By individual producers: Practical for those situated near processing dairies.

B) Milk collection cum chilling centres/depots are normally attached to city dairies. These are to preserve the quality of raw milk supplies, and to provide easy transport to the processing dairy.

Location of milk collection cum chilling centre: This is guided by

- Adequate milk production
- Adequate (potable) water supply
- Proximity to a good road or railway station
- Electric supply
- Sewage disposal facilities

Major items of equipment

a. Milk weigh tank/pan and weighing scale
b. Drop (dump) tank with cover
c. Can washer
d. Milk pump (sanitary type)
e. Surface/plate cooler
f. Refrigerating unit (of suitable capacity7)
g. Cold room (of suitable capacity)
h. Milk testing unit, etc.

Operational procedure: Essentially this is the same as a in a small dairy. On arrival, the milk is graded for acceptance/rejection, weighed, sampled for testing, cooled and stored at a low temperature until dispatch to the processing dairy.

1.2 Methods of Milk preservation

1. Corrosive sublimate or mercuric chloride

Only a small amount is required, as this chemical is highly poisonous. A dye is used along with it to identify the sample as the one preserved with mercuric chloride. Because of health hazard, it is not used as a preservative now a days.

2. Formalin (Formaldehyde 40% by volume; 36% by weight)

Add 0.1 ml of formalin to 30 ml of milk sample. Use this method for samples intended for fat testing in milk. Since it is in liquid form, it is very convenient to handle. Only objection against the use of formalin is that it causes hardening of casein in milk, and hence proteins are not easily digested by sulphuric acid.

3. Potassium dichromate

This is the most commonly used milk preservative. It is cheap and safe. It gives a bright yellow colour to milk. Normally, 150 mg of potassium dichromate is used for 100 ml of milk.

4. Bromo – 2-nitro propane-1-3-diol (Bronopol)

Use one tablet (containing 10 mg of actual ingredient) or 0.05 ml (containing 20% actual ingredient) per 50 ml sample.

1.3 Milk Reception at Dock

The operation of receiving milk may be subdivided into Unloading, Weighing, Sampling, Grading and Testing.

1) Unloading: The truck carrying the filled milk cans is brought aside to the unloading platform. The milk cans are then unloaded manually. The milk cans are then assembled for grading in a definite order, according to each supplier, viz. the contractor or patron. If a milk tanker is used, it is first properly positioned so that pipe fitting connections can be made conveniently in the Tanker bay.

2) Grading: It is well known that the quality of the finished product depends on that of the raw material used. This refers to the classification of milk on the basis of its quality, for price-fixation. The milk grader is the key man for the proper selection of milk. The principle of grading is based on organoleptic (sensory) tests such as those for appearance, smell (odour), and taste. Acidity, sediment test etc. are included under platform tests.

Note - The term **'Platform Tests'** includes all tests which are performed to check the quality of the incoming milk, to decide regarding its acceptance/rejection. They are performed on each can/tanker of milk with the objective of detecting milk of inferior or doubtful quality, preventing it from being mixed with high grade milk.

The technique of grading milk is as follows:

Milk tanker (road/rail): The grading has already been done at the milk collection-cum-chilling centre. As milk is chilled (< 5°C), it is not possible to detect off-odours. The appearance is noted, as testing of raw milk is usually avoided. After thoroughly mixing it for 5-10 min, a sample is taken for laboratory testing.

Milk can: The main tests applied to each can of milk consist of appearance, smell and temperature (touch); other tests such as taste (seldom carried out with raw milk) and sediment might be used to substantiate the initial findings. Tests involving time, laboratory facilities and special techniques are done by the quality control technician, for which a sufficiently large sample is taken.

Platform tests to be conducted for milk

Appearance: Observing each can of milk for any floating extraneous matter, off color, or partially churned milk. The milk should be normal in colour, free from churned fat globules and reasonably free from any floating extraneous material.

Smell (Odour): This furnishes an excellent indication of the organoleptic quality of milk that can be ascertained quickly (in seconds). In making the test, the cover of each can is removed, inverted and raised to the nose. The headspace in milk can is smelled. By replacing the lid and shaking the can vigorously, the test may be repeated. An experienced milk grader with a 'trained nose' decides the acceptance/rejection of the milk. The milk should be free from any off flavours.

Temperature: The temperature at which milk is delivered is often an indication of its quality. A daily check on the temperature of milk is helpful in keeping check on the quality of milk. With practice, the grader can tell with a high degree of accuracy whether the milk is sufficiently cold by touching the side of the can. A temperature of 5°C or below is satisfactory.

Sediment test: It shows the visible foreign matter contained in the milk. A low sediment is desirable. Sediment test is performed to judge the cleanliness of milk. There is no correlation between the amount of sediment and the bacteriological quality of milk. Measured quantity of milk is filtered or centrifuged and checked for sediment. A good quality milk gives no visible dirt whereas poor quality milk shows dark or blackish deposits on the filter pad. The milk is graded for its quality on the basis of BIS standards.

Acidity: 'Natural' or 'apparent' acidity of milk is desirable which does not adversely affects its heat stability. However, 'developed acidity' (Natural + Developed = Titratable acidity) adversely affects the quality of milk which cannot be processed in pasteurizer.

Lactometer reading: The addition of water to milk results in lowering its density. Hence, this test is applied for detection of adulteration of milk with water. The reading for cow and buffalo milk should be about 28 to 30 and 30 to 32 respectively, when measured at 15.5°C.

3) Sampling: While strict precautions regarding sterility of the stirrer, sampler, container etc. are required for obtaining a bacteriological sample; dryness and cleanliness of the above equipment should be sufficient for a chemical sample. The first pre-requisite of sampling is thorough mixing of milk. This can be done with a plunger or stirrer (agitator), operated manually or mechanically for milk contained in cans or tankers, as the case maybe. With the former, a representative sample may

be taken after dumping the milk in the weigh tank, whereby it gets mixed in so thoroughly that a representative sample may be taken without further mixing.

Samples may be individual, composite (mixture of two or more individual lots of milk), drip (representing the entire day's supply), etc. Samplers may be dipper-tube or proportionate (also known as milk thief), automatic vacuum, drip etc.

The composite milk sample should not be spoiled by the time it is analyzed. This is accomplished by use of a preservative. It is better to place the preservative in an empty bottle before milk is added. A wide mouthed glass bottle with a rubber stopper is suitable for keeping composite samples of milk or cream. The common preservatives used are as follows:

Mercuric chloride or corrosive sublimate: This is very poisonous. It may be added in the form of tablets, which are coloured (usually bright red) to avoid the milk to be mistaken for food for consumption.

Formalin: This is a 40% solution of formaldehyde. Being liquid it is very convenient to handle. However, it interferes with the fat test.

Potassium dichromate: This is not as effective as the above two, but is easy to handle in dairy plants because it is available in tablet form.

Note - The composite samples should be stored in a cool place away from direct sunlight. Each bottle should be properly labeled.

4) Weighing: This is an essential step in accounting for milk receipts, disposal and making payments for milk. The milk from cans is dumped into the weigh tank, either manually or mechanically. The tank is mounted on scales and the scale dial set at zero when the tank is empty. Automatic printing of the weight is now becoming a practice.

The milk in tankers (road or rail) may be measured by volume by passing it through a flow meter, and its measurement converted into weight by multiplying volume with density ($m = d \times v$). In case of road milk tankers weigh bridge can be used to determine its weight (weight of tanker when full – weight when empty).

5) Testing: Further testing is needed in case of 'doubtful quality' prior to its acceptance for processing. The Quality control laboratory of the dairy plant performs the requisite analyses. A record of the chemical and bacteriological quality of all accepted milk has to be maintained for making payments and for ISO records. (For testing methods, refer Bureau of Indian standards: BIS: 1479, (Part-I), 1960, (Part-II), 1961, (Part-III), 1962).

Quality control tests for milk:

S.no	Name of the test	Purpose	Remarks
1.	Clot-on-boiling (COB)	To find out the heat stability of milk	Applied as a platform test
2.	Acidity	To determine final acceptance/rejection of milk.	Applied as a platform test
3.	Alizarin alcohol	To find out the heat stability and pH of milk.	Applied as a platform test
4.	Lactometer	To detect adulteration of milk with water	Applied as a platform test
5.	Resazurin Reduction test	To find out the bacterial contamination and growth in milk	2 minutes RRT as a platform test
6.	Direct microscopic count (DMC)	To identify the types of micro-organisms present in milk.	Applied as a Lab. test
7.	Standard plate count(SPC)	To find out the bacterial contamination and growth in milk	Applied as a Lab. test
8.	Fat and SNF	To make payment for milk	Applied as a Lab. test

1.4 Milk chilling methods and storage

Milk contains some micro-organisms when drawn from the udder, their numbers increase during subsequent handling. The common milk organisms grow best between 20 and 40 °C. Bacterial growth is invariably accompanied by deterioration in market quality due to development of off-flavours, acidity etc. One method of preserving milk is by prompt cooling to a low temperature. Freshly drawn milk should be promptly cooled/chilled to 5 °C or below and also held at that temperature till processed.

Importance of Chilling/ cooling

- Chilling of milk means rapid cooling of raw milk to sufficiently low temperature so that the growth of micro-organisms present in milk is checked. In chilling process the temperature of milk should be reduced to less than 10 degrees Celsius preferably 3 - 4 degree Celsius.
- Various sources which contribute to the micro flora in milk are containers, udder of the animal, dust and dirt particles, fodder, leaves, atmospheric air, the milker and the animal itself. As soon as microorganisms get into the milk, they start growing rapidly because milk contains all the nutrients required for their growth, and the conditions for their growth are favourable.
- If the growth of microorganisms is not checked then their growth will continue and several biochemical changes will take place in milk. Due to these changes the quality of milk is adversely affected so much so that sometimes milk becomes unfit for consumption as fluid milk.
- Keeping quality of raw milk is very low as most of the milk is produced in the rural areas under unhygienic conditions and atmospheric temperature remains fairly high throughout the year.
- If milk has to be transported to longer distances, considerable time is involved between production and heating process. During this period milk must be protected from spoilage by the action of microorganisms.
- Chilling is considered necessary soon after the milk is received at the chilling centers. The most effective means of controlling the growth of microorganisms without affecting the physico-chemical properties and nutritive value of milk is to chill it.
- Lower temperatures inhibit the growth of most of the microorganisms. It is only a means of checking the growth of microorganisms for some time.

Methods of chilling

1. In can or can immersion method: The milk is directly poured into cans through a strainer.
   When the can is full it is gently lowered into a tank of cooling water.
   Advantages: The milk is cooled and it also stays cool. A much smaller mechanical refrigeration unit is required.

2. Surface cooler:

This may be plain-conical, spiral or horizontal-tubular in shape. The milk is distributed over the outer surfaces of the cooling tubes from the top and flows down in a continuous thin stream. The cooling medium mostly chilled water is circulated in the opposite direction through the inside of the tubes. The cooled milk is received below in a receiving trough from which it is discharged by gravity or pump.

Advantages: It transfers heat rapidly and efficiently. It is relatively inexpensive and also aerates the milk, thus improving its flavour.

3. Tubular coolers: For continuous cooling, it consists of stainless steel tube about 2.5 to 5.0 cm in diameter surrounded by a similar tube, forming a concentric cylinder. Several such tubes connected in series to obtain sufficient cooling. The cooling medium flows counter to the milk flow.

Advantages:

- Cooling is quite efficient
- Not exposed to air-borne contamination
- No evaporation losses

4. Plate Cooler: To maintain the quality of milk received in the Dairy/Chilling center, it is chilled to 4°C by milk chiller. The chiller consists of number of thin, flat, grooved, stainless steel plates sealed at the edges with a gasket and clamped tightly within a press. Chilling is done by flowing milk from one side and chilled water from other side of the plates.

Advantages:

- Cooling is quick and efficient.
- Not exposed to air-borne contamination.
- No evaporation losses.
- Cleaning and sanitization are easy.

5. In tank or bulk tank cooler: It is used extensively in developed countries. These are run by mechanical refrigeration systems. These will cool the milk rapid to a low temperature (5 °C or below) and maintain this temperature during the storage period.

Advantage: It helps in collection of produced milk on alternate days.

Storage of milk: Modern milk plants hold both raw and pasteurized milk for a much longer period. It allows a more uniform work-day for processing and bottling operations with less dependence on the time for receiving raw milk. Storage tanks are used for the storage of raw, pasteurized or processed milk in dairy plants. Types of milk storage tanks are insulated or refrigerated tanks, Horizontal or Vertical tanks and rectangular, cylindrical or oval tanks.

Short answer type questions:

1. What is milkshed area
2. What are the common systems for collection of milk
3. What are the requirements for locating milk collection/ chilling centre.
4. What are different chemicals used for milk preservation.
5. What is the importance of lactometer reading

Long answer type questions:

1. What are the various platform tests and quality control tests for milk.
2. Write about the various operations at milk reception dock in a dairy plant.
3. Explain the importance of chilling and different methods of milk chilling.

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UNIT 2

FILTRATION AND CLARIFICATION

Structure:

2.1 Milk filtration method
2.2 Milk clarification
2.3 Cream separation methods
2.4 Cream separator-parts and arrangement of parts
2.5 Factors affecting efficiency of cream separator
2.6 Milk standardisation for Fat and SNF procedure

2.1 Milk filtration method

It will improve the aesthetic quality of milk by removing visible foreign matter.

Filtration removes suspended, foreign particles by the straining process. Clarification removes same by centrifugal sedimentation. There are two types of filters/clarifiers, viz., those that operate with cold milk and those operate with warm milk. While the later is commonly used throughout the world.

2.2 Milk clarification

Clarifiers are quite similar to centrifugal cream separators. The main differences are (i) in clarifiers, there is only one outlet, while in separators there are two one for cream and another for skim milk. (ii) The discs in the clarifier bowl are smaller diameter than separators, and (iii) the milk distribution holes are at the outer edge of the discs in clarifiers, but near the centre in separators.

Location of filter/clarifier in the processing line: It is the practice to locate the filter in the raw milk lines before the milk enters the pasteurizing plant, in others the filter is located at a convenient point in the regeneration section where the temperature of the milk may be 50-60 °C.

The clarifier may be located in one of the following places

Location	Type of clarification
Between Reception and storage tank	warm
Storage tank pasteurizer	cold

Pre heater and pasteurizer	warm
Regeneration and heating section of HTST	warm
Heating section and holding tube of HTST	warm

Clarification removes sediment much more efficiently than filtration. Clarifiers remove still finer particles that escape filters.

The material retained on the filter cloth includes suspended foreign particles, milk fat, protein and some leucocytes and bacteria. The slime that accumulates in the clarifier bowl consists of foreign matter, milk proteins, leucocytes, fragments of secreted cells from udder, fat, calcium phosphate and other ash, bacteria and occasionally red blood corpuscles. The removal of clarifier slime does not affect the composition of milk to a significant extent. The loss in solids resulting from clarification is usually 0.01per cent or less.

Both filtration and clarification tend to decrease the depth of the cream layer that will form on milk. Neither filtration nor clarifications improve the keeping quality of milk. Milk should neither filtered nor clarified after pasteurization, as this might contaminate it.

2.3 Cream separation methods

The basic principle of cream separation, whether by gravity or centrifugal methods, is based on the fact that milk fat is lighter than the skim milk portion. At 16ºC (60ºF), the average density of milk fat is 0.93 and skim milk 1.036. Hence when milk, which may be considered to be a mixture of fat(as cream) and skim milk, is subjected to either gravity or centrifugal force, the two components viz, cream and skim milk, by virtue of their differing densities, stratify or separate from one another. Cream is obtained from milk by either gravity or centrifugal methods.

Gravity method

When milk is allowed to stand for some time, there is tendency for the fat to rise. The important factors that effect the rate of rise of cream in gravity method are:

1. Size of fat globules: Larger fat globules rise rapidly than smaller one

2. Temperature: As temperature increases, viscosity decreases and velocity increases.

3. Clumping: It increases the values of ‘r’ thus increase the velocity.

4. Addition of adhesives: Ultimately helps in increasing the rate at which fat globules rise.

Gravity methods, being very slow, are no longer used commercially for cream separation.

Centrifugal methods: It is used commercially.

When milk enters the rapidly revolving bowl of cream separator, it is immediately subjected to a tremendous centrifugal force, which is 3000 to 6000 times greater than gravitational force.
Both fat and skim milk are subjected to centrifugal force. The difference in density affects the heavier portion that is skim milk more intensely than lighter portion that is cream. Thereby the skim milk is forced to the periphery while the fat portion moves towards the centre. The skim milk and cream both from vertical walls within the bowl and are separated by being led through separate outlets. The cream outlet is at a higher level than the skim milk outlet, both being near the axis of rotation.

Characteristics of gravity and centrifugal creaming methods

Particulars	Gravity method	Centrifugal method
Nature of force causing separation	Gravitational	Centrifugal
Speed of separation	Extremely slow	Practically instantaneous
Direction of movement of fat and skim milk particles	Vertical	Horizontal
Bacteriological quality of cream and skim milk	Low	High
Fat per centage of cream	10-25	18-85(can be controlled)
Skim milk	0.2 or above	0.1 or below
Scale of operation	Small	Large
Fat percentage recorded in cream	Not more than 90	99-99.5

2.4Cream separator-parts and arrangement of parts

The modern centrifugal cream separator consists of

I. A bowl which can be rotated at a high speed (5000-6000rpm) by means of suitable gears and power transmission mechanism.
II. Arrangement for supplying milk to the bowl.
III. Removing the cream and skim milk.
IV. Removing the cream and skim milk.

I) Bowl parts

1. Rubber ring or Gasket**:** It fits in the bottom of the bowl base and makes the bowl leak proof.
2. Distributor: It distributes the milk into the three notches at the bottom periphery.
3. Bottom disc: It is different from the rest of the disc. It has projections on the outer as well as on inner surface and has three holes. It is also called as separating disc.
4. Intermediate discs**:** they are more in number. They are similar to the bottom disc expect that these discs do not have projections on inner side. They have projection on the outer periphery only. These discs have three holes. The increased number of discs increases the efficiency of

separation.

5. Top disc: This is very important part of the bowl. This is also called as separating or dividing disc. The connection between the skim milk and skim milk outlet is made possible by this disc. The disc has an outlet for the cream in its neck. During separation the cream near the axis of the bowl oozes out from the cream outlet. This disc has screw at its neck. The thickness of cream can be adjusted by adjusting this screw.
6. Bowl Hood: It fits over the top and covers the whole bowl parts.
7. Bowl spanner: Its function is to tighten the bowl nut.

II) Arrangement for Supplying Milk to the Bowl

1. Supply can: It holds the milk to be separated.
2. Faucet: It is used for allowing the flow of milk from the supply can into the bowl.
3. Regulator: It regulates the flow of milk into the bowl.
4. Float: It allows only a definite quantity of inflow of milk into the bowl, through the regulator.

III) Removing of Cream or Skim Milk

1. Skim milk outlet**:** The skim milk from the bowl moves between the dividing disc and inside wall of the bowl. At the top, space is provided between to disc and bowl hood, which connects with the skim milk outlet. The skim milk is let out through this cover.
2. Cream outlet**:** The cream coming out from cream screw located on the top disc is trapped in the cream cover and is let out.

IV)Driving the Machine

1. Spindle rod: The bowl rests on the spindle rod. The spindle rod has a suitable gear which is engaged with crank gear.
2. Handle: The machine is revolved with the crank handle at the speed indicated the manufactures. Generally 60-70 revolutions per minutes are sufficient to develop the speed.

2.5Factors affecting the efficiency of cream separator

- **Temperature of milk:** The lower the temperature, the higher will be the fat loss in skim milk, and vice versa. For efficient separation, the temperature of milk should be above melting point of fat, so that the milk fat in the fat globules is entirely in liquid form. A satisfactory temperature for separation is around 40 ºC (104 ºF).
- **Speed of bowl:** The lower the speed, the higher will be the fat loss in skim milk, and vice versa. At below rated speed there will be more fat loss in skim milk because insufficient centrifugal force is generated for efficient cream separation.

- **Rate of milk inflow:** The higher the rate of inflow, the higher will be the fat loss in skim milk, and vice versa. If the rate of inflow is increased above the designed capacity of the separator, the milk passes through the bowl too rapidly to allow for complete separation, thereby resulting in higher fat loss in skim milk.
- **Position of the cream screw:** If up to 50 per cent cream is present, there is little effect on the fat test of skim milk; where there is 50-60 per cent cream, there is greater fat loss in skim milk; if above 60 per cent of cream is obtained, still higher fat loss in skim milk at low temperature separation result. A good separator is designed to give efficient skimming within a fairly wide range of positions of the cream screw, so that the fat test of the cream can be varied without influencing the efficiency of skimming.
- **Mechanical condition of the machine:** Unsatisfactory mechanical condition of the cream separator causes greater fat loss in skim milk.
    - Vibration of the separator reduces the efficiency of separation by disturbing the counter- currents of cream and skim milk. Vibration is caused by installation on an insufficiently firm foundation, the bowl being out of balance, bearing being worn out, the axis of rotation not exactly vertical, etc.
    - If discs are in an unsatisfactory condition, a loss of skimming efficiency due to the un even flow of the counter current streams of cream and skim milk between them. An un-satisfactory disc is one which is out of shape, dirty, scratched or rough.
    - If too much slime accumulates, the fat loss in skim milk increases. This is caused not only by a disturbance in the even flow of the counter –currents of cream and skim milk, but by reduction in the centrifugal force because of decrease in the ‘effective’ diameter of the bowl.
- **Size of fat globules:** The greater the number of fat globules of less than 2 micron size, the higher the fat loss in skim milk and vice versa. Fat globules of less than 2 micron size usually enter the skim milk, as they are not subject to sufficient centrifugal force to be recovered in the cream. Hence, the greater the number of less than 2 micron size globules, the greater is the fat loss in skim milk.
- **Degree and temperature at which milk is agitated before separation:** The higher the degree and temperature of agitation, the greater the loss in skim milk and vice versa.

Agitation of hot milk causes the disintegration of the normal fat globules in to smaller ones which escape the effect of centrifugal force, thereby leading to more fat loss in skim milk.

- **Presence of air in milk:** The greater the amount of air, the higher the fat loss in skim milk. If the milk delivered to the separator contains entrapped air bubbles, separation of air as a consequence of centrifugal force disturbs the counter-current streams of cream and skim milk between the discs, and lowers the efficiency of separation.
- **Acidity of milk:** The higher the acidity, the lower the stability of casein particles, which in turn get precipitated and clog the bowl, thereby, lowers the efficiency of separation.

2.6 Milk standardisation for Fat and SNF procedure

Standardization of milk refers to the adjustment, i.e. raising or lower of the fat and /or solids-not-fat percentage of milk to a desired value, so as to conform to the legal or other requirements prescribed.

Milk is standardized by the addition of milk or cream with higher or lower fat percentage than that of the material to be standardized. Sometimes addition of skim milk will solve the problem. It is necessary to find the relative amounts of the original material and the standardizing material to be mixed together to give a product with the desired fat content. Once these relative amounts have been determined, it is easy to calculate the exact amount of each which must be mixed together to give a certain weight of the finished product or exact amount of standardizing material needed to use up a given weight of milk or cream.

A simple scheme, the Pearson's Square, can be used to calculate the relative quantities of the materials involved in a standardization problem. It should be remembered that all measurements based on the calculations are by weight not by volume.

Pearson's Square method: Draw a square and place in the centre of it the fat percentage desired. Place at the left- hand corners of the square the fat percentage of the materials to be mixed. Next, subtract the number in the centre from the larger number at the left-hand side of the square and place the remainder at the diagonally opposite right-hand corner. Subtract the smaller number on the left-hand side from the number in the centre and place the remainder at the diagonally opposite right-hand corner. The numbers on the right-hand side now represent the number of parts of each of the original materials that must be blended to make a product with a fat test given by the number in the middle of the square. The number at upper right corner refers to the parts of material whose fat test was placed at the upper left corner, and number at the lower right corner refers to the parts of material whose fat test was placed at the lower left corner. If the numbers on the right added, the sum obtained will represent the parts of the finished product, with the fat test given by the number obtained in the middle of the square.

Example:

Problem1. How many parts by weight of 40% cream and 3% milk must be mixed to make milk testing 5% fat?

Solution:

Hence, 2.0 parts of 40% cream when mixed with 35 parts of 3.0% milk will give 37 parts of 5% milk.

Problem II. How many kg each of 28% cream and 3% milk will be required to make 500 kg of a mixture testing 4%fat?

1:25.0 = C:500, Where C is cream required in kg

Or 1/25 =C/500 or C=500/25 = 20 kg

Milk (3%) = 500-20 = 480 kg

Proof:

500 kg of 4%milk contains 500x4/100 =20 kg fat

20 kg of 28% cream contains 20x28/100 =5.6 kg fat

480 kg of 3% milk contains 480x3/100 = 14.4 kg fat

14.4+5.6=20 kg

Short answer type questions:

1. What is the principle of milk filtration.
2. What is the principle of cream separation.
3. What is the importance of top disc in cream separator.
4. Explain standardisation of milk.
5. What are the factors affecting the rate of rise of cream in gravity method.

Long answer type Questions:

1. Write about the various parts of centrifugal cream separator
2. Enumerate the factors affecting the efficiency of cream separation
3. Write in brief about centrifugal method of cream separation
4. Write about the arrangement of various parts in cream separator.

Ψ

UNIT 3

HEAT TREATMENT OF MILK

Structure:

3.1 Pasteurisation-definition-objectives, advantages and disadvantages

3.2 Types of Pasteurisation

3.3 Batch Pasteurisation

3.4 HTST Pasteurisation

3.5 UHT Pasteurisation

3.6 Sterilisation of Milk

3.7 Homogenisation of milk – Definition, advantages and disadvantages

3.8 Packing of Milk (Pre Pack) and storage

3.1Pasteurisation-definition-objectives, advantages and disadvantages

The term “**pasteurization”** refers to the process of heating every particle of milk to at least 63 ° C for 30 minutes, or 72 ° C for 15 seconds or to any temperature- time, which is equally efficient, in approved and properly operated equipment. After pasteurization the milk is immediately cooled to 5 ° C or below.

Objectives(Purpose):

- To render the milk safe for human consumption by destruction of cent per cent pathogenic microorganisms.
- To improve the keeping quality of milk by destruction of almost all spoilage organisms (85-99 per cent).

3.2 Types of Pasteurisation

1. In the bottle pasteurization
2. Batch or holding pasteurization(LTLT)
3. HTST
4. Electric pasteurization
5. Vaccum pasteurization
6. Stassinization
7. UHT pasteurization
8. Flash pasteurization
9. Uperization

3.3 Batch Pasteurisation

This is also called the low-temperature–long time–method **(LTLT)**. The milk is heated to 63 ° C/145 ° F for 30 minutes and promptly cooled to 5 ° C or below. In this system, the heating is done indirectly. The heat moves through a metal wall into the product for heating, and out of the product for cooling.

The pasteurizers of LTLT may be of three types:

Water-jacketed vat:

- This is double walled around the sides and bottom in which hot water or steam under partial vacuum circulates for heating and cold water for cooling. The outer wall (lining) is usually insulated to reduce heat loss. The heat exchange takes place through the wall of the inner lining. The difference between the temperature of the heating water and the milk is kept to a minimum. The milk is agitated by slowly moving paddles or propellers. When heating, the vat cover is left open for escape of off-flavours, and when holding, the cover is closed. During the holding period, an air space/foam heater (steam or electrically heated) prevents surface cooling of milk.
- Advantage: Flexibility in use (It is also known as a multipurpose or multi-process vat).

Water-spray type:

- A film of water is sprayed from a perforated pipe over the surface of the tank holding the product. The product is agitated as water-jacketed vat type. A rapidly moving continuous film of water provides rapid heat transfer.

Coil-vat type:

- The heating /cooling medium is pumped through a coil placed in either a horizontal or vertical position, while the coil is turned through the product. The turning coil agitates the product.
- Disadvantage: Coils are difficult to clean, which accounts for the decline in their use.

3.4 HTST Pasteurisation

It is the modern method of pasteurizing milk and is invariably used where large volume of milk is handled. The HTST pasteurizer gives a continuous flow of milk, which is heated to 72 ° C (161 ° F) for 15 seconds and cooled promptly to 5 ° C or below.

Advantages of HTST Pasteurization:

- Capacity of the equipment to heat treat the milk can be done quickly and effectively, while maintaining the quality control over both the raw and finished product.
- Less floor space is required
- Lower initial cost
- Milk packaging can be started as soon as pasteurization begins thus permitting more efficient utilization of labour for packaging and distribution.
- Easily cleaned and sanitized, this system adopts itself well to CIP-cleaning.
- Lower operating cost (due to fullest use of regeneration).
- Pasteurization capacity can be increased at nominal cost.
- Reduced milk losses.
- Development of thermophiles is not a problem.
- The process can be interrupted and quickly restarted.
- Automatic precision controls ensure positive pasteurization.

Disadvantages of HTST Pasteurization:

- This system is not well adopted for small quantities of several liquid milk products.
- Gaskets require constant attention for possible damage and lack of sanitation.
- Complete drainage is not possible.
- Margins of safety in products sanitary control are so narrow that automatic control precision instruments are required in its operation.
- Pasteurization efficiency of high thermo duric count raw milk is not as great as it is when the holder system is used.
- Greater accumulation of milk stone in the heating section (due to higher temperature of heating).

HTST Pasteurisation

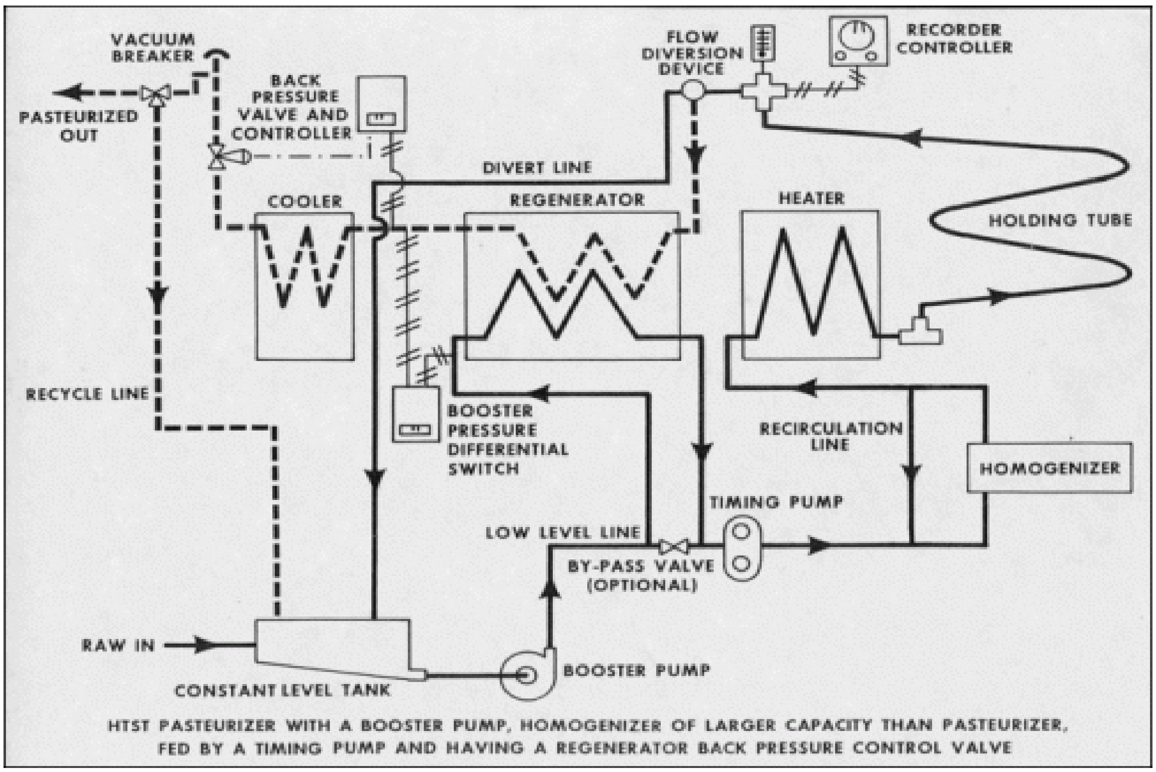

Fig.3.1 HTST Pasteurizer

Milk flow:

The following steps or stages are involved as milk passes through the HTST pasteurization system: float controlled balance tank (FCBT), pump, regenerative heating, heating, holding, regenerative cooling, and cooling by chill water or brine. An arrangement for incorporation of the filter / clarifier, homogenizer, etc., in the circuit is also made when desired.

Functions of the important parts:

i. **Float controlled balance tank (FCBT):** Maintains a constant head of milk for feeding the raw milk pump; also receives any sub-temperature milk diverted by FDV.

ii. **Pump:** Either a rotary positive pump between the regenerative heating section and heater or a centrifugal pump with a flow control device to ensure constant flow, after FCBT is used.

iii. **Plates:** The plate heat exchanger, also called Para flow is commonly used in the HTST system, especially for heating to temperatures which are below the boiling point of milk. The Para flow is a compact, simple, easily cleaned and inspected unit. Its plate may be used for heating, cooling, regeneration, and holding. These plates are supported in a press between a terminal block in each heating and cooling medium. The heat moves form a warm to cold medium through stainless steel plates. A space of approximately 3-mm is maintained between plates by a non-absorbent rubber gasket. These plates are designed to provide a uniform turbulent flow of product with rapid heat transfer. Corrugations on the plate in the form of knobs, diamonds, and channels, help to provide the turbulent action required.

iv. **Regeneration (heating):** The raw (cold) incoming milk is partially and indirectly heated by the hot outgoing milk (milk-to-milk regeneration). This adds to the economy of HTST process as the incoming milk requires less heating by hot water to raise its temperature for holding. For example,

- Milk entering at 4ºC
- Heated in regenerator to 34ºC
- Heated in heating section to 74ºC
- Cooled in regenerator to 44ºC
- Cooled in cooling section to 4ºC

Here, the increase from 4ºC to 34ºC is a change of 30ºC, and the decrease from 74ºC to 44ºC is also a change of 30ºC. Without regeneration, the milk would need to be heated by hot water or steam from 4ºC to 74ºC, a difference of 70ºC. With regenerative heating, however, hot water or steam need not be used for the temperature change between 4ºC and 34ºC. This temperature change is brought about by use of the outgoing hot milk. The saving of heat due to regeneration here is thus 43%. On the other hand, without regeneration the milk would need to be cooled by chilled water from 74ºC to 4ºC, a difference of 70ºC. With regenerative cooling, however, chilled water need not be used for the temperature change from 74ºC to 44ºC, a difference of 30ºC. This temperature change is brought about by use of cold incoming milk. The savings of refrigeration due to regeneration are thus 43%. Currently, as much as 90% efficiency has been achieved by the use of counter-current flow.

v. **Filter:** Variously shaped filter units to connect directly to the HTST system are placed after the pre-heater or regenerative heating section. These units using 40-90 mesh cloth are usually cylindrical in shape. Usually two filters are attached but they are used one at a time. This permits continuous operation, the flow being switched from one to the other while replacing the filter.

vi. **Holding:** The holding tubes or plates ensure that the milk is held for a specified time not less than 15 sec at the pasteurization temperature of 72 ° C or more.

vii. **Flow diversion valve (FDV):** This routes the milk after heat treatment. If the milk has been properly pasteurized, it flows forward through the unit; that which is unpasteurized milk (i.e. in which the temperature does not reach the legal limit) is automatically back to the FCBT for reprocessing. It is usually operated by air pressure working against a strong spring. Should the temperature fall, air pressure is released on the valves snaps shut immediate. When the temperature is regained air pressure builds up and the valve opens to forward flow. The system is so arranged that any failure of air or electricity moves the valve in the diverted portion.

viii. **Regeneration (cooling):** The pasteurized hot outgoing milk is partially and indirectly cooled by the incoming cold milk (milk-to-milk regeneration). This again adds to the economy of the HTST process.

ix. **Control panel:** It contains instruments, controls, FDV-mechanism and holding system, all centralized in one moisture proof panel. The lower half of the panel forms an air-insulated chamber which carries the holding tube.

x. **Hot water set:** It circulates hot water through the heating section of the machine to maintain the correct milk temperature within very fine limits.

xi. **Automatic control devices:** These include:

a. **Steam pressure controller:** Maintains a constant hot water temperature for heating milk accurately to the required pasteurization temperature. (Acts as a reducing valve in the steam supply line, so as to give a constant steam pressure).

b. **Water temperature controller:** Regulates the amount of steam entering the hot water circulating system.

c. **Milk temperature recorder:** Records the temperature of milk leaving the holding tube/plate. This is electric contact instrument that operates either a FDV or a milk pump, automatically preventing milk from leaving the holding section at sub legal temperatures. Both the frequency and duration of the flow diversion and the temperature of milk leaving the holder are recorded on the thermograph by means of two separate pens.

xii. **Pressure in the system:** The normal pressures maintained in the HTST system are:

- Pasteurized milk: 15 psi

- Raw milk: 14 psi
- Heating/cooling medium: 12 to 13 psi

xiii. **Holding time test:** The holding time of HTST pasteurization is the flow time of the fastest particle of milk at a prescribed temperature through the holding section. The holding time is calculated between the points at which the heated milk leaves the heating section and reaches the FDV. The efficiency of pasteurization in the HTST systems depends as much on the correct maintenance of temperature as on the holding time. Several methods are used for determination of the holding time, viz., the electrical conductivity method, the dye injection method, the electronic time method etc.

Steam or hot water is used for the heat treatment of milk. For the cooling, chilled water is used. The milk to be heated flows across one side of the plate and heating or cooling medium flows across the other side in the opposite direction. Inserting more plates can increase the capacity of this heater.

3.5 UHT Pasteurisation

In recent years UHT processing has emerged as an attractive alternative commercial alternative for marketing of fluid milk in the industrially advanced countries. Long life milk or UHT milk was originated in Switzerland in 1961. UHT processing has been widely accepted in Europe as an alternative method for milk processing.

According to the IDF (1979), a UHT product which has been subjected to the UHT treatment, which has been packaged in sterile containers under aseptic conditions. Typical minimum time/temperature combinations are: UHT milk: 132°C for not less than 1 second, UHT cream: 132 °C for not less than 2 seconds.

The National Health and Medical Research Council (NHMRC) of Australia (1979) has defined UHT milk as milk which has subjected to a temperature of not less than 133°C and aseptically packed in hermetically sealed containers and which should show no microbiological growth when examined in the prescribed fashion.

UHT processing:

UHT processing involves a continuous flow system of sterilization followed by aseptic packaging. The basis of the process is heat transfer where the product is heated to temperatures in the order of 135-150 °C for few seconds and then rapidly cooled. The result of this heat shock is a high sterilizing effect with little damage to the physical, chemical and nutritional qualities of the product.

3.6 Sterilisation of Milk

The term sterilization when used in association with milk means heating continuously to a temperature of 115 ° C for 15 min. or 145 ° C for 3 sec. or equivalent approved temperature time combination to ensure preservation of milk at room temperature for a period of not less than 15 days from the date of manufacture. Sterilized milk shall show absence of albumin by a negative turbidity test. Sterilized milk shall be sold only in the container in which the milk was sterilized.

3.7 Homogenisation of milk – Definition, advantages and disadvantages

Homogenized milk is milk which has been treated in such manner as to insure breakup of the fat globules to such an extent that after 48 hours quiescent storage no visible cream separation occurs on the milk and the fat percentage of the milk in the top 100 ml. of milk in quart bottle, or of in proportionate volumes in containers of other sizes, does not differ by more than 10% of itself from the fat percentage of the remaining milk as determined after thorough mixing.(In efficiently homogenized milk, the fat globules are subdivided to 2 microns or less in diameter).

Advantages:

i. No formation of cream layer/plug
ii. Fat in milk does not churn due to rough handling or excessive agitation.
iii. Better adapted for bulk dispensing; mixing not necessary.
iv. More palatable due to brighter appearance, heavier body and richer flavour.
v. Produces soft curd and is better digested; hence recommended for infant feeding.
vi. Less susceptible to oxidized flavour development.

Disadvantages:

i. Increased cost of production
ii. Returned homogenized milk difficult to salvage, fat recovery is a problem;
iii. Sediment appears to a greater degree
iv. Curdling in cookery
v. More susceptible to production of activated or sunshine flavour defect.
vi. Greater tendency for milk ‘seepage’ through bottle cap.

3.8 Packing of Milk (Pre Pack) and storage

Milk is a liquid and so requires a container at every stage. Packaging of milk is the technique of using appropriate containers to protect, carry, and merchandise any milk product. It is vital link between the manufacturer and consumer. Necessary for delivering fresh, sound and convenient form of milk.

Packaging

It is a tool that protects and contains our goods with the aim of minimising the environmental impact on our consumption. Or it is a technology of enclosing or protecting products for distribution, storage, sale and use.

History of milk packaging

Metal cans were developed for distribution of milk in 1860-70. In the third decade of this century, bottling of pasteurized milk was developed. Development and introduction of plastic materials for packaging in the dairy industry (initially polyethylene) in 1940.

Packaging trends in abroad

The glass bottle for milk introduced in USA in 1884. Plastic containers i.e. single-service HDPE containers were introduced in 1964. Paperboard industry in USA introduced a new twin pack comprising two-half gallon containers. In German Federal Republic, pasteurized milk packaged in cartons. Liquid milk in Berlin packed in plastic bags placed in returnable plastic crates.

Basic packaging materials used

1. Paper and paper based products
2. Glass bottles
3. Tin plate
4. Aluminium foil
5. Plastics
6. Low polymer
7. High polymers
8. Paper laminates for tetra packs

Role of packaging material

1. Containing the product
2. Selling the product
3. Safety of the product

4. Facilitating the handling and storage
5. Protecting against biological, chemical and distribution damages
6. Providing convenience
7. Information
8. Security
9. Increasing shelf-life
10. Economical
11. Marketing and advertising tool
12. Attractive to the consumer

Packaging of liquid milk

Flexible pouches 92%, glass bottles 7% and aseptic packaging 1%.

Plastic materials in aseptic packaging of milk product are polyethylene, polypropylene, polystyrene etc.

Popular commercial systems available are tetrapak, Combo block, Pure pack, Hind pack etc.

Short answer type questions:

1. What is meant by pasteurization of milk
2. What is the objective (Purpose) of pasteurization of milk
3. Explain UHT pasteurization
4. What is sterilization of milk
5. What is homogenization of milk
6. What are the basic packaging materials used for milk and milk products?

Long answer type questions:

1. Write about types of pasteurization and their advantages and disadvantages of pasteurization
2. Write in brief about method of HTST pasteurization of milk
3. Write about homogenization and UHT of milk
4. Write about Packaging and storage of milk.

UNIT 4

CLEANING AND SANITIZATION

Structure:

4.1 Detergents and Sanitizers – Desirable characters

4.2 Cleaning and Sanitization – Methods – Hand, Machine and CIP systems

4.3 Cleaning and Sanitization of cans – types of can washers

4.4 Cleaning and Sanitization of HTST Pasteurizers and other equipment

4.1 Detergents and Sanitizers – Desirable characters

The operation of cleaning of the dairy utensils is achieved by employing detergents. The detergents are a substance which functions to remove milk deposits and other foreign matter from the surface to be cleaned. Many detergents however, combine the action with sterilizing action. For a substance to act effectively as detergent, it should have good wetting properties i.e. the ability to spread itself uniformly over the surface to be cleaned. Besides this it should have the following desirable properties.

a. Wetting and penetrating power
b. Emulsifying power
c. Saponifying power
d. Defloculating power
e. It should be completely and quickly soluble in water.
f. It should be non corrosive. Dairy detergents are broadly classified into four groups.

Sanitizers: Chemical substances which prevent growth of micro-organisms are known as antiseptics while those with cause death are called "disinfectant "," germicide", or "Sanitizer". Sanitizers should have the following properties.

a. Quick acting.
b. Easily and quickly applied.
c. Relatively inexpensive
d. Relatively non corrosive to hands and dairy utensils.

4.2 Cleaning and Sanitization – Methods – Hand, Machine and CIP systems

Hand washing:

1. Thoroughly rinse the utensil with clean cold or luke warm water.
2. Introduce suitable detergent solution of 0.8 to 1 percent at 50^0 C temperature into the utensil. Thoroughly brush the surface with a clean brush.
3. Wash the utensil with enough fresh water using a clean brush to remove all traces of detergent.
4. Allow the utensil to drain thoroughly and let it dry.
5. Sanitize the equipment surface by steam or hot water after cleaning or by rinsing with chlorine solution just before using.

Precautions:

1. Follow the manufacturer instructions for specially coated surface equipments.
2. For general use employ correct strength of detergent or sanitizer solution
3. Regular temperature conditions.
4. Ensure that utensils are cleaned prior to sterilization.
5. Avoid deposition of milk stone or other residue on the surface.
6. Preferably use seamless pails or utensils.
7. Use rubber glove to avoid skin injury from detergent action.

Material required / Apparatus:

1. Nylon brushes
2. Scraper
3. Water supply or hose connection
4. Heating source or boiler for steam
5. Soaking tank
6. Detergent mixture sanitizer unit
7. Racks for drying of utensils
8. Rubber hand gloves / gum boots for workers if possible.

Procedure for cleaning and sanitizing of dairy utensils:

1. Remove any residual loose milk or other solid material by rinsing the utensils with cold or luke warm water to remove as much milk residue and other material as possible.
2. After being rinsed and drained, the utensils should be brushed with a hot detergent solution (120 0 F) to remove any remaining from lids.
3. Rinse again with hot water to remove traces of detergents and any loose material.

4. Sanitize the utensils before use either by steam or chemicals to destroy all pathogens and almost all non-pathogenic organisms.
5. Drain the utensils to prevent further bacterial growth.
6. Dry the utensils by keeping it in inverted position.
7. Do not use a cloth or towel for drying.

4.3Cleaning and Sanitization of cans – types of can washers

Milk is procured from villages in cans, and brought to the Dairies or Bulk milk collection centers. At dairies, if the collection through cans is in large quantities, the cans have to be cleaned using mechanical means. If the quantities are less, then it can be done manually, using can washing trough and mechanically operated brushes and steaming blocks. The mechanical can washers are again two types. The smaller capacity ones are Rotary can washers, whose capacity is 3 to 5 cans/min, while the larger capacity ones are Straight-through can washers, whose capacity is about 12 cans/min.

1. **Cans washing or Can scrubber**

This method is adopted in all milk chilling centres where less number of cans is to be washed. One man can operate this unit conveniently.

Construction of can scrubber is shown in figure and described below

1. The scrubber machine is made of 10 SWG G.I. sheet or M.S.sheet with totally galvanised.
2. The machine is painted with 'epoxy' paint to avoid corrosion.
3. The can scrubber consists of a tank in which two revolving nylon brushes are mounted on shafts.
4. The extension of shafts are properly encased in sealed enclosures and provided with suitable bearings and lubrication points.
5. Gland packing is used to avoid the leakage through the shaft.
6. A stationary nylon brush is fitted with a bracket on the inner wall for cleaning outside of the cans.
7. Side stationary brush is changeable. It can be fitted on either side of the inner wall.
8. Cylindrical nylon brushes, revolve at a low speed, i.e., 80 to 100 rpm, in opposite directions by a motor and reduction gear unit, give thorough and effective cleaning action on either side of the can..
9. Steam and water connections are given to the tank for making warm water for washing operation.
10. At the bottom of the tank a drain valve is fitted for easy draining and cleaning of the tank.

Preparation: Can scrubber is prepared for can washing as follows

1. Check the oil level in the gearbox and lubricate the chain over the sprockets for the brushes.
2. Check the rotation of the brushes.
3. Clean the tank and close the drain valve.
4. Open the water valve and fill the tank to the marked level.
5. Add. 0.8% washing soda and 0.2% tri-sodium phosphate to the water.
6. Open the steam valve and raise the temperature of the detergent solution to 55°C.
7. Start the rotating brushes by switch on the drive motor.

Washing Operation: Washing operation is done as follows

1. First of all can is pre-rinsed with warm water at about 40°C both from inside and outside.
2. Then can is inserted on the top rotating brush and brushed thoroughly from both sides for 10 seconds.
3. Then can is taken out and rinsed with hot water at about 60°C.
4. Final rinsing, sterilization and drying of can are carried out on the steaming block.

2. Steaming Block

Steaming block is always used with can scrubber for final rinsing and sterilization of washed cans. The construction of steaming block is as below:

1. The stationary part of steaming block is made of cast iron material and the working parts are of stainless steel.
2. At the base water and steam lines are connected through spring loaded valves and the valves are operated by the pedestal levers.
3. A steam mixing battery is fitted inside the vertical column.
4. The top portion has a concave surface on which a spray nozzle, drain hole, and seat rests for can mouth are provided.

Operational precautions:

1. Steam supply should be given through a steam mixing battery to avoid vibration.
2. If the brushes do not rotate, check the direction of rotation and correct it or tighten the idler wheel, provided on the chain, as required.
3. It will be hard to insert the can on a new brush. Do not cut the nylon bristles to reduce brush diameter in order to reduce the worker's labour. If this is done, the scrubbing and cleaning will be ineffective.
4. Periodically check the lubrication and alignment of gearbox and sprockets to avoid any breakdown.

3. Rotary Can Washer

Rotary can washer has a revolving platform, with holes on which the cans can be placed in an inverted position. As the revolving platform moves intermittently, the inverted can is jetted by various solutions, as shown in Fig. Under the platform, a series of tanks, containing washing solutions will be provided. These solutions are forced at high pressure, by centrifugal pumps, through jets placed below and to the sides of the cans. The liquid returns through the platform grating to the respective tanks. The platform is rotated intermittently to ensure that each can receives a constant period of treatment over the jets.

The sequence of operations preceding simultaneously are

1) Loading of can in vertical inverted position
2) Rinsing with warm water (which is drained)
3) Drainage of rinse water
4)Treatment with detergent solution at high pressure (at 65 to 70^{o} C) to soak, loosen and dislodge milk film from can surfaces
5) Drainage of wash solution back to detergent tank
6) Hot water rinsing at 65 to 70^{oC}
7) Blasting with dry saturated steam
8) Drying of steam condensate with hot air blast, and
9) Unloading of the can, inverting and placing the lid on the can.

The can washer is provided with a stationary canopy with chimney to take away the exhaust steam. The capacity of washer is suitable for small chilling centres, and can wash about 3 to 6 cans / min. The same operator can load and unload the can, thus saving man power.

1. Straight through Can Washer

Straight through can washer carries the cans through the washer in a straight line by means of a continuously moving conveyor or slide along rail as they move intermittently from one jetting position to the next. The driving unit moves the can forward from one position to the next at regular intervals.

4.4 Cleaning and Sanitization of HTST Pasteurizers and other equipment

Operation of the Pasteurized CIP circuit

1. The pasteurized CIP circuit is used to clean the all of the pasteurized storage tanks, filler lines, and the bottle and bag filling equipment.
2. If needed, the equipment is pre-rinsed with water to remove most of the residual product.
3. The necessary line connections are made and the pasteurized CIP program is activated. a. The first step is a water rinse.
4. Then water is heated and a chlorinated alkaline detergent is added. This solution is circulated throughout the circuit while valves and agitators are periodically pulsed to aid in soil removal.
5. The wash cycle is followed by a water rinse which cools down the circuit.
6. Finally an acid sanitizer is added, circulated throughout the circuit, and allowed to drain to the floor.
7. The line connections are returned to their original configuration.
8. Prior to the equipments next use a CIP sanitation step is performed using an acid sanitizer.

Operation of the HTST CIP circuit

1. The HTST CIP circuit is used to clean the bowl, homogenizer, separator, and pasteurizer, all of the lines connecting these pieces to equipment, as well as the lines and valves leading to the pasteurized storage tanks.
2. If needed, the equipment is pre-rinsed with water and the bowl is allowed to overflow with water in order to remove most of the residual product.
3. The necessary line connections are made and the HTST CIP program is activated following the required initial ten minute delay.
4. The first step is a caustic rinse using an alkaline cleaner. This solution is circulated throughout the circuit while valves are periodically pulsed to aid in soil removal. It is also allowed to overflow the bowl.
5. The caustic rinse cycle is followed by a water rinse.
6. The water is then heated and an acid detergent is added. This solution is circulated throughout the circuit while valves are periodically pulsed to aid in soil removal. During this time the bowl may be hand washed if needed.

7. An alkaline cleaner is then added to the acid detergent that is being circulated (caustic override). During this time the heat is maintained and the valves continue to pulse periodically.
8. The wash cycle is followed by a water rinse which overflows the bowl and cools down the circuit.
9. Finally an acid sanitizer is added and circulated throughout the circuit. This sanitizer remains in the system until the equipment is used again.
10. The line connections are returned to their original configuration.
11. Prior to the equipments next use a CIP sanitation step using an acid sanitizer is performed.
12. The residual acid sanitizer (from step 3f above) is rinsed out with water.
13. A fresh solution of acid sanitizer is prepared in one of the mixing tanks.
14. The HTST is started up using its product setting (not CIP) and high speed. This will pump the acid sanitizer from the mixing tank through all of the equipment that is scheduled to be used that day.

Short answer type questions:

1. What is detergent
2. What are the properties of detergent
3. What is a sanitizer
4. What are the desirable characteristics of sanitizers
5. What are the mechanical can washers

Long answer type questions:

1. Write briefly about mechanical can washing
2. Write about hand washing procedure of dairy equipments
3. Write about cleaning and sanitization of HTST pasteurizer

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UNIT 5

LIQUID MILKS

STRUCTURE

5.1 Flavored milk

5.2 Sterilized milk

5.3 Tonned milk

5.4 Double tonned milk

5.5 Recombined milk

5.6 Reconstituted milk

5.7 Standardized milk

5.8 Humanization of milk

5.9 Irradiated milk

5.1 Flavoured milk

Flavoured milk is a sweetened dairy drink made with milk, sugar, food colorings and artificial or natural flavourings. Flavoured milk is often pasteurized using ultra-high-temperature (UHT) treatment, which gives it a longer shelf-life than plain milk.

Purpose:

1. To make more palatable to those who do not relish it as such.
2. To increase the sale of milk.
3. To put skim milk to profitable use.

Types

The main types are

1. Chocolate milk
2. Fruit flavoured milk
3. Sterilized flavoured milk

Methods of manufacture of chocolate / fruit flavoured milks drinks.

(a) Details of manufacture

i. Chocolate milk drinks. The following formula may be used.

(i) Cocoa powder 1 to 1.5%

(ii) Sugar (Sucrose) 5 to 7.0 %

(iii) Stabilizer 0.2% (Sodium Alginate)

Fat level in milk/drink: Minimum legal standard is 2% fat. The milk on receipt is standardized preheated to 35-40^{0}c and filtered, alternatively after standardization. It is preheated to 60^0 c, homogenized at 2500 psi and then clarified. To the warm milk the desired amounts of cocoa mix, sugar and stabilizer are slowly added and stirred so as to dissolve them properly. (The cocoa powder may also be added in the form of syrup, and the stabilizer in the form of solution). The mixture is then pasteurized at 71^{0}c/30 minutes, cooled rapidly to 5^{0}c bottled and kept under refrigeration (5^{0}c) until used. The bottles should be in variably inverted up and down a few times before consumption.

Note: Standardized milk is homogenized to prevent or delay in rising of cream flug. It may be homogenized after addition of cocoa and sugar, but this has the effect of increasing sedimentation. Stabilizer is usually added to delay or prevent settling of cocoa particles, it also aids in the prevention cream separation.

ii. **Fruit Flavoured milk / drink:** Permitted fruit flavoured essences, together with permitted (matching) colour and sugar are used. The method of preparation is similar to that used for chocolate milk/drinks. The common flavours used are strawberry, orange, lemon, pineapple, banana, vanilla etc. However in order to obtain good results the following precautions should be taken.

(i) No acid (citric or tartaric) should be added to the fruit syrups, as this may result in curdlings. The pH of the milk syrup mix should be about 5, which keeps the mix safe from curdling.

(ii) Excessive sweet syrups should be avoided. The optimum sugar content of the syrup may be between 45-55 percent.

(iii) Add 1 part of fruit syrup to 5 parts of milk. (Fruits which give particularly good results are strawberry, orange, lemon, pineapple, blackberry, raspberry, and black currant etc.).

(iv) Care should be taken to see that, there should be pleasant blend of sweet, fruity and milky flavours (together with an appealing colour).

5.2 Sterilized milk

Sterilized milk may be defined as (homogenized) milk which has been heated to a temperature of 1000C or above for such lengths of time that it remain fit for human consumption for at least 7 days at room temperatures. Commercially sterilized milk is rarely sterile in the strict bacteriological sense.

Advantages and Disadvantages

Advantages

(i) Remarkable keeping quality, does not need refrigerated storage

(ii) No cream layer/plug formation.

(iii) Forms a soft digestible curd, and hence useful for feeding of infants and invalids

(iv) Distinctive 'rich' (due to homogenization)

(v) Economical touse

(vi) Less liable to develop oxide taints.

Disadvantages

(i) Increased cost of production

(ii) More loss in nutritive value than pasteurization (50 percent of the vitamin C and 33% of vitamin B originally present are destroyed and there is slight reduction in the biological value of the milk proteins).

5.3 Toned milk

Toned milk is a method, developed in India, of treating buffalo milk by adding skim milk, powdered skim milk and water to buffalo milk. This process decreases the fat content, increases the quantity of available milk, and 'tones up' the non-fat solids level to the original amount.

5.4 Double-toned milk

Double-toned milk is a similar to toned milk, where the fat content of the milk is reduced to 1.5% and the non-fat solids content increased to 9%.

5.5 Recombined milk

Recombined milk is the liquid milk obtained by adding skim milk powder (SMP) to water and adding milk fat separately to achieve the desired fat and total solids content.

5.6 Reconstituted milk

Milk is reconstituted by combining dry whole milk powder with the appropriate amount of water (1 part powder to 7-8 parts water). Usually spray- dried powder is used as it is more soluble and produces less sediment.

5.7 Standardized milk

Standardized milk is a product, whose fat and/or solids-not-fat (SNF) content have been adjusted to a certain pre-determined level. The standardization can be done either by partially skimming the fat in the milk with a cream separator, or by admixture with fresh or reconstituted skim milk in proper proportions.

5.8 Humanization of milk

Humanized Cow's milk that has had its composition modified to resemble human milk, for infant feeding. The main change is a reduction in protein content, achieved by dilution with carbohydrate and restoration of the fat content.

5.9 **Irradiated milk:** Irradiated milk is milk in which vitamin D content has been increased by exposure to U.V. rays.

Short answer type questions:

1. What is Flavoured milk
2. What is sterilized milk
3. What is toned milk
4. What is double toned milk
5. What is recombined milk
6. What is Reconstituted milk
7. What is Standardized milk
8. What is Humanization of milk
9. What is Irradiated milk

Long answer type questions:

1. Write about manufacture of chocolate / fruit flavored milk
2. Write about sterilized milk, toned milk, double toned milk, recombined milk, reconstituted milk, standardized milk humanization of milk and Irradiated milk.

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UNIT 6
FAT RICH PRODUCTS

Structure:

6.1 Cream – Definition, Composition and Types of Cream

6.2 Methods of cream separation

6.3 Factors affecting cream separation

6.4 Butter – Definition, Composition and legal standards

6.5 Methods of Manufacture of Butter

6.6 Types and uses of Butter

6.7 Ghee – Definition, Composition and legal standards

6.8 Desi method of Ghee preparation

6.9 Preparation of Ghee from cream

6.1 Cream – Definition, Composition and Types of Cream

According to PFA Rules (1976), cream, exclusively sterilized cream, is the product of cow or buffalo milk or a combination thereof which contains not less than 25 per cent milk fat.

6.2 Methods of cream separation

Cream is obtained from milk by either gravity or centrifugal methods.

Gravity method: When milk is allowed to stand for some time, there is tendency for the fat to rise. The velocity or rate at which the fat globules rise, is given by the following equation, which is known as Stocke's Law.

$V= 2/9Gr^2$ ds-df/n

Where, V= rate of rise of fat globule in centimetre pre second

r= radius of fat globule

G= force of gravity(981dynes)

n=viscosity of skim milk

ds=density of skim milk

df=density of fat globules

The important factors that effect the rate of rise of cream in gravity method are:

1. Size of fat globules: larger fat globules rise rapidly than smaller one
2. Temperature: As temperature increases, viscosity decreases and velocity increase.
3. Clumping: clumping increases the values of 'r' thus increase the velocity.
4. Addition of adhesives: Ultimately helps in increasing the rate at which fat globules rise.

Gravity methods, being very slow, are no longer used commercially for cream separation.

Centrifugal methods (used commercially):

When milk enters the rapidly revolving bowl of cream separator, it is immediately subjected to a tremendous centrifugal force, which is 3000 to 6000 times greater than gravitational force. While both fat and skim milk are subjected to centrifugal force, the difference in density affects the heavier portion that is skim milk more intensely than lighter portion that is cream. Thereby the skim milk is forced to the periphery while the fat portion moves towards the centre. The skim milk and cream both from vertical walls within the bowl and are separated by being led through separate outlets. The cream outlet is at a higher level than the skim milk outlet, both being near the axis of rotation.

The speed (rate) of cream separation is increased by

i) Greater radius of fat globule

ii) Greater difference in density between skim milk and fat

iii) Greater speed of bowl

iv) Greater size of bowl

v) Lower viscosity of skim milk

Characteristics of gravity and centrifugal creaming methods

Particulars	**Gravity method**	**Centrifugal method**
Nature of force causing separation	Gravitational	Centrifugal
Speed of separation	Extremely slow	Practically instantaneous
Direction of movement of fat	Vertical	Horizontal

and skim milk particles		
Bacteriological quality of cream and skim milk	Low	High
Fat per centage of cream	10-25	18-85(can be controlled)
Skim milk	0.2 or above	0.1 or below
Scale of operation	Small	Large
Fat percentage recorded in cream	Not more than 90	99-99.5

6.3 Factors affecting cream separation

The factors affecting fat loss in skim milk are

1. Temperature of milk: The lower the temperature, the higher the fat loss in skim milk, and vice versa. For efficient separation, the temperature of milk should be above melting point of fat, so that the milk fat in the fat globules is entirely in liquid form. A satisfactory temperature for separation is around 40 ºC (104 ºF). The higher the temperature, the more efficient the separation. There is no marked increase in efficiency after 43-49 ºC (110-120 ºF). On the other hand separation at low temperatures may lead to partial clogging of the bowl due to the high velocity of cream at these temperatures, resulting in greater fat loss in skim milk.

2. Speed of bowl: The lower the speed, the higher the fat loss in skim milk, and vice versa. At below rated speed there will be more fat loss in skim milk because insufficient centrifugal force is generate for efficient cream separation. However at above rated speeds, the skimming efficiency will not increase greatly.

3. Rate of milk inflow: The higher the rate of inflow the higher the fat loss in skim milk, and vice versa. If the rate of inflow is increased above the designed capacity of the separator, the milk passes through the bowl too rapidly to allow for complete separation, thereby resulting in higher fat loss in skim milk. On the other hand, under feeding the separator does not greatly increase the efficiency of separation.

4. Position of the cream screw: If up to 50 per cent cream is present, there is little effect on the fat test of skim milk; where there is 50-60 per cent cream, there is greater fat loss in skim milk; if above 60 per cent of cream is obtained, still higher fat loss in skim milk at low temperature separation result. A good separator is designed to give efficient skimming within a fairly wide range of positions of the cream screw, so that the fat test of the cream can be varied without influencing the efficiency of skimming. With most separators, the position of the cream screw has little effect on the fat test of skim milk until the cream test above 45 to 50 per cent. From this point up to a 60 per cent fat test in cream, the fat content of the skim milk increases. Separation of very thick cream at low temperatures may lead to higher losses through clogging of the bowl with viscous cream.

5. Mechanical condition of the machine: Unsatisfactory mechanical condition of the cream separator causes greater fat loss in skim milk.

- Vibration of the separator reduces the efficiency of separation by disturbing the counter-currents of cream and skim milk. Vibration is caused by installation on an insufficiently firm foundation, the bowl being out of balance, bearing being worn out, the axis of rotation not exactly vertical, etc.
- Discs in/ an unsatisfactory condition suffer a loss of skimming efficiency due to the un even flow of the counter current streams of cream and skim milk between them. An un-satisfactory disc is one which is out of shape, dirty, scratched or rough.
- Amount of separator slime in bowl: If too much slime accumulates, the fat loss in skim milk increases. This is caused not only by a disturbance in the even flow of the counter – currents of cream and skim milk, but by reduction in the centrifugal force because of decrease in the 'effective' diameter of the bowl.

6.Size of fat globules : The greater the number of fat globules of less than 2 micron size, the higher the fat loss in skim milk and vice versa. Fat globules of less than 2 micron size usually enter the skim milk, as they are not subject to sufficient centrifugal force to be recovered in the cream. Hence, the greater the number of less than 2 micron size globules, the greater is the fat loss in skim milk.

7. Degree and temperature at which milk is agitated before separation: The higher the degree and temperature of agitation, the greater the loss in skim milk and vice versa. Agitation of hot milk causes the disintegration of the normal fat globules in to smaller ones which escape the effect of centrifugal force, thereby leading to more fat loss in skim milk.

8. Presence of air in milk: The greater the amount of air, the higher the fat loss in skim milk. If the milk delivered to the separator contains entrapped air bubbles, separation of air as a consequence of centrifugal force disturbs the counter-current streams of cream and skim milk between the discs, and lowers the efficiency of separation.

9. Acidity of milk: The higher the acidity, the lower the stability of casein particles, which in turn get precipitated and clog the bowl, thereby lowering the efficiency of separation.

6.4 Butter – Definition, Composition and legal standards

According to the PFA Rules (1976), table (creamery) butter is the product obtained from cow or buffalo milk or a combination thereof, or from cream or curd obtained from cow or buffalo milk or a combination thereof, with or without addition of common salt and annatto or carotene as colouring matter. It should be free from other animal fats, wax and mineral oils, vegetable oils and fats. No preservative except common salt and no colouring matter except annatto or carotene may be added. It must contain not less than 80 per cent by weight of milk fat, not more than 1.5 per cent by weight of curd and not more than 3 per cent by weight of common salt. Diacetyl may be added as flavouring agent but, if so used, the total diacetyl content must not exceed 4 ppm. Calcium hydroxide, Sodium bicarbonate, sodium carbonate, sodium poly phosphate may be added, but must not exceed the weight of butter as a whole by more than 0.2 per cent.

6.5 Methods of Manufacture of Butter

Receiving milk/cream

This consists of (a) unloading (b) grading (c) sampling (d) weighing (e) testing.

a) Unloading: the cans of cream brought to the creamery/butter making factory are unloaded on the receiving platform which is at truck-deck height, and arranged according to route and the patrons.

b) Grading: The purpose of grading is to pay for the product on the basis of its quality. Cream is graded on the same principles as is milk i.e on examination of smell, taste, appearance, touch, acidity and sediment. Cream for butter making is graded in accordance with the grades of butter that can be made from it.

First Grade Cream – Sweet or slight sour

Second Grade Cream – Sour, coagulated

Reject Grade Cream – Markedly sour, fermented

c) Sampling: Before sampling, the cream in the can is thoroughly mixed by a combined rotary and vertical movement of the plunger/stirrer. Then a representative sample may be drawn for testing purpose.

d) Weighing: The cans of cream, which have been accepted, are then weighed and the weight recorded for accounting and other purpose.

e) Testing: The cream samples drawn are then tested for fat, solids-not-fat, acidity, etc., by standard methods.

Pre-heating of milk: To increase efficiency of cream separation

Separation of milk: by centrifugal methods

Neutralization of cream: Neutralization of sour cream for butter-making refers to a partial reduction in its acidity.

Objectives:

a) To avoid excessive fat loss in buttermilk that results from churning highly acid pasteurized cream.

b) To guard against the production of an undesirable off-flavour in cream which may result when high-acid cream is pasteurized.

c) To improve the keeping quality of butter made from high acid cream

Procedure: The procedure for correct neutralization is

a) Adoption of a definite standard of churning acidity

b) Testing correctly for acidity

c) Correct amount of neutralizer to be added

d) Adding neutralizer to cream by correct method

e) Checking results by re-testing acidity

a) Adoption of a definite standard of churning acidity

Butter for long storage: Cream acidity should be reduced to 0.06 -0.08 per cent before churning for optimum results.

Butter for early consumption: Cream acidity should be reduced to 0.25 -0.30 per cent before churning.

b) Testing correctly for acidity: The procedure is

i) Take a sample of cream after thorough mixing

ii) Heat cream to boiling point for 1 minute before testing for acidity

iii) First partially neutralize acid cream with a known amount of standard alkali, then treat as above.

iv) Determine lactic acidity of cream by titration of fixed weight (10g) with a standard alkali (N/9 sodium hydroxide solution), using Phenolphthalein as an indicator.

c) Correct amount of neutralizer to be added : The considerations are :

i) The quantity of neutralizer to be added to a vat of cream varies with the acidity of cream, the final acidity desired in pasteurized cream and with the neutralizer compound used.

ii) First calculate the quantity of lactic acid to be neutralized per 100 kg cream. Then the amount of neutralizer required must be calculated.

iii) There are two groups of neutralizers available for use. Viz., lime(calcium hydroxide and Magnesium hydroxide) and soda (Caustic soda, sodium carbonate, sodium bicarbonate and sodium sesqui carbonate)

d) Correct procedure for adding neutralizer to cream:

i) The neutralizer should never be dry when added, but should be dissolved in clean potable water and properly diluted. It should be distributed quickly and uniformly in the cream and mixed thoroughly by stirring vigorously.

ii) The temperature of cream when adding the neutralizer should preferably be 29-32ºC (85-90ºF).The stirring should be continued for 5-10 minutes after adding the neutralizer, then the cream should be pasteurized.

e) Checking results by re-testing acidity: The cream acidity should now be determined to check whether it has been correctly neutralized.

Standardization of cream: This refers to adjustment of fat level in cream to the desired percentage, conforming to standard requirements.

Procedure: The fat percentage in cream is usually adjusted to the prescribed level by the addition of calculated amount of skim milk.

Pasteurization of cream: Pasteurization of cream refers to the process of heating every particle of cream to not less than 71^0C (160^0 F and holding at a such a temperature for at least 20 minutes, or to an suitable temperature- time combination.

Objects (Purpose)

i) To destroy the pathogenic microorganisms in cream so as to make it safe for human consumption.

ii) To destroy undesirable microorganisms and inactivate the enzymes present so as to prolong the keeping qualities of the cream and butter.

iii) To complete the neutralization process

iv) To eliminate some of the gaseous tainting substances

v) To make possible the removal of some volatile off-flavours during vacreation.

Methods:

i) Holding pasteurization: This is a batch process used for small scale handling. The cream is heated to 71ºC for 20 minutes and then promptly cooled.

ii) HTST (plate) pasteurization: This is a continuous process used for large scale handling. This is better suited to freshly separated sweet cream than neutralized cream as the latter more easily forms burnt-on films on the plates. The maximum heating temperature may be 95-100ºC for 15-16 seconds.

iii) Vacuum pasteurization (vacreation): A characteristic of vacuum pasteurization is that a dilution of initial cream takes place and the fat test may be lowered by 6 to 8 per cent; this fact has to be kept in view when standardizing cream.

Cooling and ageing of cream

Cream is cooled by lowering its temperature, and aged by holding at this temperature for few hours. After pasteurization, the cream has to be cooled and then aged to make churning possible. Cream will not churn until the butter fat in the fat globules has at least partially solidified(crystallized);if insufficiently solid, due to improper cooling and ageing of cream, the fat loss in the butter milk will be excessive and the butter obtained will have an unsatisfactory, weak body. Under Indian conditions the optimum temperature for the cooling and ageing of cream should preferably be 5-10ºC. Cooling cream to abnormally low temperatures, and ageing at same temperature render the fat globules so firm that they coalesce with each other during churning only with difficulty, there by greatly prolonging the churning process. High cooling and ageing temperatures of cream shorten the churning period, yield large fat losses in butter milk and produce butter which has a relatively soft body. Low cooling ageing temperatures prolong the churning period, decrease fat losses and produce a firm body that has a satisfactory standing –up capacity. The ageing period should be at least 2- 4 hours, preferably 15-16 hours (over night). During ageing crystallization of fat in the fat globules should be satisfactory completed. The optimum temperature for cooling and ageing cream depends on: composition of fat, size of fat globules, fat per cent of cream, period of ageing, temperature of churning, and acidity of cream.

Ripening of cream: This refers to the fermentation of cream with the help of desirable starter cultures.

Objects:

a) To produce butter with a pleasing, pronounced characteristic flavour and aroma, uniformly from day to day

b) To obtain exhaustive churning i.e. a low fat loss in butter milk.

Procedure: The butter starter cultures containing lactic acid producers such as Stre.lactis and /Stre.cremoris together with aroma (diacetyl) producers such as Stre.diacetilactis, Leuc.citrovorum and Leuc.dextranicum in correct proportions is added to the standardized, pasteurized and cooled (20-22ºC) cream at 0.5 -2.0 per cent. After being thoroughly mixed, the cream is incubated at 21 ºC for 15-16 hours.

Role of diacetyl: The typical flavour of butter from ripened cream is mainly the effect diacetyl, and to smaller extent, of acetic and propionic acids. There is no diacetyl in sweet cream. The flavour intensity in butter depends on its diacetyl content. The normal diacetyl content of ripened-cream butter is on average 2.5 ppm and rarely over 4 ppm. Diacetyl is produced from its mother substance acetyl-methyl- carbinol.

Synthetic flavours: Cream ripening is expensive, time-consuming and exacting. Most of the flavouring substances enter in to the butter milk and wash water, and are lost to the butter. Hence, the use of synthetic flavour compounds during working process to impart the characteristic flavour of ripened- cream butter to the finished product.

Churning: Churning of cream consists of agitation at a suitable temperature until the fat globules adhere, forming larger and larger masses, and until a relatively complete separation of fat and serum occurs. The object of churning cream is to produce butter.

Churning of cream: Good churn ability refers to : i) ease of churning ii)completeness of churning iii) satisfactory washing iv) optimum churning period.

Churning operation:

i) Preparing the churn: A new churn requires careful pre- treatment before use. An old churn requires proper sanitation and cooling, to render it clean.

ii) Filling cream in to the churn: The cream should be strained so as to remove lumps and chance objects.

iii) Addition of butter colour: This is done to maintain the uniformity of yellow colour in butter throughout the year for consumer satisfaction. The amount of standard colour varies from 0 to 250 ml or more per 100 kg of butter fat. Butter colours are of the following types.

Vegetable origin: Annatto and carotene. Annatto is obtained from the seeds of the annatto plant. Carotene is extracted from carrots and other carotene –rich vegetable matter.

O mineral origin: Harmless, oil-soluble coal-tar dyes are mixed with neutral oil as above. Examples are: Yellow AB(Benzene Azo-β - nahthyl- amine), Yellow OB(ortho

Tolune Azo-β - naphthyl-amine). These are advantages like more concentrated and permanent.

Operating the churn: After initially rotating the churn for 5 to 10 minutes, the liberated gas is removed once or twice by opening the churn vent. Then the cream sample is drawn for the fat test. During the churning process there is invariably rise in temperature from 1 to 3 ºC. Churning is accompanied by foaming. Then comes the breaking stage. At this stage the fat in the skim milk emulsion breaks and very small butter granules of the size of pin heads make their appearance. It is necessary to add break water at this stage, to reduce the temperature of the churn contents, and there by control the body of the butter. After breaking stage the churning is continued until the butter grains are of the desired size i.e. pea-size in large churns.

Washing:

a) Draining the buttermilk: When the cream has been churned, the churn is stopped in proper position, a drain plug is fixed, and buttermilk removed through a sieve.

b) Purpose of washing is

- To remove all loose buttermilk adhering to butter grains so as to reduce the curd content of butter thereby improving its keeping quality.
- To correct defects in the firmness of butter by proper adjustment of wash water temperatures
- To decrease the intensity of certain off-flavours.

c) Procedure of washing: After draining, chilled water is added to the butter grains in the churn. The temperature of water is usually 1-2 ºC lower than the churning temperature of the cream and an amount equal to the quantity of buttermilk removed. After few revolutions, the wash water is drained out.

Salting and working:

Salting: This refers to addition of salt to butter to improve keeping quality, taste and to increase over run. Usually, common salt is added at the rate of 2 to 2.5 per cent of butter fat.

Method of salting:

i) Dry salting: Most common. Consists in adding the desired amount of dry salt by sprinkling it over the surface of the butter during working.

ii) Wet salting: The calculated amount of salt is wetted in the least amount of potable water and then sprinkled over the butter during working.

iii) Brine salting: The salt is added in the form of a saturated solution of brine.

Working: This refers to the kneading of butter

i) To completely dissolve, uniformly distribute and properly incorporate the salt

ii) To expel the buttermilk and to control the moisture content of butter.

iii) To fully incorporate the added make-up water in butter.

iv) To bring the butter grains together into a compact mass for convenient handling and packaging.

The working should be continued until the butter has a compact body, a closely knit grain, a tough waxy texture and an even distribution of salt and moisture. Both over working and under working is harmful and should be avoided. The former damages the body and texture of butter, while the later produces leaky butter. Working increases the air content of butter. Normally worked butter has an air content of 0.5 to 10 ml per 100g of butter. The air content of butter is important because it affects i) the density of butter, ii)its microbial spoilage; and iii) its oxidative spoilage. The legal limit of moisture content of butter in most countries is 16 per cent.

Packaging and storage:

Objects of packaging:

i) To offer protection against contamination and damage.

ii) To protect the butter against loss in weight and degradation

iii) To provide ease and safety of transport

iv) To provide a convenient form of disposal

v) To identify the contents and increase sales appeal, appearance etc.

Packaging materials: These include

i) Wood or timber : White pine, Firkin, Teakwood, etc

ii) Parchment paper: Vegetable parchment paper, butter paper, cellophane; polythene etc.

iii) Aluminium foil / laminates: Moisture and grease proof; non- tainting and non – toxic, opaque; air – tight etc.

iv) Tin – plate cans: Advantageous in tropical countries not only in preventing melting butter from escaping in hot weather but also in preventing absorption of foreign flavours.

Technique of packaging:

i) Hand moulding and wrapping: slow and cumbersome.

ii) Mechanical moulding: Reduces labour costs and losses; suitable for large scale operations.

Storage:

The temperature of commercial cold storage of butter ranges from -23ºC to -29ºC (-10ºF to – 20ºF).

Keeping quality of stored butter:

i) Temperature of storage: the higher the temperature the lower the keeping quality

ii) Copper and iron content of butter

iii) Salt content of butter

iv) Acidity content of butter

v) Curd content of butter

vi) Air(oxygen) content of butter

From item ii to vi: the higher the content the lower the keeping quality.

vii) Raw or pasteurized cream: Pasteurization of cream increases keeping quality of butter.

viii) Method of packaging: sanitized high quality packaging materials and sanitary methods of packaging increase keeping quality and vice versa.

ix) Exposure to light: Lowers keeping quality

6.6 Types and uses of Butter

1. **Cultured butter:** Butter made from a fermented cream is known as **cultured butter**. During fermentation, the cream naturally sours as bacteria convert milk sugars into lactic acid. The fermentation process produces additional aroma compounds, including diacetyl, which makes for a fuller-flavored and more "buttery" tasting product .Today, cultured butter is usually made from pasteurized cream whose fermentation is produced by the introduction of *Lactococcus* and *Leuconostoc* bacteria.
2. **Sweet cream butter:** Butter made from pasteurized fresh cream is called **sweet cream butter**.

Production of sweet cream butter first became common in the 19th century, with the development of refrigeration and the mechanical cream separator.

3. **Raw cream butter:** Butter made from fresh or cultured unpasteurized cream is called **raw cream butter**. While butter made from pasteurized cream may keep for several months, raw cream butter has a shelf life of roughly ten days.
4. **Clarified butter:** Clarified butter is butter with almost all of its water and milk solids removed, leaving almost-pure butterfat. Clarified butter is made by heating butter to its melting point and then allowing it to cool; after settling, the remaining components separate by density. At the top, whey proteins form a skin, which is removed. The resulting butterfat is then poured off from the mixture of water and casein proteins that settle to the bottom.
5. **Whey butter:** Cream may be separated (usually by a centrifugal separator) from whey instead of milk, as a by-product of cheese-making. Whey butter may be made from whey cream. Whey cream and butter have a lower fat content and taste more salty, tangy and "cheesy".

6.7 Ghee – Definition, Composition and legal standards

Ghee may be defined as clarified butter fat prepared chiefly from cow or buffalo milk. Sheep of goat milk also employed, although rarely, in the preparation of special designated ghee.

According to the PFA Rules (1976), ghee is the pure clarified fat derived solely from milk or from *desi* (cooking) butter or from cream to which no colouring matter is added.

Chemical composition of ghee:

Characteristics	**Requirements**	
	Cow	**Buffalo**
Milk fat	99 to 99.5 per cent	
Moisture	Not more than 0.5 per cent	
Unsaponiable matter		
a) Carotene (ug/g)	3.2 -7.4	--
b) Vit.A (I.U/g)	19-34	17-38
c) Tocopherol(ug/g)	26-48	18-37

Free fatty acid (% oleic acid)	Max.2.8 (Agmark)
Charred casein, salts of copper and iron etc	Traces

Agmak Ghee Specifications:

Agmark ghee can be freely marketed in any part of the country even though the Agmark specifications of ghee may differ from those prescribed by the constituent States of the Indian Union. The current specifications are shown in table.

Agmark standards for ghee

Tests	All-India	Regional	
		Winter	Summer
1. Baudoun		Negative	
2. Phytosterol acetate		Negative	
3. B.R.reading (40ºC)	40.0 to 43.0	41.5 -44.0	42.5-45.0
4. R.M. value	Not less than 28.0	Not less than 23.0	Not less than 21.0
5. P value	1.0 -2.0	0.5-1.2	0.5-1.0
6. Moisture(%)	Not more than 0.3		
Free fatty acid (%oleic acid) a)Special grade Agmark Red label b)General grade Agmark Green label	Not more than 1.4		

	Not more than 2.5

6.8 Desi method of Ghee preparation

The lot of makkhan, fresh or accumulated over a few days, is usually taken in a suitable open mud-pot or metallic vessel, and heated and stirred on a low fire to drive out the moisture. When practically all the moisture has been removed, a stage judged by experience, further heating is stopped and the vessel removed from fire. On cooling, when the residue has settled down, the clear fat is decanted into suitable containers.

Merits: Desirable flavour, body and texture

Demerits: i) Extremely small scale production causing collection and marketing problems; ii) low keeping quality and vitamin content.

6.9 Preparation of Ghee from cream

In this method the cream is usually obtained by normal separation of milk is heated in the same ghee boiler described for the creamery- butter method. The procedure for heating and moisture removal, final temperature of clarification, cooling and sedimentation, granulation and packaging also remain the same.

Merits: Overall economy in labour compared to the creamery butter method, since one stage viz.

Cream to butter, is eliminated.

Demerits: i) Lower percentage of fat recovery in ghee due to greater fat loss in ghee residue – the amount which is higher in this method than the butter methods; ii) slightly greasy texture in ghee.

Short answer type questions:

1. Define cream according to PFA rules
2. Enumerate methods of cream separation
3. Define butter as per PFA rules
4. What is ripening of cream
5. What is the importance of salting of butter
6. Define Ghee according to PFA rules

Long answer type questions:

1. Write briefly about manufacture of butter
2. What are the types and uses of butter
3. Write about chemical composition and AGMARK specifications of ghee.
4. Write about preparation of desi method of ghee and ghee from cream

Ψ

UNIT 7

ICE CREAM

Structure:

7.1 Ice Cream – Definition, composition and legal standards

7.2 Methods of preparation of Ice creams

7.3 Classification of Ice creams

7.1 Ice Cream – Definition, composition and legal standards

Ice cream may be defined as a frozen dairy product made by suitable blending and processing of cream and other dairy products together with sugar and flavour, with or without stabilizers or colour, and with the incorporation of air during the freezing process.

According to the PFA rules (1976), ice cream is the frozen product obtained from the cow or buffalo milk or a combination thereof or from cream and or on other milk products, with or without the addition of cane sugar, eggs, fruits, fruit juices , preserved fruits, nuts, chocolate, edible flavours and permitted colours. It may contain permitted stabilizers and emulsifiers not exceeding 0.5 per cent by weight. The mixture must be suitably heated before freezing. The product should contain not less than 10% milk fat, 3.5% protein, and 36% total solids. However, when any of the aforesaid preparations contains fruits or nuts or both, the content of milk fat may be proportionately reduced but not less than 8 % by weight, starch may be added to a maximum extent of 5 %, with a declaration to that effect on the label.

7.2 Methods of preparation of Ice creams

Method of manufacture of Ice cream

Flow diagram of manufacture:

Selection of ingredients

↓

Figuring the mix

↓

Making the mix

↓

Pasteurizing the mix (68ºC/30 min.)
↓
Homogenizing the mix (I-stage: 2500 psi; II-stage: 500 psi)
↓
Cooling and ageing the mix (0 - 4 ºC)
↓
Freezing the mix (- 4 to -5 ºC)
↓
Packaging the ice cream
↓
Hardening and storage of ice cream (- 23 to - 29 ºC)

1. Selection of ingredients: The selection of ingredients depends on (i) Availability of milk products; (ii) Perishability of the products; (iii) Convenience in handling; (iv) Effect on flavour, body and texture of ice cream (v) Cost and (vi) Equipments available.

Ice cream ingredients may be grouped into dairy and non dairy products.

I. Dairy products: These constitute the basic materials for ice cream preparation.

(i) ***Source of fat:*** (a) Sweet cream: This is the most desirable concentrated source of fat for use in a mix; (b) Frozen cream; (c) Plastic cream; (d) Unsalted butter; (e) Butter oil.

(ii) ***Source of milk-solids- not fat:***(a) Skim milk; (b) Skim milk powder-this is most frequently used in the spray dried or flaked form;(c) Condensed skim milk (plain/sweetened); (d) Sweet cream buttermilk.

(iii) ***Sources of both fat and solids-not-fat:***(a) Whole milk; (b) Whole milk powder; (c) Condensed whole milk (plain/sweetened); (d) Evaporated milk.

II. Non-dairy products

(i) Sweetening agents

(a) Cane sugar or beet sugar (sucrose): Most commonly used. The use of a combination or blend of sugars in either dry or liquid forms is a popular practice. Sugar blends consists of 70 per cent sucrose and 30 per cent corn sweeteners. Sugars (sucrose) depress the freezing point of the mix, produce a thinner mix with a slower whipping rate, and an ice cream with a smoother body and texture with faster melting qualities.

(b) Corn sweeteners:

(1) Refined corn sugar (dextrose): It is a dry crystalline product. Dextrose is 80 per cent as sweet as sucrose. It has a lower freezing point than sucrose and can be used to about 25 per cent of the total desired sugar.

(2) Dried corn syrup solids (dextrose+maltose with dextrin): Usually added to the extent of not more than one-third of the total sweetener.

(3) Corn syrup: It contains variable amount of dextrose and maltose.

(c) Invert sugar (glucose +fructose): It is mixtures of glucose and fructose (resulting from hydrolysis of sucrose) and obtained in the form of syrup. It is sweeter than sucrose. It depresses the freezing point and hence should be used to supply not more than one-fourth to one-third of the total sugar in the mix.

(**d) Saccharin:** Artificial sweetener. Sweetening effect is up to 550 times that of sucrose. It is used in diabetic ice cream.

The sweetening power of the sugars in descending order is as follows:

Fructose → Sucrose → Dextrose → Maltose → Lactose

(ii) Stabilizers: These may be defined as substances which help to preserve emulsion. Although, added in small amounts, they perform a very important role. Stabilizers are added in ice cream to produce smoothness in body and texture, retard or reduce ice crystal growth during storage, and provide uniformity in the product and resistance to melting. Stabilizers function through their ability to form gel structures in water or combine with water as water of hydration. The permitted stabilizers are:

(a) Gelatin: It is animal origin. It was one of the first of the commercial stabilizers and still used, its advantages lies in its ability to form a gel in the mix during the aging periods as well as during the freezing process, and even after the frozen product is placed in the hardening room. Its peculiar gel structure and its great affinity for waste prevent the formation of large ice crystals in ice cream and contribute to the smoothness in texture and firmness in body of the frozen product. The amount of gelatin used depends on several factors such as the source of gelatin whether from calf, pork skin or bone materials. Its gel structure is measured by bloom test. Commonly gelatin is used at the rate of 0.25 to 0.5 % for a 250 bloom gelatin. The ice-cream mix stabilized with gelatin usually requires about 4 hours of ageing developing complete stabilizing properties, while other stabilizing materials do not require an ageing period.

(b) Sodium alginate: It is a vegetable origin and widely used. It is also sold under the trade name of "Dariloid". The basic stabilizing principle 'algin' is extracted from ocean kelp (seaweed) growing on the shores of California and in Japan. This product improves whipping ability and leaves a slightly cleaner flavour in the mouth. It dissolves properly only when added to the mix at about 68-71ºC. A slightly smaller amount is needed to produce the same stabilizing effect as gelatin.

(c) Carageenan: This is extracted from Carageen (Irish Moss), as a seaweed growing on the coast of Ireland, etc. It is used together with gum stabilizers.

(d) Agar-agar: This product is extracted from red algae (sea weed) growing on the Pacific Coast. More useful for sherbets and ices.

(e) Carboxy Methyl Cellulose: This is high water holding capacity and can be easily dissolved in the mix. Also acts as an emulsifier. Slightly less of it is to be used than gelatin. It doesnot form as firm a gel as gelatin and some of the vegetable stabilizers, but seems to be good for use in ice cream.

(f) Guar gum: It is a carbohydrate obtained from Indian legume. Often used in combination with carrageenan. It is readily soluble in cold solutions and used as stabilizer for mixes to be pasteurized by HTST or continuous pasteurization methods.

(g) Pectin: This is a carbohydrate obtained mainly from citrus fruits. Not satisfactory as a stabilizer for ice cream, although suitable for sherbets and ices.

(h) Other gums: Such as Tragacanth, Arabic, Karaya, or India gums are exudates from incisions made in the bark of certain trees and plants usually in tropical countries. More useful in preparation of sherbets and ices.

(iii) Emulsifiers: They may be defined as substances which help to form emulsions. The value of emulsifying agents in the manufacture of ice cream lies mainly in the improved whipping quality of the mix, the production of drier ice cream with a smoother body and texture, in their superior drawing qualities at the freezer, and the possibility of maintaining more precise control over the various manufacturing processes.

There are two kinds of emulsifiers used in the manufacture of ice cream i.e) mono-and di-glycerides derived by the chemical reaction of naturally occurring glycerides and polyoxyethylene derivatives of hexahydric alcohols, glycol and glycol esters. The mono-glycerides improve fat dispersion and whipping ability and have a moderate effect on stiffness and melting rate. The poly-derivatives are effective in producing dryness, stiffness and increasing the melting time.

Emulsifiers are available in liquid, semi-solid and powder forms and may include glycerides, lecithin and fatty acid esters. In general, emulsifiers have little effect on the acidity, pH or viscosity of the ice cream mix. A significant reduction in whipping time is encountered when any emulsifier is used. The use of emulsifiers decreases the melting rate in the finished ice cream. Emulsifiers seem to produce somewhat smaller ice crystals which are more evenly distributed, and smaller air cells that result in smoother ice cream. Several factors may affect the action of an emulsifier. Among these are: ingredients of the mix; procedure of processing; freezing and hardening; and the amount of emulsifier used. Some disadvantages in the use of emulsifiers are: homogenization of the mix is essential in order to obtain good results and they seem to favour the development of a 'shrinkage' defect. Excessive use of emulsifiers may cause a short body and poor texture, slow melting and a curdy meltdown in the finished ice cream.

(iv)Flavours: The two most popular flavours viz., vanilla and chocolate are using all most entire world.

(a) Vanilla: This is the most popular flavour all over the world. Vanilla flavouring is obtained from the perennial climbing plant *Vanilla Planifolia Andrews,* a member of the orchid family, and it is the native of Mexico. Vanillin is the principal flavouring material. The typical vanilla flavours are developed by fermenting the bean. Artificial or synthetic vanilla is a product of a slightly different flavour than the natural one.

Classification: 1. ***True vanilla flavourings:*** a) True vanilla extract; b) Concentrated vanilla extract; c) True vanilla powders; d) Vanilla paste; e) True vanilla flavour.

2. ***Compound vanilla flavourings:*** Reinforced vanilla.

3. ***Imitation vanilla flavourings:*** a) Blends; b) synthetics.

Usage: Vanilla may be used at rates ranging from 1/8 ounce to 5-6 ounce per 10 gallons of ice cream, depending upon the extract concentration.

(b) Chocolate: Chocolate and cocoa rank second only to vanilla as flavouring of ice cream. They are obtained from cocoa beans, the fruit of the perennial tree *Theobroma cocoa*, growing in such tropical regions as Mexico, Ghana, Brazil, Venezuela, Nigeria, Ecuador, The West Indies, AfricanGold Coast and The East Indies etc. Cocao bean must be subjected to a fermentation process before the characteristic flavour develops.

Type of chocolate flavourings: a) Chocolate liquor; b) Cocoa powder; c) Chocolate blends; d) Dutch process cocoa powder.

Usage: Usual recommendation varies from as much as 4 kg of cocoa (or 6 kg of chocolate liquor) to 100 kg of ice cream mix.

(c) Strawberry; (d) Pineapple; (e) Lemon; (f) Banana; (g) Mango; (h) Orange etc.

(v) Colours: Only harmless, edible, permitted food colours should be used. Generally, colours are matched with the flavours added.

(a) Yellow; (b) Green; (c) Pink etc,

(vi)Egg solids: Frozen and powdered egg yolks are used by many ice cream manufacturers. Usually not more than 0.5 per cent of egg yolk solids are added to the mix. Egg yolk solids improve the whipping quality of the mix. They are especially desirable in mixes in which butter or butter oil constitute the main source of fat.

(vii) Fruits and nuts: The fruits in ice cream may be fresh, frozen or canned. Fresh fruits must be considered the best source of flavour when available at low prices; they should be thoroughly washed and peeled or hulled before use. Fruits may be used whole, sliced or crushed. It is better to mix fruits with sugar in the ratio of 2-7 kg. Fruit to 1 kg. Sugar and hold them at about 5ºC for 12-24 hours before using @15-20 per cent of the mix. In India, pieces of chopped mango, banana, etc. are added towards the end of the freezing process@7-8 per cent of the mix. Care should be taken to exclude inedible and fibrous parts. Eg: Apple, Banana, Mango, Pineapple and Grape.

Nuts should be sound, clean and free from rancid flavours. Considerable care should be taken to prepare them for the ice cream mix so that there are no foreign materials. To make them safe, nuts are dry-heated to pasteurizing temperature or above, they may also be fried in oil or dipped in boiling, slightly slated, sugar solution for a few seconds. All nuts should be chopped into very small pieces before they are added to the mix at 1-3 per cent. Eg. Almond, Pistachio, Cashew nut, Walnut and Groundnut.

2. Figuring the mix

Knowledge of calculation of ice cream mix is helpful in properly balancing the mix, in maintaining a uniform quality and in producing ice cream that conforms to legal standards. Ice cream mix may be divided into two groups, namely simple and complex. Simple mixes require the least calculation and are made of ingredients, each of which supplies one constituent. Complex mixes are more difficult to calculate they include mixes where at least, one constituent is obtained from two or more products. Complex mixes require the use of the Pearson's square, algebraic methods.

Before a mix can be calculated, it is necessary to:

(a) Decide upon the composition of the mix to be made.

(b) Decide on the amount of mix to be made in the batch at one time (Whether the amount, it may be calculated on the basis of 100 kg, if so desired).

(c) Choose from the available ingredients those that will give the desired quality characteristics and composition at the lowest cost.

(d) Be familiar with the composition (i.e the analysis) of ingredients to be used.

Fluid milk is usually used as the basic ingredient in ice cream mix. Since ice cream contains a higher percentage of fat than fluid milk, one of the mix ingredients must be high in fat. Cream, plastic cream or butter is usually used for this purpose. Ice cream also contains more SNF; and a source of high in these solids, such as condensed skim/whole milk, or milk powder is needed. Calculation of the mix involves finding the required weights of these ingredients along with the necessary sugar and stabilizer.

The calculations are simplified by first finding the weight of ingredients needed to make 100 kg of the desired mix. With the algebraic method, symbols such as X,Y, Z is used to represent the weights of dairy ingredients required for a 100 kg batch of mix. These symbols are then used in writing the three equations that express the weight of fat, serum solids (SNF) and the total weight of dairy ingredients needed for 100 kg of mix. The method is applicable to all types of mix problems.

3. Making the mix

The order in which ingredients are added is as follows:

All liquid ingredients are placed in a jacketed vat provided with a power stirrer, and the agitation and heating started at once. The dry ingredients, including skim milk powder, sugar, and stabilizers are added while the liquid material is agitated before the temperature reaches 49ºC. Proper suspension to avoid lumpiness of the dry ingredients may be obtained by either mixing the dry materials thoroughly with part of the sugar before slowly adding it to the liquid, or by sifting / slowly adding these substances to the liquid.

If gelatin is the stabilizer used, it is best added after it is thoroughly mixed with an equal volume of sugar, and before the liquid material reaches 49ºC. Alternatively, it can be sprinkled on the surface of the cold liquid and allowed to soak before the mixture is heated or soaked in water and then the mixture heated to completely dissolve the gelatin, which is usually added to a warm (38-49ºC) mix.

If sodium alginate (Dariloid) is used, it should not be added until the temperature of the liquid material has reached at least 66ºC. The dry Dariloid is not allowed to soak but is stirred up with cold water and immediately dumped into the hot mix.

If butter, plastic cream, frozen cream, or other frozen products are used, they should be cut into small pieces and added after time has been given to allow for complete melting before the pasteurizing temperature is reached. With a few exceptions, colouring and flavouring materials are added when the mix is frozen.

4. Pasteurization the mix

Proper pasteurization of ice cream mixes should be compulsory because this process this process destroys all pathogenic or disease producing bacteria, thereby safeguarding the health of the consumer. Pasteurization has come to be considered as highly desirable and requires only slight additional expense, since the homogenization process can be best accomplished at the pasteurization temperature level.

The ***advantages*** of Pasteurization are:

a) It renders the mix completely free of pathogenic bacteria,

b) It dissolves and helps to blend the ingredients of the mix.

c) It improves flavour,

d) It improves keeping quality, and

e) It produces more uniform products.

Proper pasteurization consists in rapidly heating the mix to a definite temperature, holding it at that temperature for a definite minimum period of time and then rapidly cooling it to below 5ºC.

The ISI specification for pasteurization temperature – time combination for ice cream mix are as follows:

Batch system: 68.5ºC for not less than 30min.

HTST method: 80 ºC for not less than 25 sec.

There is a trend towards the higher temperature process. In the batch system, the mix is usually heated and held before going to the homogenizer and from there passes over a cooler. In batch system the heating and holding may be accomplished in the vat used for mixing the ingredients.

5. Homogenization the mix

The main purpose of homogenization is to make a permanent and uniform suspension of the fat by reducing the size of the fat globules to a very small diameter, preferably not more than 2 microns.

The **advantages** of homogenisation are:

a) It prevents fat separation during ageing.

b) Produces more uniform ice cream with a smoother texture.

c) Improves whipping ability

d) Shortens ageing period.

e) Decreases the risk of churning occurring in the freezer and

f) Leads to the use of slightly less stabilizer.

The mix is usually homogenized at temperature from 63 to 77º C at pressure of 2500 to 3000 psi with one valve, or 2,500 to 3000 psi at the first stage and 500 psi at the second stage will usually give good results for an average mix (with 3to 12 % fat). [At low temperatures, homogenization increases the formation of clumps of fat globules, as also the viscosity and the freezing time in batch freezers. The pressure required for homogenization depends upon several factors: a) desired viscosity; b) composition of the mix; c) stability of the mix; d) temperature used; e) construction of the homogenizing machine].

6. Cooling and ageing of mix

Cooling the mix immediately after homogenization to 0-5ºC is essential, after which it should be held in ageing tanks until used. Surface coolers or cabinet coolers are generally used for this purpose. Ageing the mix before the freezing has been practiced since the inception of the ice cream industry. Ageing refers to holding the mix at a low temperature for a definite time before freezing. The ageing temperature should not exceed 5ºC. The ageing time under commercial conditions may range from 3 to 4 hours, except for sodium alginate which requires no ageing. Ageing produces the following results:

a) Improves the body and texture of ice cream,

b) Improves the whipping capacity of the mix,

c) Increases maximum overrun,

d) Increases melting resistance.

7. Freezing the mix

(a) Freezing is one of the most important operations in the making of ice cream for upon it depends the quality, palatability and yield of the finished product.

The freezing process may be divided into two parts. A) The mix, with the proper amount of colour and flavouring materials generally added at the freezer, is quickly frozen while being agitated to incorporate air in such away as to produce and control the formation of small ice crystals which is necessary to give smoothness in body and texture, palatability and satisfactory overrun in the finished product. B) When the ice cream is partially frozen to a certain consistency it is drawn from the freezer into packages and quickly transferred to cold storage rooms where the freezing and hardening is completed without agitation.

7.3 Classification of Ice creams

Frozen food has a complex classification problem because of frequent innovations and various possible combinations of ingredients used. Some of the frozen deserts can be classified as follows.

A. Ice cream:

1. Plain/Standard Ice cream: Ice cream in which the colour and flavouring ingredients together amounts to less than 5 per cent of the volume of the unfrozen ice cream. Example: vanilla and coffee ice creams.

2. Chocolate: Ice cream flavoured with cocoa or chocolate.

3. Fruit Ice cream or Parfait: Ice cream containing fruits with or without additional fruit flavouring or colour. Fruits such as strawberry, apricot, pineapple, mango, banana, etc., may be fresh, frozen, frozen packed, canned or preserved.

4. Nut Ice cream: Ice cream containing nuts, such as almonds, pistachio, walnuts, cashew nut, etc., with or without additional flavouring or colour.

5. Bisque Ice cream: It is made by the addition of bakery product like cake etc. and appropriate flavourings. Nuts such as grape nuts and macaroons may be added.

6. Mousse: For the preparation of mousse; sugar, colour, fruits and more flavouring materials are gently mixed into the "whipped cream". The mixture is then set into freezing mixture of ice and salt or in hardening room before freezing if required. For better consistency condensed milk may be added.

7. Rainbow Ice cream: It is a mixture of several (six or more) different coloured ice cream to give a rainbow coloured effect in final product.

8. Soft serve ice cream (Softy): Sold as drawn from the freezer without hardening

9. Philadelphia Ice cream or New York Ice cream: Some more colour for Philadelphia Ice cream and some more fat and eggs for New York ice cream are added in plain vanilla ice cream.

10. Fancy Ice cream/Fancy moulded Ice cream: Moulded in fancy shapes and composed either of one colour and flavour of ice cream or a combination of colours and flavours, or especially decorated. **Examples:** brick ice cream, cakes, cake roll, moulds representing fruits, etc.

11. Neapolitan Ice cream: If contains two or more distinct flavour in the same package.

12. French Ice cream or frozen custard: It contains some more colour and egg in such a proportion that egg yolk solids should not be less than 1.4 % of the finished product by weight.

13. Mellorine Ice cream or Filled Ice cream: When butter fat has been replace by suitable vegetable fat/oil such as dalda, ground nut oil, coconut oil and soybean oil etc, is know as filled ice cream or mellorine type product.

14. Confection: Ice cream with appropriate flavourings and particles of candy such as peppermint, butter crunch or chocolate syrup.

15. Variegated Ice cream: A plain ice cream cousin with syrup such as chocolate or butter scotch.

16. Frappe: An ice made from a mixture of fruit juices frozen to a slurry consistency and served as a drink.

17. Parevine-type products: Similar to ice cream except that no dairy ingredients are used.

B. Novelties: Novelty ice cream or frozen is an especially shaped and usually low priced package containing an individual serving whose main appeal consists in its shape, size, colour or convenience for eating. This may be made from ice cream, fruit ice, sherbet or whipped cream singly or in combination. Eg: Chocolate coated ice cream bars etc.

C. Pudding Ice cream: Such ice cram contains a mixture of fruits, nuts and raisins with or without liquor, spices (ginger, nutmeg, clove, cinnamon and allspice) or eggs.

D. Milk ices or milk lollies: According to the PFA rules (1976) these refers to the frozen product obtained from the milk or skim milk or milk products with or without the addition of cane sugar, eggs, fruits, nuts, chocolate, edible flavours, and permitted food colours. It may contain permitted stabilizers not exceeding 0.5 % of the product. The mixture should be suitably heat treated before freezing. The product should contain not more than 2.0% milk fat, less than 3.5% proteins and not less than 20.0 % total solids.

E. Fruit Ices: Made of fruit juices sugar and stabilizers with or without additional fruit acid, colour, flavouring, or water, and frozen to the consistency of ice cream. Usually contain 28 to 30 per cent sugar, 20 – 25 per cent over run and no dairy products.

F. Sherbet: made of juices, sugar, stabilizers and milk products. It is similar to an ice except that milk, either whole, skim, condensed or powdered, or ice cream mix, are used in place of all or, part of the water in an ice.

G. Souffle: When the egg yolk is added to the sherbets is known as soufflé.

H. Lacto or Frozen yoghurt: The product made by addition of sour milk to sherbets termed as lacto.

I. Granite: Water ice frozen with a very little agitation

J. Kulfi: Kulfi has whitish to slight brownish appearance, compact body, ice texture, nutty and caramel flavour. It is not whipped during processing and contains 7-8% fat, 17 – 18% SNF and 13 - 15% sugar. Kulfi mix contains concentrated milk, sugar, nut colour and flavours. Mix is poured into conical metallic moulds and frozen in a mixture of ice and salt.

Fig . 7.1 Bisque Icecream

Fig. 7.2 **Choclate Icecream**

Fig . 7.3 Fruit Icecream

Fig.7.4 Nut Icecream

Fig. 7.5 Fruit Salad

Fig. 7.6 Rainbow Icecream

Short answer type questions

1. Define Ice cream according to PFA rules
2. What are the flavours used in Ice-cream
3. What are the stabilzers used in Ice-cream
4. What is Kulfi
5. What is Fruit Ice-cream
6. What is Nut Ice-cream

Long answer type questions

1. Write briefly about the method of manufacture of ice-cream with flow diagram.

2. Write about the classification of Ice-creams

Ψ

UNIT 8
FERMENTED MILK PRODUCTS

Structure:

8.1 Starter Cultures – Types of cultures
8.2 Classification of Fermented Milks
8.3 Dahi, Srikhand & Yoghurt
8.4 Classification of cheese varieties
8.5 Chaddar and cottage cheese

8.1 Starter Cultures – Types of cultures

Fermented milks: It refer to those milks which have been made by employing selected microorganisms to develop the characteristic flavour and or body and texture.

8.2 Different fermented milks:

Natural buttermilk, cultured buttermilk, Acidophilus milk, Bulgarian buttermilk, Kumis, Kefir, Yoghurt and Dahi.

8.3 Dahi, Srikhand & Yoghurt

Dahi : According to PFA Rules (1976), dahi or curd is the product obtained from pasteurized or boiled milk by souring natural or otherwise, by a harmless lactic acid of other bacterial culture. Dahi may contain additional cane sugar.

Dahi may be classified into two types.

I. For churning into desi butter (makkhan)
II. For direct consumption

a) i).Whole milk dahi ii).Skim milk dahi

b) i). Sweet dahi ii). Sour dahi iii). Sweetened dahi

Designation of fermented milk products

Designation	Culture used
Sweet dahi	*Str.lactis* *Str.diacitilactis* *Str.cremoris* Single or in combination with or without *Leuconostoc* species
Sour dahi	Same as above, along with *Lact.bulgaricus* or *Str.thermophilus* or both

Requirements for fermented milk products

Characteristics	Requirements	
	Sweet dahi	Sour dahi
Acidity, lactic (percentage weight)	0.70	1.0
Yeast and mould count/gm	100	100
Coliform count/gm	10	10
Phosphatase test	Negative	Negative

Method of production:

Traditional method of Sweet or sour dahi:

In the household, the milk is boiled, cooled to body temperature, inoculated with 0.5-1 per cent starter (previous day's dahi or buttermilk) and allowed to set undisturbed overnight. In cooler weather, the dahi-setting vessel is usually wrapped up with woollen cloth to maintain warmth. Where as in shops the milk is concentrated before inoculation and the dahi is usually set in circular earthenware mould.

Standardized method:

FLOW DIAGRAM

Receiving milk

↓

Pre-heating (35-40ºC)

↓

Filtration/Clarification

↓

Standardization

↓

Pre-heating (60ºC)

↓

Homogenization (176 kg/sq.cm)

↓

Pasteurization (80-90ºC/15-30min)

↓

Cooling (22-25ºC)

↓

Inoculation

↓

Packaging

↓

Incubation (22-25ºC/16-18 hrs)

↓

Dahi

↓

Cooling and Storage (5ºC)

Fresh, sweet, good –quality milk is received, pre-heated to 35-40ºC, and subjected to filtration /clarification. It is then standardized to 2.5-3.0 per cent fat and 10 per cent solids-not-fats pre-heated to 60ºC and homogenized single stage at a pressure of 176 kg/sq.cm. The milk is pasteurized at 80-90ºC for 15-30 minutes, cooled to 22-25ºC and incubated with 1-3 per cent of specific starter culture. It is then filled in suitable containers of required capacity and incubated at 22-25ºC for 16-18 hours, during which period the acidity reaches 0.6-0.7 per cent and a firm curd is formed. The curd is cooled to less than 12ºC in about 1 hour and then stored at about 5ºC in cold room.

Sweetened dahi:

In the eastern region of the country, especially West Bengal, a sweetened variety of dahi known as misti dahi, lal dahi or payodhi is quite popular. It has a characteristic brown colour, a cooked and caramelized flavour and firm body. It is prepared commercially by adding 6.5 per cent cane sugar to milk either before boiling or at the time of setting. The pronounced and intense heating causes the milk to brown and partially concentrated. The volume gets reduced to about three-fourths of the original. Artificial colour, sugar-caramel and gur (jiggery) are also added during production. After heat treatment, the milk is cooled to room temperature and then seeded with previous day’s product. It is usually set in earthenware basins and the finished product obtained after 15-16 hours.

The desirable qualities in dahi offered for sale for direct consumption have been given in the table.

Market quality of dahi

Qualities	Requirements
Colour	Yellowish- creamy white for cow and creamy-white for buffalo milk; free from browning.
Appearance	Smooth and glossy surface, creamy layer on top; free from extraneous matter.
Flavour	Mild, pleasant smell, clean acid taste, free from off-flavours
Body	Soft and firm, free from gas holes and whey-pockets
Acidity (per cent lactic acid)	0.75 to 0.85

Packaging and storage: The traditional container for dahi is an earthenware cup. However, modern package includes glass bottle and plastic/plastic-coated cup. The recommended storage temperature is around 5-10ºC.

Keeping quality: When prepared in the conventional manner, dahi has a short keeping quality at room temperature; on prolonged storage, it becomes highly acidic; this is accompanied by whey formation, making product unfit for human consumption. Under refrigerated storage(5-10C), it is keeps well for a maximum period on one week.

Yoghurt:

Originally yoghurt is made from boiled concentrated whole milk, but most modern methods of manufacture use whole or partly defatted milk containing small amounts of skim milk powder or concentrate. The fat content in yoghurt may vary from 0-5 per cent and the solids content from 9 to 20 per cent.

Two microorganisms, Lact.bulgaricus and Str.thermophilus growing together symbiotically, are responsible for the lactic fermentation of yoghurt. The optimum pH and temperature for growth of Str.thermophilus is 6.8 and 38ºC(100ºF);Str.thermophilus cultures normally attain acidities of 0.85 to 0.95 per cent,whereas Lact.bulgaricus reaches acidities of 1.20 to 1.5 per cent. Cultures of Str.thermophilus are incubated at 38ºC and Lact.bulgaricus at 43ºC.Normally coagulation occurs in 12-18 hours , at which time the cultures are cooled to 5ºC. A commercial yoghurt culture which contains both micro-organisms should be incubated between 41-43ºC.

FLOW DIAGRAM

Receiving whole milk or defatted milk

↓

Addition of skim milk powder concentrate

↓

Filtration/clarification(35-40ºC)

↓

Pre heating the mix 60ºC)

↓

Homogenization (2500 psi)

↓

Pasteurization (85C/30 min)

↓

Cooling (43-44ºC)

↓

Inoculation (2%)

↓

Packaging

↓

Incubation (41-42 C/3 hrs) (0.75%T.A)

↓

Cooling and storage (5-7C)

Manufacture:

Skim milk powder or concentrate is added to whole or partly defatted milk to increase the solids-not-fat content by 2-3 per cent to a total of approximately 12 per cent. The milk is pre heated to 60ºC and homogenized single stage at 2500 psi. The milk is heated in a vat to 85ºC for 30 minutes and then cooled to 43-44ºC, inoculated with 2 per cent bulk starter and stirred briefly to ensure proper mixing. The mix is then packaged, care being taken that the temperature does not fall below 41ºC during the filling operation. The time interval between inoculation and filling should not exceed 45 minutes. Yoghurt is incubated in the package without further agitation at 41-42ºC for about 3 hours, till a titrable acidity of 0.75 per cent is reached. It is then placed under refrigeration to cool to 5-7ºC for 8 hours. A final acidity of 0.9 per cent is desired in the product.

Flavoured yoghurt has a definite advantage over plain yoghurt in that harsh acidity in the product is less pronounced, the incidence of objectionable off-flavours is reduced and much of the need of concentrating the milk is eliminated.

8.4 Classification of cheese varieties

Cheese can be classified according to the following systems:

(a) *Geographical considerations:* country, valley, institution, town or region where first produced/ marketed.

(b) *Type of milk:* cow, sheep, and goat, buffalo.

(c) *Method of manufacture:* Temperature of cooking, degree of acidity, fineness of cutting etc. These affect moisture retention which in turn affect the firmness and slow the rate of ripening.

(d) *General appearance:* flavour, size, colour, keeping quality.

(e) *Physical appearance and rheological properties:*

1. Very hard- less than 25% per cent moisture
2. Hard – 25 to 36% moisture
3. Semi-hard- 36 to 40 % moisture and
4. Soft cheese- 40 % moisture.

(f) *Chemical analysis:* water, calcium, sodium chloride, casein, lactose, fat, acidity contents.

(g) *Microbiological properties:* bacterial ripened, mould ripened, un ripened etc.

Note: The factors that influence the resultant cheese from a given lot of milk are: type of organisms added, enzymes added, acid development, temperature and time used for cooking the curd, amount of salt added, moisture content of cheese etc.

A summary of classification of some important variety is of cheeses

Country of origin	Soft	Semi hard	Hard	External mould ripened	Internal mold ripened
UK	Cream(C)	Lancashire	Cheddar Cheshire	-	Stilton
France	Neufchatel		Gruyere(P)	Camembert	Roquefort/Blue (G)
Belgium	-	Limburger (S)	-	-	-
Italy	-	-	Parmesan (VH)	-	Gorgonzola

			Romano Provolone (W)		
Germany	Romadur.	Munster	-	-	-
Holland (The Netherlands)	-	-	Edam Gouda	-	-
USA	Cottage Cream (C)	Brick	Cheddar Swiss (P)	-	Blue (G)
Sweden	-	-	Herrigard (P)	-	-
Switzerland	-	-	Swiss/ Emmental, Sapsago	-	-
Norway	-	-	-	-	Gammelost.
Hungary	Liptau	-	-	-	-

Remarks

C=high fat content; G= a general name; P = propionic fermentation leading to holes (eyes) R = ripened; s= surface slime; U= un-ripened; W = washed (plastic) VH = very hard.

8.5 Chaddar and cottage cheese

METHOD OF MANUFACTURE OF CHEDDAR CHEESE

a) Flow diagram of manufacture**:**

Receiving of milk
↓
Pre-heating (35-40 ºC)
↓
Filtration/clarification.
↓
Standardization
↓
Pasteurization (63ºC/30min.)
↓
Adding starter cultures (Ripening) at 31ºC
↓
Adding colour
↓

Adding Rennet (Renneting) 31ºC.
↓
Coagulation/Setting
↓
Cutting
↓
Cooking (up to 37-39ºC)
↓
Drainage of whey
↓
Cheddaring
↓
Milling
↓
Salting
↓
Hooping
↓
Dressing
↓
Pressing
↓
Drying
↓
Paraffining
↓
Curing/ Maturing.

b) Details of Manufacture:

Although not included in the above flow diagram, record keeping and preparation of equipment are both important.

Receiving milk: Only high-grade milk can yield high grade cheese. The quality of finished cheese depends upon the initial quality of milk from which it is made. Cheese is no better than the milk form, which it is made. Successful cheese factories follow a system of daily, efficient grading of all milk received. This consist of

Determining the odour of milk in each can/tanker. No off flavour should be accepted.

Inspecting the appearance of milk, this should be free from all extraneous matter.

Determining the sediment, either once a week or every ten days.

Performing MBRT, Resazurin and Rennet curd tests on the milk.

Determining the percentage of titratable acidity.

Examining milk for bacteriophage, antibiotics, and inhibitory substances.

After the milk has been examined for quality and accepted, it is weighed, then a representative sample is taken for determining of fat and casein contents etc.

Filtration and Clarification: The objectives of this step are to remove visible dirt in milk so as to improve the aesthetic quality of cheese made. The milk is usually preheated to 35 to 40ºC for efficient filtration and clarification.

Standardization : In cheese making standardization refers to adjustment of the casein/fat ratio in cheese to 0.68 to 0.70. The objectives are

- To regulate the fat in the dry matter of cheese.
- To produce the maximum amount of cheese per kg. of fat in cheese milk.

Pasteurization

The usual temperature-time employed for pasteurization of cheese milk is:

1. Holder – 63ºc for 30min,
2. HTST – 72ºC for 15sec.

The objectives or advantages of pasteurization of cheese milk are:

1. To destroy all pathogens
2. To destroy fault producing microorganism.
3. To produce a more uniform product of high quality.
4. To increase the yield.

The chief limitations of pasteurization are:

1. It destroys the typical flavour and body of cheese.
2. It entails a longer ripening period.
3. It encourages the use of low quality milk.
4. It increases the overall cost of cheese making.

Homogenization

Advantages:

- Lower fat losses in whey and thereby a higher yield of cheese.
- Reduced fat leakage of cheese at elevated temperatures,
- Increased rate of fat hydrolysis in some cheeses, such as blue cheese.

Disadvantages:

- A softer curd is formed, which necessitates modifications in the cheese making process.

Cheese milk is not normally homogenized.

Addition of calcium chloride: Excessive heat treatment of milk causes the precipitation of a part of calcium salts in milk. This results in slower renneting action and a weaker curd, which can be corrected by the addition of 0.01 to 0.03 per cent calcium chloride to milk.

Adding starter (Ripening)

Ripening or souring of milk refers to the development of acidity in milk from the time it is received in the vat until renneting. In cheese milk, ripening is done by the addition of starter.

The starter is the **heart** of the cheese. A bad starter is almost certain to give low quality cheese. A good starter may make up for other defects, such as contaminated milk; there are different kind of cheese starters, such as those producing acids, aroma, special effects such as'eyes' etc. A cheddar starter usually contains *Streptococcus. lactis* and /or *S. cremoris*.

The usual time to add the starter is before all the milk has been received in the vat. The amount of starter added is to the extent of 0.5 to 1 per cent of the milk, and the temperature of addition is 30 to 31ºC. Before being added to the milk, the starter should be examined for its quality; it should then be stirred until smooth and creamy in consistency; then strained and added in the required quantity and mixed thoroughly and uniformly into the milk.

Ripening (or addition of starter) aids in: (i) the formation of desirable curd; (ii) establishing a favourable bacterial flora (and checking the growth of undesirable micro-organisms); (iii) controlling moisture.

Ripening (or addition of starter) in milk is measured by titration, rennet test and pH meter.

Adding colour: The colour is used, it is added just before renneting. The colour of cheese is usually an alkaline solution of annatto. The colour is usually diluted with approximately 20 times its volume of potable water for even distribution. The usual amount of colour is 30 to 200 ml or more for 1000 kg of milk. It is vigorously agitated to ensure uniform and rapid distribution. Rennet and colour should not be mixed together before being added to the milk.

Adding Rennet (Renneting):Adding rennet to milk in cheese making is commonly known as renneting or setting.

Rennet: It is the crude preparation or extract from the abomasums or fourth or true stomach of the young calf, known as the vell. Rennet contains two principal enzymes viz., rennin, and pepsin. Rennin is an extremely powerful clotting enzyme, which causes rapid clotting without much proteolysis. On the other hand pepsin induces proteolysis is leading to bitterness in cheese. Rennet is available as liquid or powder or as tablet. Commercial rennet should be stored in a closed vessel, in a dark room at below 10ºC. The pioneer in the commercial manufacture of rennet was Christopher Hansen (Danish) who established his first rennet factory in 1874. The Hansen brand of rennet is world famous.

Properties of Rennet: It is a sulphur containing protein. One part can clot about 5 million parts of milk. In cheese making, one part of liquid rennet (2%) is used for about 5000 parts of milk. It is very sensitive to alkali. Heating to 70ºC at pH 6.8 –7.0 will destroy it in 14 minutes.

Rennet preparations other than calf rennet: These include goat and lamb rennets, plant enzymes such as withania coagulans, ficus and papain etc.

Difference in behaviour between animal and vegetable rennet: Although vegetable rennet clots cow and vegetable milks, animal rennet do not clot vegetable milks even if the calcium ion concentration is raised to that of cow's milk.

Bacterial rennet: The use of enzymes from microorganisms, particularly aerobic spore formers (*Bacillus subtilis*) and some of the gram-negative rods (*Serratia marcesens*) is a fairly new development in cheese technology.

Adding rennet: Rennet is added when it has been determined that the acid is developing at the desired rate. Thus, when making cheese from ripened milk rennet is added when the acidity has increased from initial level by 0.02 %. The ideal temperature for setting raw milk under normal conditions is 30ºC and for pasteurized milk, 31ºC. The amount of rennet extract used should be such as to form curd that is firmer enough to be cut in 25-30 minutes after the addition of rennet.

The amount of rennet, which should be added, depends on:

- Strength of the rennet
- Temperature of milk
- acidity of the milk
- composition of milk

Usually, liquid rennet is diluted with 20-40 times its volume of (potable) water before it is added, to ensure proper distribution for uniform coagulation. The milk is thoroughly stirred during the addition of the rennet and also for 3 to 5 minutes afterwards. The vat is covered as soon as possible when the stirring is over, to keep the surface warm and protect it from contaminating dust particles.

Coagulation/Setting

This refers to liquid milk changing to a semi-solid junket. The first signs of coagulation are that bubbles of air stirred into the milk surface take longer to break and a spatula dipped into the milk and withdrawn shows small flakes of curd.

Cutting: This refers to cutting of the ‘firm’ coagulum into cubes of a specific size.

When to cut the curd: When a glass rod inserted at a 45º angle and lifted straight up makes a clean breaking the curd, it is ready for cutting. If the curd is cut too soon, there will be a lower yield of cheese, if cut too late, cutting will be difficult and moisture expulsion delayed.

Curd Knives: These consist of stainless steel wires or strips, 6 or 9 mm apart, one horizontal and the other vertical.

Method of cutting: The curd is usually first cut with the horizontal knife lengthwise, then with the vertical knife lengthwise and width wise.

Syneresis of cheese curd*:* This refers to the expulsion of whey and contraction of the curd. From the cheese-making point of view, the factors controlling the loss of whey and contraction of the coagulum are: cutting, temperature, acidity, agitation, time and salt.

Behaviour of curd after cutting: After the curd is cut, whey begins to appear between the cubes and a film begins to form on the outer surface of each cube. This film should not harden, i.e., become firm, too rapidly. Care has also to be taken to avoid breaking this film.

Acidity of the curd after cutting: Decreases by 0.05 % to 0.08 % from that of milk at renneting.

Stirring curd after cutting: During the first 2-3 minutes after cutting, the curd is not stirred. Then gentle stirring starts. The speed of stirring increases with the gradual firming of curd cubes. Matting is indicative of inadequate stirring.

Cooking: This refers to the heating of curd cubes; it begins within 15 minutes of cutting.

Regulation of heating: The heat is applied slowly to begin with. If the temperature is raised too rapidly, a condition similar to 'case-hardening' will result, and the curd cubes will be hard on the outside but soft and 'water-logged' inside. The rate of heating is such that the temperature rises to 32ºC in about 15 minutes and thereafter to a maximum cooking temperature (37 to 39ºC) at the rate of 1º C every 4 minutes.

Amount of heat required: This depends chiefly on the type of cheese required. For cheddar, a maximum of 37 to39ºC is normal. Too high a temperature can reduce the souring rate and activity of the starter organisms.

Note: If acidity is developed faster, then a faster rate of heating and cooking to a higher-temperature than normal is necessary and vice versa.

Drainage of Whey (dipping): This refers to the removal of whey from the curd. When the cubes have been reduced to about one-half of their size at cutting, the acidity approaches a desirable limit and the cube attains a desirable consistency (elastic feel when squeezed), stirring is stopped and the cubes 'pitched'. (Pitching refers to the curd cubes dropped to the bottom of the vat and piling them up together). The curd cubes are pushed away from the gate of the vat, a strainer is inserted in the gate, a curd-pail is hung on the curd out let, and the whey is drawn from the vat. In actual practice, especially with large vats, it is desirable to remove one-half of the whey before the curd is quite ready so as to make quick removal of the remaining whey possible at the proper time.

Cheddaring: This refers to the combined operations of packing, turning, piling and repiling the curd cubes.

Packing: After the bulk drainage of whey, the curd cubes are kept closely together in two heaps with a channel in between. This is known as packing and takes 5 to 15minutes after dipping. It results in the formation of two long slabs of curd. These are cut with a cheese knife into blocks or strips 15 to 20 cms wide.

Turning: As soon as the blocks (strips) of curd can be handled without breaking, they are rolled bottom-side in the vat. This is called turning and is carried out every 15 minutes till the curd is ready for milling and salting.

Note: The vat is kept covered and the temperature of the curd maintained at about 32 °C.

Piling and repiling: Within 30 to 45 minutes of packing, blocks of curd are turned and laid one over another in twos or threes. This is called piling. Then the position of the curd block is altered and this is known as repiling.

The **Cheddaring** operation usually lasts for two hours or more and is very important not only for moisture control but also for improving body and texture. After cheddaring, the curd becomes drier, more mellow and silky and changes from a sorbo rubber-like material to one resembling chicken breast-meat. In the latter stages, it tends to tear apart in fibrous shreds and develops a characteristic nutty and buttery aroma. The end of the cheddaring operation is indicated by:

- Titratable acidity: 0.30-0.35 per cent more than at cutting.
- Hot iron test: long threads, 12 mm or slightly more.
- pH: About 5.4

Milling

This refers to the mechanical operation of cutting the blocks of cheddared curd into small pieces with the help of a cheese mill, with the following objectives:

- To promote the further removal of whey,
- To enable quick distribution of salt in the curd,
- To prepare curd for pressing into final form,

- For odourization,
- Cooling of the curd,
- Making cheese more uniform in composition.

Types of mill: The curd mill may be hand or power-driven. Milling is done in such a way that the curd falls into the vat itself. The curd pieces are stirred gently to prevent matting.

Salting

This refers to the addition of common salt to the curd pieces. Salt in cheese affects flavour, body and texture, and keeping quality. Cheese without salt is often soft, ripen quickly and rapidly develop unpleasant flavours.

(a) Objectives

- For further removal of whey
- Hardening and shrinking of curd
- Retarding further formation of lactic acid
- Checking the undesirable fermentation
- Produce desirable quality characteristics.

(b) Holding before salting: Salting may be delayed (by more than 15 minutes if needed) when it seems desirable to develop more acid in the cheese curd to encourage further drainage of whey, or to aerate the curd to improve its flavour.

(c) When done: Cheese curd is normally salted

- About 15 minutes after milling
- When a hot iron test shows threads 1 to 2 cm long
- When acidity is 0.4 to 0.5 % and
- When pH is 5.4 to 5.

(d) Amount of salt added: This depends on the amount of curd in the vat and salt desired, and generally varies from 1 to 2 % (average 1.5 %).

Note: Both under salting and over salting of cheese are undesirable; while under-salting produces a weak and pasty body. Open texture and abnormal ripening, over salting produces a harsh body, slow ripening, close texture and cracked rinds.

(e) Methods of salting: The curd is salted in one of the following ways: (i) Direct addition: One-third of the calculated amount of salt is added to the curd in the vat in three application; (ii) rubbing salt on the surface of the cheese; (iii) floating the cheese in 18-20 per cent brine.

Note: After the curd has been salted, there is no danger of matting.

Hooping: This refers to the curd being placed in hoops or moulds in which the cheeses curd is pressed into its final shape.

(a) Condition of curd at hooping: The salt should have dissolved completely and the curd should feel mellow and silky.

(b) Temperature at hooping: For hooping operation the temperature at hooping should be 30-32º C. Hooping and pressing at too high a temperature causes an excessive loss of fat, decreased yield, development of abnormal flavours and exaggeration of bacterial defects. On the other hand, hooping and pressing at a too a low temperature result in an open texture, imperfect rind formation and lack of whey drainage.

Dressing: This refers to arrangement of the cheese cloth before and after pressing.

(a) Before pressing: Large cheese hoops are lined with cloth before they are filled with cheese curd for pressing. Small hoops are filled with curd and pressed for 30-60 minutes without any cloth. A cloth is necessary to form a closed rind or surface. The hoops are carefully lined with cloth in order to produce a smooth surface in the finished cheese.

(b) After (first) pressing: To remove all wrinkles formed during pressing.

Pressing: This refers to the operation of forcing the particles of milled and salted curd in the hoops into the smallest possible space to give cheese its final shapes.

(a) Method: The curd is pressed in two stages: (i) Preliminary or first pressing: This shapes the cheese and reduces it to almost its final volume. It ends after 30-60 minutes when the cheese is dressed. (ii) Final pressing after dressing: This lasts for 6-12 hours (average 15 hours).

The average pressure applied on around hoops is around 70 psi and on square hoops 25 psi. While pressing some whey comes out from the curd. Pressure is applied lightly and gradually at first, but rapidly enough to prevent the curd settling at the bottom of the hoops. Full pressure is reached in about 30 minutes. Too much initial pressure traps whey in the openings between the curd particles and tens to produce on open texture.

(b) Type of press: Cheese pressing is done with the help of presses which may be, Screw or Pneumatic or Hydraulic or Spring types. In Spring type - full pressure is maintained all the time.

Drying: It is done for rind formation in cheese. It involves the following steps:

(i) First taking the cheese out of the hoop. Care is taken to see that the cheese removed from the hoop is neat, clean and uniform in size and regular in shape.
(ii) Stamping the cheese: The date, batch number, variety name etc., are stamped on the cheese for identification and record.
(iii) Keeping cheese in a drying room at 12 to 16 º C for a few days with average relative humidity of 50 %. The cheese is turned at 24-hour intervals so that both ends and sides of the cheese can dry and form the desired rind.

Paraffining: This refers to the operation of dipping the cheese for a few seconds in a bath of melted paraffin, whereby a thin coating of the paraffin is applied to the surface of the cheese.

(a) Objectives

- To reduce the loss of moisture during curing
- To prevent extensive mould growth
- To protect it against insects (as long as cheese is free from cracks).

(b) Kinds of paraffin:

(i) Paraffin wax: This is a product of the petroleum industry. The type used for cheese has a melting point of 51-52 º C.

(ii) Micro-cry stalling wax: More water and vapour-resistant.
(iii) Flexible waxes: These are combinations of paraffin and micro-crystalline waxes. They are frequently coloured (red, brown, black etc.) for an identification of the cheese.

Note: The samples of cheese for analysis are taken before paraffing.

(c) Procedure: The following steps are involved

(i) Melting of paraffin in a steel tank. Only that quantity of paraffin is used which avoids over flow when the cheese blocks are dipped in it.

(ii) Keeping the cheese-blocks, a few at a time, on metal racks (with wooden slates) on which the blocks rest on their curved surfaces while being dipped.

(iii) Maintaining the temperature of liquid paraffin in the tank at 104-121 º C. both over-heating and under heating are avoided for best results.

(iv) The cheese –blocks are dipped quickly and completely, held under paraffin for about 5 seconds, and allowed to drain for 10 seconds or until they can be handled without rubbing off the paraffin coating.

Curing: The curing/ripening/souring/maturing of cheese refers to the storage of cheese for at least 2 to 3 months at a given low temperature (0-16ºC) during which its physical, chemical and bacteriological properties are profoundly changed, resulting in the development of a characteristic flavour, body and texture.

The term 'green cheese' is usually applied to hard-pressed cheese in the early stages of ripening before the characteristic flavour, body and texture of ripened cheese developed.

The procedure involves dipping of cheese blocks quickly and completely in the melted paraffin held at 104-121º C for about 5 seconds, allowed to drain for 10seconds.

Ripening agents: These influence the rate, extent and nature of ripening in cheese and include micro-organisms (chiefly bacteria and moulds) and enzymes, including pepsin.

Systems of curing: These are,

Particulars	Cold curing	Warm curing
Temperature	0-4 º C average:1.5 º C	10-16 º C average:12.5 º C
Humidity	75 %	85 %
Duration	3-12 months	0.5-2 months
Quality of cheese obtained	Mild flavour, bacterial de minimized.	Sharp flavour, bacterial de exaggerated

Note: Soon after curing, the cheese are stored at 0.5 º C to prevent over ripening.

Changes during curing (Cheddar):

Physico-Chemical:

(i) Flavour: From a mildly acid taste and aroma in green cheese to the development of characteristic flavour of ripened cheese which is a blend of several odours and tastes of diacetyl, traces of butyric and caproic acid, esters of alcohol, salts of propionic and acetic acids in well aged cheeses. Pungent odours of compounds of ammonia and sometimes hydrogen sulphide in very old cheese.

(ii) Body: The cheese becomes slightly harder, due to loss of moisture. There is a gradual change from the rubbery body in the green cheese to a mellow and waxy body in the ripened cheese.

(iii) Texture: Curd cheese tends to acquire a fairly close to close texture.

(iv) Chemical changes: The chief chemical changes which occur during the curing of cheddar cheese are: fermentation of lactose to lactic acid and small amounts of acetic acid, propionic acid and carbon dioxide; proteolysis; and a slight fat break down. The most obvious chemical changes are the breakdown of the proteins, the newly created solubility of about 25 % of total proteins in the cured cheddar cheese. In addition to fat breakdown, the ammonia produced by moulds and certain bacteria may have considerable effect on the bacteria and so assist in the growth of other types of bacteria.

An increase in acidity and decrease in pH takes place for the first few days. The pH is lowest in cheese on about the third or fourth day after pressing, and is normally 5.10 to 5.05. It then decreases slowly and steadily during the curing period.

pH of cheese (cheddar) in relation to age:

Age of cheese	pH
3 days	5.05
7 days	5.06
49 days	5.13
9 months	5.32
24 months	5.58

Microbiological changes: All cheeses contain, or should contain, predominantly lactic streptococci during manufacture and the early stages of curing. In cheddar cheese type, which are low in moisture and close in texture sustain a steady changeover from Streptococci to Lactobacilli, some of which contribute to the flavour. Other types are of course present and the higher the proportion of miscellaneous types, the quicker is the curing and greater the possibility of off-flavours.

Shrinkage in Cheese: This refers to the loss in weight of cheese during curing/storage. Although a slight shrinkage is natural, excessive shrinkage should be prevented. Shrinkage is caused mainly by 'loss of moisture'.

Factors causing Shrinkage in Cheese:

- Temperature of curing: Higher the temperature, higher the shrinkage, and vive-versa
- Relative humidity of curing: Higher the humidity lower the shrinkage and vice-versa.
- Size (and shape) of cheese: Larger the size, lower the shrinkage and vice-versa
- Moisture content of cheese: Higher the moisture content, higher the shrinkage
- Paraffining of cheese: Paraffined cheese undergoes less shrinkage, than non-paraffined cheese.

Note: The other cause of shrinkage is loss of fat.

(f) Methods of measuring the curing process:

1. Judging: This is the most practical method. The cheese is examined organoleptically at regular intervals for changes in flavour, body, texture, colour and appearance.
2. Physico-chemical and microbiological changes: These include: (i) rheological properties such as hardness/firmness, elasticity, plasticity etc., (ii) the freezing point; (iii) enzyme content; (iv) microbiological flora and content; (v) moisture, lactose, fat-acidity, pH, volatile-acidity contents; oxidation-reduction potential, salt-distribution, etc.
3. Protein changes: Protein degradation measurements have been used systematically in studying the ripening of cheese. The rate of ripening is measured by determination of the 'ripening index'

Ripening Index= % soluble nitrogen / %total nitrogen X 100

Factors affecting the rate of Cheese curing:

(i) Time: The rate of curing is higher in the earlier stages than in the later ones. (During the first three months, two-thirds of the total water soluble protein-degradation compounds are formed).

(ii) Temperature: The higher the moisture content, the higher the rate of curing and vice-versa.

(iii) Moisture content of cheese: The higher the moisture content, the higher the rate of curing, and vice versa.

(iv) Size of cheese: The larger the size, the higher the rate of curing and vice versa.

(v) Salt content of cheese: The greater the salt content, the lower the rate of curing and vice versa.

(vi) Amount of rennet added for coagulation of milk: The greater the amount of rennet added, the higher the rate of curing, and vice-versa.

(g) Role of lactic acid in cheese making and curing: Lactic acid plays an important role in the manufacture and curing of cheese because of the following effects:

1. Helps in curing milk with rennet,
2. helps in expulsion of whey,
3. helps in the fusion of curd particles,
4. exerts protective action against putrefactive bacteria,
5. Favours proteolysis action of rennet extract during curing.

FREEZING OF CHEESE

Freezing of cheese may damage its texture. Whereas in fresh cheese the substances dissolved in the moist portion include lactose, milk salts and sodium chloride, as the cheese cures, increasing amounts of water soluble protein degradation compounds are added. There is also a gradual decrease in moisture due to evaporation. Thus the percentage concentration of substances dissolved in cheese-moisture gradually increases and the freezing point is continually lowered as curing progresses. On average, the freezing point of cheddar cheese may be – 4.5 ° C in fresh cheese and – 14.5 ° C in cheese more than a year old.

COTTAGE CHEESE

This is a soft, unripened cheese usually made from skim milk. It has mildly acid flavour and consists of small particles or flakes or curd, which have a meaty consistency. Creamed cottage cheese has cream mixed to it up to 4 % level. Both varieties are salted.

Cottage cheese can be prepared by both, direct acidification and by starter culture methods. In direct acidification method, any food grade acid, phosphoric, lactic acid etc., are used.

The types of curd are Acid curd, in which the milk is coagulated by lactic acid developed by the action of lactic starter and Rennet curd in which milk is coagulated by the action of rennet in the presence of lactic acid, developed in turn by the action of lactic starter.

Character of cottage cheese in relation to type of curd:

Type of curd	**Character of cheese**
Acid	Small particles/grains
	Extremely acid flavour (mildly acidic if thoroughly washed)
	Lowers yield
Rennet	Large particles/flakes
	Mildly acidic flavour
	Higher yield
	Meaty body

Rennet curd may be formed either by short setting or long setting methods, particulars of these rennet curd formation are:

Particulars	Short setting	Long setting
Setting temperature	29 – 32 ° C	22 ° C
Setting time	4 – 6 hours	15 – 16 hours
Amount of starter added to milk	4 - 5 % (up to 10 %)	0.3 – 1.0 %

METHOD OF MANUFACTURE

Receiving (pasteurized) skim milk

↓

Adding calcium chloride

↓

Adding starter culture (lactic cultures)

↓

Adding rennet (0.01 %)

↓

Setting (30ºC)

↓

Cutting

↓

Cooking (up to 46ºC, over 2 hrs)
↓
Drainage of whey
↓
Washing and draining the curd
↓
Salting
↓
Creaming
↓
Packaging and storage

1. Receiving of Milk: The skim milk should be fresh, sweet, low in fat and bacterial count and clean in flavour. It should be pasteurized immediately after separation preferably by LTLT method as it produces softer curd which is easily broken while cutting and handling.

2. Adding Calcium Chloride: Calcium chloride is generally added to the skim milk at the rate of 1 ml saturated solution per 100 liters of milk, with the objective of increase the concentration of calcium ions for better setting and formation of the firm curd desired. It is added after the pasteurized milk has been cooled to the setting temperature.

3. Adding Starter culture: A high quality starter consisting of either *S.lactis, S.cremoris,S.diacetylactis, L.dextranicum,* etc., singly or in combination is then added at1 to 2.5 % levels and thoroughly mixed into it.

4. Adding Rennet: Rennet is added at 2-2.5 ml per 1000 litre of milk. It is diluted with water up to 40 times with water before adding.

Note: Cheese colour may be added, if desired, at 2-4 ml . per 1000 litres of milk before adding rennet.

5. **Setting:** The temperature is set around 29-32ºC.

6. Cutting: The most desirable acidity of whey at cutting is approximately 0.5 % (pH 4.6-4.7). The whey should be clear and free from curd particles.

Note: Too low acidity at cutting causes an undesirable rubbery consistency in the curd. On the other hand, too high an acidity induces a brittle consistency in the curd; and this causes it to shatter during handling, thus decreasing the yield.

7. Cooking: This begins soon after cutting and continues for an hour or two until the temperature reaches 46ºC or until the curd becomes hard enough for removal of whey. Stirring during cooking is done very gently and at a minimum rate.

8. Drainage of Whey: Whey is removed when the curd cubes no longer have a 'soft center' and when a handful of them squeezed gently show slight elasticity. The whey is removed from the curd approximately two hours after cutting. By this time the size of the curd cubes is approximately two-thirds of their original volume. The whey is drained in the same way as in cheddar cheese.

9. Washing and Draining: The curd is washed after removing all the whey to produce desired firmness and mildness in flavour. The wash water is at the temperature of 21ºC and after soaking for 15 minutes the water is drained. Second washing is done with water at 16ºC. Draining should be thorough; the cubes are placed in draining rack with perforations at the bottom, which can be wheeled into cold store rooms.

10. Salting: This is done when the free moisture has been drained from the curd. Salt can be added to the curd in the vat, or it can be dissolved in the cream for creamed cottage cheese. Salt is added @ 1 % of curd weight (or 15 % of milk).

11. Creaming: This is done immediately after draining, if the product is to packed at once. Holding the curd overnight in a cold room before it is creamed makes it more firm when creaming. The amount of 20 % cream is required to give 4 % fat in the finished product is then homogenized before mixing so as to form thick glossy coats over the curd particles.

12. Packaging and Storage: Cottage cheese, creamed or uncreamed, may be packed in waxed / polythene-coated paper cups or in polythene bags. Storage is at 5 ºC or less.

YIELD OF COTTAGE CHEESE

The yield of cottage cheese before creaming depends essentially on:

- The composition of the milk
- Manufacturing losses
- The moisture content of the cheese

Approximately the yield of cottage cheese is 15 %.

KEEPING QUALITY OF COTTAGE CHEESE

The keeping quality is short even under refrigerated conditions (5-10 ºC). Uncreamed cottage cheese may be preserved for 90 days or longer by freezing or by brine storage. However, it will deteriorate in quality because freezing often leads to graininess and curd-shattering, particularly with rennet cheese.

Short answer type questions:

1. Define dahi according to PFA
2. Write classification of dahi
3. Write about cultures used in sweet and sour dahi
4. What is renneting of cheese
5. What is cheddaring of cheese
6. Define cottage cheese as per PFA rules
7. Enumerate different types of fermented milks

Long answer type questions:

1. Write about traditional method of dahi preparation with flowchart?
2. Write about the preparation of yoghurt with flow chart
3. Write briefly about the method of manufacture of cheddar cheese with flowchart
4. Write briefly about the method of manufacture of cottage cheese with flowchart

Ψ

UNIT 9

Concentrated and Dried Milks

Structure:

9.1 Classification of Concentrated Milks

9.2 Preparation of Condensed and Evaporated milk

9.3 Dried Milks – Definition, Types and standards

9.4 Preparation of whole Milk Powder and Skim Milk Powder

9.1 Classification of Concentrated Milks

According to the PFA, (1976) the various condensed milks are specified as follows:

Unsweetened condensed milk (evaporated milk): It is the product obtained from cow or buffalo milk or a combination therefore, or from standardized milk, by the partial removal of water. It may contain added calcium chloride, citric acid and sodium citrate, sodium salts of orthophosphoric acid and polyphosphoric acid not exceeding 0.3 per cent by weight of the finished product. Such addition need not be declared on the label. Unsweetened condensed milk should contain not less than 8.0 percent milk fat, and not less than 26 per cent milk solids.

Sweetened condensed milk (condensed milk): It is the product obtained from cow or buffalo milk or a combination thereof, or from standardized milk, by the partial removal of water and after addition of cane sugar. It may contain added refined lactose, calcium chloride, citric acid and sodium citrate, sodium salts of ortho phosphoric acid and poly phosphoric acid not exceeding 0.3 per cent by weight of the finished product. Such addition need not be declared on the label. Sweetened condensed milk should contain not less than 9.0 percent milk fat, and not less than 31 per cent milk solids and not less than 40.0 per cent cane sugar.

Unsweetened condensed skim milk (evaporated skimmed milk): It is the product obtained from cow or buffalo milk or a combination thereof, by partial removal of water. It may contain added calcium chloride, citric acid and sodium citrate, sodium salts of ortho phosphoric acid and poly phosphoric acid not exceeding 0.3 per cent by weight of the finished product. Such addition need not be declared on the label. Unsweetened condensed skim milk should contain not less than 20.0 percent total milk solids. The fat content should not exceed 0.5 per cent by weight.

Sweetened condensed skim milk (condensed skimmed milk): It is the product obtained from cow or buffalo skimmed milk or a combination thereof by the partial removal of water and after addition of cane sugar. It may contain added refined lactose, calcium chloride, citric acid and sodium citrate, sodium salts of orthophosphoric acid and polyphosphoric acid not exceeding 0.3 per cent by weight of the finished product. Such addition need not be declared on the label. Unsweetened condensed skim milk should contain not less than 26.0 per cent total milk solids and not less than 40 per cent cane sugar. The fat content should not exceed 0.5 percent by weight.

9.2 Preparation of Condensed and Evaporated milk

Method of manufacture, packaging and storage of Condensed Milk

Receiving milk
↓
Filtration /Clarification (38-40ºC)
↓
Standardization
↓
Fore warming/preheating (115-118 ºC / No Hold)
↓
Condensing (2.5:1)
↓
Addition of sugar
↓
Homogenization
↓
Cooling and Crystallization
↓
(Quickly cooled to 30ºC
↓
Seeded with 0.1 - 0.3% lactose
↓
Vigorous stirring and slow cooling for 1 hour.
↓
Temperature of 15 ºC reached
↓
Stirring continued until packed)
↓
Packaging
↓
Storage at 10 ºC.

Details of manufacture:

The basic principle in the production of condensed milk and evaporated milk is that high quality milk is filtered /clarified, standardized, fore-warmed and condensed /evaporated to the desired level. The concentrated product is preserved by the addition of sugar for condensed milk and by heat sterilization for evaporated milk.

1. Receiving Milk: When the milk is received at the plant, its temperature should be at 10ºC or below. The milk should be clean, sweet, and free from off-flavours and odours and reasonably free form extraneous material. Contamination by antibiotics, pesticides and other chemical residues and metals is highly undesirable; abnormal milk should not be accepted. Acid development is objectionable for not only does this indicate an excessive bacterial count, but it also reduces the heat stability of milk.

The various platform tests and laboratory tests usually performed on the intake milk to determine its acceptance /rejection of milk but much reliance is placed on Alcohol test and Clot-on-Boiling (COB) test.

Alcohol test: To make this test, 5 ml of milk is placed in a test tube and an equal amount of solution with 68 % alcohol added, the mixture is shaken and any formation of clot or flake denotes a positive test, i.e., the milk is susceptible to heat coagulation. A disturbed salt balance affects alcohol coagulation in the same manner as heat coagulation. The test detects: abnormal milk including colostrum. Which is high in mineral salts and developed acidity in milk, mastitis milk likely to result in sweet curdling etc., It is more sensitive than the COB test.

Alcohol index: determined by placing absolute alcohol in the burette and 10 ml of milk in a beaker. The number of ml of alcohol required for flake formation is known as the Alcohol Index (AI). An AI of 7 is indicative of good stable milk for acceptance, while 3 or less shows that the milk is fit for rejection.

Alcohol alizarin test: This test not only determines the heat stability of milk but also the pH.

Clot on boiling test: In this test, 5 ml of milk is placed in a test tube and kept in a boiling water bath for 5 minutes, afterwards it is removed and examined for precipitation, if curd is observed, the milk is said to fail the COB test and should be rejected.

After the milk has been accepted on the basis of the above tests, it is weighed, sampled and tested for fat and SNF etc.

2. Filtration/clarification: This is done in order to remove the visible foreign matter at a temperature of 35-40ºC, and then cooled.

3. Standardization: This is done so as to conform to legal standards in the finished product. Standardization of the raw milk is carried out in 3 stages:

- The first standardization which establishes the desired fat / SNF ratio (usually 1:2.44, done in raw milk))
- The second, which establishes the desired ratio of added sugar to the total milk solids (done prior to condensing)
- The third, which adjust the concentration of the finished condensed milk to the required percentage of total solids content (after finishing the batch, i.e., prior to homogenization)

4. Forewarming / Pre-heating: This refers to the heating of milk before it is condensed. The purpose of pre-heating of milk is:

- Making the finished product free from microorganisms and enzymes,
- To ensure uninterrupted boiling in the vacuum pan,
- To control objectionable age thickening in the finished product.

The temperature-time combination varies over 82-93ºC for 5-15 minutes or 116-149 ºC for 0.5 to 5 minutes. Now a day's HTST heating such as 115-118 ºC, for no hold/flash is practicing. Tubular heat exchangers are commonly used for pre-heating; either double tube or shell and tube heat exchangers are preferred. The several systems of fore warming may be grouped as below:

Equipment	Principle of heat-exchange
Hot well	Either direct heating by injection of live steam, or indirect steam-in -jacket heating.
Continuous flow Heaters (plate or tubular)	Indirect steam heating in alternate plates or concentric tubes
Closed pressure heater (tank or tubular)	Indirect steam heating in a closed tank or in concentric tubes under Pressure.

5. Addition of sugar

Sugar is added for preserving the condensed milk, without resorting to sterilization process, and cane sugar or beet sugar is commonly added as sweetening agent. This ranges from 40-45 % in the finished product, which requires 18-20 percent sugar on milk basis. As per Hunziker, (scientist), advocated a sugar ratio (sugar-in –water concentration) of 62.5 to 64.5 per cent. This amount not only ensures proper protection against microbial growth, but also prevents sugar crystallization.

Sucrose in granulated or syrup form must be of good quality. Liquid sugars (appx. 65 % sucrose) should be subjected to a high pasteurizing temperature to destroy the micro-organisms before they are added to condensed milk.

Sugar is added at the end of the condensing process. The dry sugar is dissolved in the least possible quantity of water. If added before condensing, an increase in viscosity and greater difficulty in the evaporation of moisture result. If added during forewarnings, increase the heat resistance and survival capacity of the micro-organisms, thereby adversely affecting the keeping quality.

6. Condensing: The basic principal consists in the removal of water from the standardized/whole milk by boiling it under partial vacuum at a low temperature till the desired concentration is reached. This operation is carried out in an evaporator, which should preferably single-effect type (also known as a vacuum pan). The chief advantages of condensing milk in vacuum are:

- ✓ Economy of operation,
- ✓ Rapidity of evaporation,
- ✓ Protection of milk against heat damage.

Vacuum condensing achieves the object of obtaining a finished product which is free from any cooked flavours and can be readily reconstituted into the original milk.

7. Homogenization:

At proper consistency, the product is removed from the vacuum pan and homogenizes to obtain a uniform fat emulsion and reduce fat separation to a minimum during storage. A special type of homogenizer suitable for homogenizing viscous product is used at a pressure of 200 PSI at first stage and 500 PSI at second stage (total pressure is 2500 PSI). A temperature and time combination that reduces the fat globules to less than 2 microns in diameter is required.

8. Cooling and crystallization:

Prompt cooling is desirable to delay the tendency of age-thickening and discolouration, which is accelerated by prolonged exposure to heat. The product is cooled to about 30-40 °C and seeded with lactose. Lactose plays an important role in the successful control of the texture of condensed milk. The size of lactose crystals in condensed milk determines the relative smoothness of the product.

Seeding condensed milk: "Seeding" refers to the introduction of lactose in very fine powder form (3, 00,000 to 4, 00,000 crystals per cubic mm) during the cooling process to provide nuclei for crystallization. The purpose of seeding is to give the lactose present in the supersaturated state an added incentive to crystallize. The seed material commonly used is powdered lactose of commerce (α-lactose-hydrate) or pulverized non-fatty dry milk, or sweetened condensed milk from a previous batch. For best results, the seed lactose should be able to pass through a 200-mesh screen (Mesh refers to the number of screen openings per lineal inch) consistent with preservation of sharp crystal edges. Before seeding, lactose powder should be heated to 93 °C under vacuum. This converts the α-lactose-hydrate to α-anhydride form. Now grind the α-anhydride lactose using impact pulverize mill. After packaging, this lactose powder should be sterilized at 130 °C for one to two hours.

Amount of seed lactose to use: The rate of seed lactose is 375-500 gms pr 1000 kg raw milk or 0.1 to 0.3 per cent of condensed/finished milk. The amount of non-fat dry milk (SMP) and condensed milk for seeding is about tow times than lactose.

Method of adding seed lactose to the batch: The seed lactose should not be added to the batch in dry form. Such practices causes it to lump together into large aggregates which do not disintegrate readily. In this condition the seed material is incapable of inciting mass crystallization. A means of ensuring a uniform dispersion of seed material is essential. Therefore, before seeding, seed material should be blended in a small amount of condensed milk then add to the batch during vigorous agitation. The agitation must continue while crystallization takes place, in order to stimulate the formation of numerous small crystals of lactose (rather than a few larger ones). The above operation must be carried out under strict hygienic conditions.

Lactose crystal formation: Rapid crystallization leads to the formation of a large number of small crystals, giving a smooth texture to the condensed milk; on the other hand, slow crystallization creates a small number of large crystals which produce a sandy or gritty texture. After "seed" lactose is uniformly dispersed, cooling of the product may be continued slowly to 24 °C about one hour. Then cooling is completed to 13-18°C with continued agitation. The rate of crystal formation is controlled by the amount of agitation, number of nuclei, total solids in the product, temperature and viscosity. Vigorous agitation (stirring) during cooling is highly important which increases the rate of crystallization, besides ensuring uniform small sized lactose crystals in the batch system.

Finishing the cooling process: After seeding and crystallization, cooling is resumed under constant agitation, as rapidly as possible, until the final temperature is reached. Agitation is continued for another hour or longer, when the product is ready for packaging.

Condensed milk
(Discharged from vacuum pan)
↓
Quickly cooled to 30 °C
↓
Seeded with 0.1-0.3 % lactose
↓
Vigorous stirring and slow cooling for 1 hour
↓
Temperature of 15°C reached
↓
Stirring continued until packaged

Systems of Cooling: These are (a) Batch type; (b) Continuous flow; (c) Combination of Batch and Continuous; (d) Vacuum cooling systems.

(a) Batch type: The equipment for cooling and crystallization consists of an especially designed tank or vat, with water-jacketed sides and bottom, and a powerful rotary agitator. These coolers are provided with nylon/rubber scrappers of special design that press closely to the cooling surface. The cooling is done by controlled circulation of refrigerated water through the jacket. The milk is seeded at the proper temperature for mass crystallization and the cooling resumed at the end of the forced crystallization period. Some of the batch coolers are operated under vacuum.

(b) Continuous-flow type: This system is represented by the internal tube counter-current. This type of cooler is used in large-scale operations, particularly when condensed milk is the main product of the plant.

(c) Combined batch and continuous: A common combination is to use the continuous internal tube cooler from the pan to seeding temperature, and finish the operation in a crystallizer tank. Alternatively, the batch is run from the pan into the crystallizer tank, and then cooled to seeding temperature, seeded, and the cooling finished by means of the continuous flow internal tube cooler.

(d) Vacuum cooling:

The milk is condensed in the regular vacuum pan or evaporated to a predetermined point, after making due allowance for the additional evaporation that will occur in the cooler. The batch is dropped from the pan directly into the vacuum cooler. When the temperature in the cooler has been lowered to about 32 °C, the batch is seeded (by blowing lactose 'dust' through the side of the cooler, using pressure difference as the motivating force). This causes mass crystallization. At the end of the forced crystallization period, the milk is further cooled to 10°C. Agitation is continued throughout until the product is packaged.

Advantages over other systems:

1. The time required for cooling is relatively short.
2. The cooling is uniform throughout the batch.
3. This cooling system yields mass crystallization; the size of most of the lactose crystals ranges from 5 to 8 microns.
4. The finished product has an exceptionally smooth and velvety texture.
5. It enhances the keeping quality of the finished product.

10. Packaging: The product is then aseptically packaged in tin-containers which are hermetically sealed. Bulk packing may be done in barrels of various sizes, drums with polythene liners, or tin-containers. For the retail market, fillers are used to package condensed milk in cans. After filling, the cans are sealed, labelled and packed in cases for storage and distribution. The retail cans are filled with automatic filling machines. In general, the filling machines consist of multiple-piston pumps. The cylinder charge can be adjusted to the size of the cans to be filled. It is important to fill the cans fully in order to exclude as much of the air from the container as possible.

11. Storage: Properly packaged product can be stored for several months at room temperature. During storage, a wide temperature variation may increase the tendency of sandiness. A very low storage temperature such as 0 °C or below may not only cause sandiness but also sugar (sucrose) separation. Cool storage is important to prevent storage. In recent years, storage of condensed milk at 10 °C or slightly below. The humidity of surrounding air should be low (below 50 %) to check spoilage of cans and labels.

METHOD OF MANUFACTURE OF EVAPORATED MILK

Flow diagram of manufacture

Receiving milk
↓
Filtration / Clarification (35-40° C)
↓
Standardization
↓
Forewarming / Pre-heating (115-118° C / No hold)
↓
Evaporation (1:2.5)
↓
Homogenization fisrt satge - 2000psi

Second stage - 500psi
↓
Cooling (7°C)
↓
Pilot sterilization test (117°C, for 15 mins)
↓
Packaging
↓
Sterilization (116-118°C / 15 mins)
↓
Cooling (27-32°C)
↓
Shaking
↓
Storage (5-15°C)

1. Receiving milk: It is same as condensed milk.

2. Filtration/clarification: It is same as condensed milk.

3. Standardization: Standardization of the raw milk is carried out in 3 stages,

- For desired fat/SNF ratio, (usually 1:2.44, done in raw milk)
- Desired ratio of added sugar to the total milk solids (done prior to condensing)

- To adjust the concentration of the finished product to the required total solids content (after finishing the batch, i.e., prior to homogenization).

4. Fore-warming/Pre-heating

The main purpose of this is to improve heat stability of milk and to ensure a medium viscosity in the finished product. Further, this is done for making the finished product free from micro-organisms and enzymes, to ensure uninterrupted boiling in pan and to control age thickening in the finished product. The time temperature combination varies over 82-93ºC for 5-15 minutes or 115 –118ºC for no hold. Tubular heat-exchangers are commonly used.

5. Evaporation

Evaporation means the concentration of milk or liquid products: the water has to reach a boiling point: and the steam must have a pressure equivalent to ambient pressure. Vapour (steam) is removed by the pressure difference. No sugar is added here and normally a continuous operation takes place. It is customary to slightly over-condense the milk to facilitate standardization later.

6. Homogenization

After evaporation and before cooling, the evaporated milk is thoroughly homogenized to obtain a uniform fat emulsion and reduce separation of fat to a minimum during storage. The temperature is usually 49 ºC as the product is removed from the last part of the evaporator. Two-stage homogenization is generally recommended, 2000 psi in the first stage and 500-psi in the second stage.

Note: In developed countries, evaporated milk is enriched with Vitamin-D. This is done either through irradiation (U.V. radiation) or fortification (addition of Vit-D rich substances).

7. Cooling:

After homogenization, the evaporated milk is cooled to 7 ºC if it is to be sterilized on the same day, as in small-scale handling; however, in large-scale handling it is cooled and held at 5 ºC. The cooled product is held in large storage tanks for re-standardization of fat or total solids. Stabilizing salts may also be added at this point if pilot tests indicate such a need.

8. Pilot sterilization test

Purpose is to determine the amount of chemical stabilizers (trisodium citrate or disodiumphosphate) to be added to any given batch of evaporated milk for the most satisfactory heat stability.

An approximate 10 percent solution of stabilizer is prepared for use, so that 0.1ml of the solution is equivalent to the addition of 1 g of dry salt for every 16 kg of evaporated milk or nearly 6 to 7 gm stabilizer is added for 100 kg evaporated milk in the form of 10% solution.

The amount of stabilizers to be added to any batch is determined by trial. The sample cans containing measured amount of stabilizer solution and a fixed quantity of evaporated milk are sterilized at 117 ºC for 15 minutes and then cooled rapidly to 24 ºC. As soon as they have been cooled the cans are opened, examined for smoothness and colour and tested for viscosity. According to Mojonnier and Troy, a viscosity of 150ºR on the Mojonnier-Doolittle viscosimeter represents the correct viscosity of evaporated milk as it comes out of the sterilizer.

If the viscosity tests for pilot sterilized can show that no stability correction is necessary, the batch is ready to be filled into the cans. However if the tests show otherwise, stability corrections becomes necessary.

Based on the pilot sterilization test, the calculated quantity of stabilizer should be added to the evaporated milk in the form of a solution using just enough water to dissolve it.

9. Packaging

The cans are now mechanically filled with volumetric fillers, the types of one used for this purpose are the sanitary can, the can with a solder seal, and the vent hole can. The temperature of evaporated milk when filling the cans should be neither high nor low, but around 5 ºC; a higher temperature cause foaming; while a lower temperature increases the tendency towards ‘flipping’ (This refers to the sudden snapping of can ends from their slightly concave contour to a convex outward bulge, which is usually accompanied by an audible sound). The cans should be filled as nearly full as possible.

10. Sterilization

Immediately after sealing and before sterilization, each can is tested by means of a dependable leak checker /detector, where the cans pass submerged in a hot-water bath. In case of leaky cans, air bubbles rise to the top: these cans are removed for repair. The filled and sealed cans, which have passed the test for leaks, are now ready for sterilization. The purpose of sterilization is to destroy all germ life and enzymes present, thereby preserving the product permanently. In addition, the sterilizing process is utilized to increase the viscosity and improve the body so as to give a creamy consistency to the finished product. During sterilization, the temperature is raised to 116-118 ºC and held at this temperature for 15 minutes. If the cans cannot be sterilized within an hour or two, they should be then held under refrigeration (5-7 ºC).

There are two types of sterilizers in use, viz., batch and continuous.

Merits and demerits of sterilizers:

Type of sterilizer	Merits	Demerits
Batch	Useful for both small and large plants Usable for cans of all sizes Low initial cost	Higher labour cost
Continuous	Low labour cost	Not useful for small plants Made for a particular can size only High initial cost

11. Cooling

Immediately after holding time is over, the evaporated milk is cooled within 15 minutes to 27-32ºC. Rapid and uniform cooling is important. This requires, for the batch system, not only a plentiful supply of cold water but also its uniform distribution all over the sterilizer. Further, delayed cooling may cause the cans to bulge badly. Bulging can be avoided by admitting sufficient quantity of compressed air. In the continuous system, the cooler operates at 10 psi.

12. Shaking

This is done to mechanically break down any curd, which might have formed during the process of sterilization to a homogenous smooth consistency. A shaking period from about $1/4^{th}$ -2 min is usually sufficient. Excessive shaking should be avoided as it decreases the viscosity.

13. Storage

Though evaporated milk can be stored at room temperatures, a storage temperature of 5-16 ºC is generally used, which helps to keep the product acceptable even up to 2 years. The humidity of surrounding air should be low (below 50 %) to inhibit spoilage of cans and labels. Inversion of cans once in 3-6 months during storage will help to minimize fat separation.

9.3 Dried Milks – Definition, Types and standards

Dried milk or milk powder is the product obtained by the removal of water by heat or the suitable means, to produce a solid containing 5 per cent or less moisture. The dried product obtained from whole milk is called Dried whole milk or whole milk powder (WMP); and that from skim milk is known as Dried Skim Milk or Skim Milk Powder (SMP), or Non-fat Dry Milk (NFDM).

a. PFA Legal Standards

Whole Milk Powder: "According to the PFA Rules, (1976), whole milk powder is the product obtained from cow or buffalo milk, or a combination thereof, or from standardized milk, by the removal of water. It may contain calcium chloride, citric acid and sodium citrate, sodium salts of ortho phosphoric acid and poly phosphoric acids, not exceeding 0.3 per cent by the weight of the finished product, and 0.01 per cent of butylated hydroxy anisole (by weight) of the finished product. Such additions need not be declared on the label. Milk powder should contain not more than 5.0 per cent of moisture and not less than 26.0 per cent of fat. The total acidity expressed as lactic acid should not be more than 1.2 per cent. The standard plate count may not exceed 50,000/g and the Coliform count may not exceed 90/g. The maximum solubility index should be 15.0 for roller dried and 2.0 for a spray dried product.

Note: The process of drying must be mentioned on the label. The spray dried product must be packed in hermetically sealed containers when the net quantity exceeds 510/g.

Skim Milk Powder: "According to the PFA Rules, (1976), skim milk powder is the product obtained from cow or buffalo milk, or a combination thereof, by the removal of water. It may contain calcium chloride, citric acid and sodium citrate, sodium salts of ortho phosphoric acid and poly phosphoricacids, not exceeding 0.3 per cent by the weight of the finished product. Such additions need not be declared on the label. Skim milk powder should contain not more than 1.5 per cent of fat and the moisture may not exceed 5.0 percent. The total acidity expressed as lactic acid should not be more than 1.5 per cent. The standard plate count may not exceed50.000/ g. and the Coliform count may not exceed 90/g. The maximum solubility index should be 15.0 for roller dried and 2.0 for a spray dried product.

b. Indian standards for Dried Milks:

According to the Indian Standards Institution, the specifications for dried milks are:

Characteristics	Requirement for	
	Whole milk powder	Skim milk powder
Flavour and odour	Good	Good
Moisture (%Wt) (Max)	4.0	5.0
Total milk solids (%Wt)	96.0	95.0
Solubility :		
(a) Solubility index (Max)	15.0 (Roller dried) 2.0 (Spray dried)	15.0 (Roller dried) 2.0 (Spray dried)
(b) Solubility (%Wt) (Min)	85.0 ml (Roller dried) 98.5 ml (Spray dried)	85.0 ml (Roller dried) 98.5 ml (Spray dried)
Total ash (on dry basis) (% wt) (Max)	7.3	9.3
Fat (% Wt)	Not less than 26.0	Not more than 1.5
Titratable acidity (% lactic)	1.2	1.5
Bacterial count per g. (Max)	50,000	50,000
Coliform count per g. (Max)	90	90

9.4 Preparation of whole Milk Powder and Skim Milk Powder

Method of manufacture of Drum process of Whole Milk Powder (WMP) and Skim Milk Powder (SMP)

Whole Milk Powder

Receiving Milk
↓
Filtration/Clarification (35-40 °C)
↓
Standardization
↓
Forewarming (85°C/10 min)
↓
Condensing
↓
Homogenization {2500 psi- I stage; 500 psi-II stage (63-77°C)}
↓
Pre-heating (74-85 °C)
↓
Drum drying
↓
Packaging
↓
Storage (Room temperature)

Detailed Manufacturing Process:

a) Receiving milk: Only high quality milk should be accepted.
b) Filtration/Clarification: The chief object of this is to remove extraneous matter.
c) Standardization: This is done to adjust the ratio of fat and solids-not-fat in raw milk to meet the legal standards for composition in dried whole milk. Raw milk is standardized by adding to it a calculated amount of skim milk or cream.
d) Forewarming: This is important for the destruction of micro-organisms and inactivation of enzymes, and for improving the physical quality of the finished product. Heating skim milk to 85 °C for 10 minutes ensures good baking properties in the skim milk powder.
e) Condensing: Normally total solids of 16-18 % in the condensed product are appropriate.
f) Homogenization: The whole milk is usually homogenized after concentration and before drying to reduce the propagation of free fat in the dried product, thereby lowering the chances of

oxidized flavour development. The homogenization is carried out at 63-77°C in two stages, 2500 psi on the first stage and 500 psi on the second stage.

g) Pre-heating: This increases the efficiency of drum drying. It is carried out by heating the feed-concentrate to 74-85°C before pumping it into the reservoir between the drums.
h) Drum drying:
i) Packaging:
j) Storage:

Skim Milk Powder

Receiving Milk
↓
Pre-heating (35-40 °C)
↓
Separation
↓
Forewarming (85°C/10 min)
↓
Condensing
↓
Pre-heating (74-85 °C)
↓
Drum drying
↓
Packaging
↓
Storage (Room temperature)

Same as for whole milk powder except that 'standardization' and 'homogenization' are omitted, while 'clarification' is taken care of during centrifugal cream 'separation'.

Method of manufacture by Spray process of Whole Milk Powder (WMP) and Skim Milk Powder (SMP)

Whole Milk Powder

Receiving milk
↓
Cooling (5°C)
↓
Standardization (Fat/SNF:1/2.769)
↓
Pre-heating (71°C)
↓

Filtration/Clarification
↓
Homogenization {2500 psi- I stage; 500 psi-II stage (63-74°C)}
↓
Heating (93°C for 3 min)
↓
Condensing
↓
Pre-heating (71°C)
↓
Pumping (2500 psi)
↓
Spray drying (82°C outlet air)
↓
Cooling (32 °C)
↓
Sifting
↓
Vacuum treatment plus nitrogen
↓
Packaging
↓
Storage (Room temperature)

Detailed Manufacturing Process:

a) Receiving milk: Only high-grade milk should be accepted.
b) Cooling: To preserve the quality of milk.
c) Standardization: This is done to adjust the ratio of fat and solids-not-fat in raw milk to meet the legal standards for composition in dried whole milk. Raw milk is standardized by adding to it a calculated amount of skim milk or cream.
d) Pre-heating: For efficient filtration/clarification.
e) Filtration/Clarification: The chief object of this is to remove extraneous matter.
f) Homogenization: It improves keeping quality of the powder. A pressure of 3000 psi (2500 psi on the first stage and 500 psi on the second stage) at 63-74 °C is sufficient.
g) Heating: This actually serves the purpose of forewarming/preheating. The main object is to prolong the shelf life of the dried product by inactivation of lipase. The pre-heating should also ensure pasteurization, thus reducing the viable micro-organisms. A beneficial influence on the heat stability of the product may follow from the pre-heat treatment. Several optimum temperature-time combinations of heating in the range of 82°C for 15 minutes to 93°C for 3 minutes are used in commercial practice.

h) Condensing: Normally a concentration of 35-45 % total solids is produced, and the concentrate is continuously removed from the evaporator with the help of a continuous density tester.

i) Pre-heating: The temperature of the condensed milk after leaving the evaporator is boosted approximately 71°C in a heat-exchanger before being pumped, in order to increase the efficiency of spray drying.

j) Pumping: This forces the hot concentrate through the atomizer. Generally a pressure of 2500 psi is used.

k) Spray drying: The concentrated milk is dried with inlet air at 143-232°C and exit air at 74-93°C, depending on product characteristics. To reduce heat- damage during drying and yet obtain the desired moisture, a low exhaust air temperature is preferred.

l) Cooling: The dry whole milk should be removed promptly from the hot air stream to maintain better flavour and body characteristics and also keeping quality. The higher the temperature and the longer the time, the product is above the melting point of fat, the greater the amount of free fat obtained, thus adversely effecting keeping quality. Hence it is essential to cool the powder immediately to a temperature below the melting point of fat.

m) Sifting: A 12-inch mesh screen is used for sifting dry whole milk.

n) Packaging:

o) Storage:

Skim Milk Powder

Low heat SMP:

Receiving milk
↓
Cooling (5°C)
↓
Pre-heating (35°C)
↓
Separation
↓
Pasteurization
↓
Low heat SMP (71°C/15 sec)
↓
Condensing
↓
Re-heating (63°C)
↓
Filtration

↓
Pumping (3000 psi)
↓
Spray drying (85°C outlet air)
↓
Cooling (32 °C)
↓
Sifting
↓
Packaging
↓
Storage (Room temperature)

High heat SMP:

Receiving milk
↓
Cooling (5°C)
↓
Pre-heating (35°C)
↓
Separation
↓
Pasteurization
↓
High heat SMP (71°C/15 sec)
↓
Pre-heating (85 °C/ 20 min)
↓
Condensing
↓
Re-heating (74°C)
↓
Filtration
↓
Pumping (3000 psi)
↓
Spray drying (85°C outlet air)
↓
Cooling (38 °C)
↓
Sifting
↓
Packaging
↓
Storage (Room temperature)

Detailed Manufacturing Process:

a) Receiving milk:

b) Cooling:

c) Pre-heating and separation: Cream can be separating with or without pre-heating the milk; special cold milk separators are required for the low-temperature method. The most important consideration is a high degree of separation efficiency (not more than 0.1 % fat in skim milk).

d) Pasteurization: (I) Low heat SMP: Its manufacture requires that heating will be carefully controlled during pasteurization so as to produce the minimum number of heat-induced changes. Control of both temperature and time is important. Higher temperature and/ or longer holding time contribute directly to whey protein nitrogen (WPN) content per g. of powder. It should have a WPN of 6 mg. or more. (II) High heat SMP: A higher heat treatment imparts good baking qualities to the powder. For this purpose, besides pasteurizing at 71°C for 15 seconds, the powder is pre-heated a second time at 85°C for 20 minutes before being condensed. Its WPN content should be not more than 1.5 mg.

e) Condensing: Normally a concentration of 40-42 % total solids is produced, and the concentrate is continuously removed from the evaporator with the help of a continuous density tester.

f) Re-heating: The temperature of the condensed milk after leaving the evaporator is boosted approximately 63°C (in low heat SMP), 74°C (in high heat SMP) in a heat-exchanger before being pumped, in order to increase the efficiency of spray drying.

g) Filtration: This is done to remove any extraneous matter from the concentrate before atomization, so that it can function smoothly.

h) Pumping: This forces the hot concentrate through the atomizer. Generally a pressure of 3000 psi is used.

i) Spray drying: The concentrated milk is dried with inlet air at 143-232°C and exit air at 74-93°C, depending on product characteristics. To reduce heat- damage during drying and yet obtain the desired moisture, a low exhaust air temperature is preferred. Low heat SMP is dried up to 3-4 % moisture, while high heat SMP usually has not more than 3.5 % moisture.

j) Cooling: Most milk driers have a continuous removal system to immediately separate the dry product from the hot air stream. The dry product should be cooled at once. If the SMP is too hot when packed, it may become lumpy due to 'heat-caking', and development of storage defects in flavour and colour may be rapid.

k) Sifting: A 25-mesh screen is commonly used for sifting dry skim milk.

l) Packaging:

m) Storage:

INSTANTIZATION

It refers to the process by which dried milk and milk products are made instant-soluble.

1. Purpose: To improve the rate and completeness of the reconstitutability of dry milk and milk products. This process affects wettability, sinkability, dispersability and solubility of the particles, however total solubility is not improved.

2. Products: Mainly applied to SMP/non-fat dried milk. However, WMP and other milk fat containing dry dairy products are also being instantized.

3. Characteristics:

1. Lowers bulk density and hence increases packaging costs.
2. Increases moisture content of the finished product, which lowers the keeping quality.

This process involves moistening the particles surface, agitating the particles in an air stream so that they collides and adhere one to another to form loose, irregular clumps of particles or agglomerates, then again drying, cooling and sorting them in size.

4.Major systems/Processes: These are (i) The Peebles process; (ii) The Cherry-Burrell process; (iii) The Blow-Knox process. The above process are American and in addition, there are NIRO and ANHYDRO Agglomerators are Danish. The equipments of each system vary in detail.

Common features: These are: (i) *Wetting* of the surface of the particles with steam, atomized water, or a mixture of both (in a tube or chamber); (ii) *Agglomeration*, which occurs because the particles collide with each other due to turbulence, and adhere to each other to form clusters (in a tube or chamber or cyclone); (iii) *Re-drying,* with hot filtered air (in a chamber or cyclone or deck); (iv) *Cooling,* it is cooled to proper temperature (v) *Sizing* to eliminate the very large agglomerates and the very small particles; (vi) *Sifting and packaging,* particle size should be uniform as possible. A minimum size of fine particles in the range of 25-50 microns are preferred. After sifting the powder in a required sized meshed screen, it should be packaged properly.

Packaging of Dried Milks:

The powder-packaging unit should be isolated to reduce the spread of powder dust to the drier building. Of the several packing material used, fiber board carton with an over wrap of foil laminated to paper, or with an inner lining of foil laminated to paper. A polythene bag inside the fibreboard carton is also used. Plastic coated paper bags are the latest. Powder packing should be carried out in a dry atmosphere, sealed promptly hermetically in moisture proof package to prevent caking of lactose and fat decomposition leading to off-flavours. Usually, in packaging of milk powders, the head space is reduced followed by removal of oxygen, by injecting vacuum and then replacing it with nitrogen.

Presently plastic coated paper bags are in use for packaging of dried dairy products. Powder packaging should be done:

1. In a dry atmosphere between the drier and sealed package.
2. Promptly in a hermetical moisture proof package.

This is because lactose is present in a amorphous state in freshly prepared dried milks which is very hygroscopic. If exposed in a humid atmosphere it will readily absorb moisture, become sticky and cake in storage.

The general procedure for gas packaging of whole milk powder is to remove oxygen immediately by subjecting the product to a vacuum of 71 cm of Hg within 24 hours of drying with final packaging in few days. Less than 2 % oxygen in the head space gas of the package is considered satisfactory for most storage conditions. A good quality whole milk powder with low oxygen content can be expected to withstand room temperature for more than six months without any oxidized off-flavour. Delay in packaging cause a deterioration in quality during the holding period. Nitrogen or nitrogen plus carbon dioxide (<20%) are used in packaging whole milk powder.

Skim milk powder is generally packaged in barrels, drums and bags. For retail purposes it is packaged in cans, glass jars or cartons. A 2 mil-polythene bag inside a 4-ply-kraft paper bag is common package for domestic commercial trade, cartons of fibre boards, foil and metal as retail containers.

Storage of Dried Milks:

High storage temperature us detrimental to the keeping quality of dried milk and milk products. A temperature, less than 24 °C is desirable. For maximum keeping quality, dried milk products should be stored in moisture proof and vapour proof sealed package in a dark, cool and dry place. In warm climate, a refrigerated storage should be used. Container should not be open for retail distribution; it should be done in original containers of required size.

Yield of Dried Milks: The yield of milk powder depends on the total solids content in the raw milk, losses during production and moisture content in the final product.

Short answer type questions:

1. Define evaporated milks
2. Define condensed milk
3. Define evaporated skim milk
4. Define condensed skim milk
5. Define whole milk powder
6. Define skim milk powder

Long answer type questions:

1. Write briefly about the manufacture of condensed milk with flowchart?
2. Explain briefly about the manufacture of evaporated milk?
3. Explain about manufacture of spray process whole milk powder with flow chart
4. Explain about manufacture of spray process skim milk powder with flow chart

Ψ

UNIT 10
INDIGENOUS MILK PRODUCTS

Structure:

10.1 Classification of Indigenous Milks with examples

10.2 Khoa and Khoa based sweets

10.3 Channa and Channa Based sweets

10.4 Paneer

10.5 Kheer

10.6 Kulfi

10.1 Classification of Indigenous Milk products with examples

Classification of different indigenous milk products

Indian Dairy Product	Corresponding western product
I. Concentrated Whole milk products:	
1. Kheer/Basundi	Condensed milk
2. Khoa/Mawa	Evaporated milk
3. Rabri	Clotted cream
4. Kulfi	Ice cream
II. Coagulated milk products	
1. Dahi	Curd/Yoghurt
2. Srikhand	Curd (sweetened)
3. Paneer	Soft cheese
4. Channa	lactic coagulated green cheese

III. Products of the clarified butter fat industry

1. Makkhan — Butter
2. Ghee — Butter oil
3. Lassi — Buttermilk
4. Ghee residue

10.2 Khoa and Khoa based sweets

According to the PFA Rules (1976), Khoa is the product obtained from cow or buffalo(or goat or sheep) milk, or a combination there of , by rapid drying. The milk fat content should not be less than 20 per cent of the finished product.

Classification:

The main types of Khoa , viz., Pindi, Dhap and Danedar. All these varieties are required for specific types of sweets.

Type	Gross composition(%)		Specific sweets produced	Remarks
	Fat	Moisture (Total solids)		
Pindi	21-26	31-33(67-69)	Burfi (plain, pista, chocolate,coconut) Peda etc	
Dhap	20-23	37-44(56-63)	Gulabjamoon, pantooa , etc.	
Danedar	20-25	35-40(60-65)	Kalakand,Gourd Barfi,etc	Milk of high acidity produces a granular khoa

Methods of production:

Three methods have been known in the production of khoa. They are

i) Existing trade practices
ii) Improved method

iii) Continuous method

Existing practice/trade practice:

Required quantity of milk is taken as per batch and boiled in a karahi (vessel) of different shape and size over a brisk non-smoky fire. The milk is stirred vigorously and constantly with a circular motion by a ladle or khunti. During this operation, all parts of the pan with which the milk comes in contact are lightly scraped to prevent the milk from scorching. Constant evaporation of moisture takes place and the milk thickens slowly. However, no sugar is added and milk-dehydration continues. At certain concentration (cow milk2.8; buffalo milk 2.5) until heat-coagulation of milk proteins begins and the concentrate becomes insoluble in water. There is change of colour at this stage, and heating is continued with greater control with increased stirring-cum scraping speed. Soon the viscous mass reaches a semi-solid/pasty consistency and begins to dry up. The final product is ready when it shows signs of leaving the bottom and sides of the karahi and sticking together, which is known as the khoa-pat. This is invariably made after removing the pan from the fire and working the contents up and down into a single compact mass.

Improved method:

This is followed in organized firms, where, the equipment, conditions of dehydration, and the quality of the milk used are given importance. The karahi and open fire substituted with stainless steel jacketed-pan or kettle, which is heated by water or steam. Milk is boiled till it assumes pasty consistency and then held at 85 ± 3ºC and stirring at 96-100 rpm. Regarding the quality of the milk used, buffalo milk is preferred over cow milk as the latter produces soft, loose body and gives smooth a granular texture which is not relished. The milk should contain 4% and 5% fat respectively for cow and buffalo milk. Neutralization of acid milk improves the texture but does not improve the flavour of khoa. Starch adulterated milk gives hard khoa. Homogenization of milk produces softer body and fat leakage.

Continuous method:

Here milk is continuously heated in the steam jacketed drum heater, where it is partially concentrated. This is followed by another heating and concentration of the milk in open pans till a viscous semi-solid product is obtained and is removed mechanically. The equipment basically consists of

1. A steam-jacket drum heater with a rotary scrapper and milk outlet
2. Two open steam-jacketed pans with outlet valves

3. Two sets of scrapers for the pans and
4. A power drive for the scrapers.
5. A cover is provided in the pan to prevent any dust or dirt falling into it.

Principle: The milk is continuously heated in the steam-jacketed drum heater, wherein it is partially concentrated. This is followed by further heating and concentration of the milk in open-steam jacketed pans till a viscous semi-solid consistency is obtained and the khoa is removed mechanically. Power-driven scrapers provided in the drum heater and in the open steam-jacketed pans, scrape the vigorously to prevent it from scorching and burning.

Physico-chemical changes in milk on conversion into khoa

The following are the changes that are encountered while milk is being converted into khoa.

a) Change of state :From liquid milk to solid khoa (due to considerable dehydration)
b) Change in intensity of colour: From 'light' to a more intense shade of colour with a tinge of brown.
c) Homogenization of milk fat: The fat globules are appreciably subdivided due to vigorous agitation of the milk at a high temperature.
d) Free-fat formation: Considerable free fat is produced due to rupturing of the fat globule membrane by the scraping action of the stirrer.
e) Heat coagulation of milk proteins: The serum proteins are coagulated by the action of heat and concentration.
f) Super-saturated solution of lactose : From a dilute solution in milk, lactose is present in khoa as a super-saturated solution.
g) Partial precipitation of milk salts: A portion of the milk salts are precipitated by the action of heat.
h) Increase in Iron content: From 2 to 4 ppm in milk, the iron content in khoa exceeds 100 ppm due to scrapping of the pan surfaces during the manufacture.

Physical quality:

This includes: i) colour and appearance ii) body and texture iii)flavour, and iv) suitability for sweets.

Physical quality of cow and buffalo khoa

Particulars	Cow	Buffalo
Colour	Sraw/pale yellow with a tinge of brown	Whitish(dull/light greenish white), with a tinge of brown
Appearance	‘Moist’ surface	‘Slightly oily/greasy’surface
Body	Slightly hard	Soft
Texture	Slightly sandy	Smooth and granular
Smell	Rich, nutty	Rich, nutty
Taste	Slightly salted	Slightly sweet
Suitability for sweets	Suitable	Highly suitable

Yield: The type of milk, cow or Buffalo, influences the yield by virtue of its total solids content. Buffalo milk with higher total solids gives higher yield than cow milk. Normally the yield of khoa with 28% moisture ranges from 17 to 19 % from cow milk and 21to 23 % for buffalo milk.

Over-run: The over-run in khoa refers to the ‘the excess weight of khoa obtained over the amount of total (milk) solids used. It is influenced by the moisture chiefly. The formula for calculating overrun (OR) in khoa is:

%OR = K – TS / TS X 100

Where,

K = weight of khoa (in kg)

TS= Weight of total solids in milk (in kg).

Packaging: The following modern packaging materials are commonly used; Vegetable parchment paper wrappers; plastic (polythene) film bags/pouches, laminated preferable aluminium coated pouches; tin plate cans etc. The pack size usually varies from 0.5 to 1.0 kg.

Storage: Khoa has a low keeping quality at room temperature, and storage at low temperatures (5-10ºC) has been found to extend shelf-life. The average storage life of Khoa made either from cow or buffalo milk at 37± 1ºC, 23-24 ºC and 5-10ºC was 7,10 and 25 days respectively.

Other Traditional Indian Products

1. **Burfi:** A khoa based sweet, it is white to light cream in colour with firm body and smooth granular texture. Prepared by heating khoa over a low fire with 25-35%sugar to form a smooth mass. Nuts and flavourings may be added while heating to produce a variety of burfies.
2. **Gulabjamun:** Khoa is mixed with small amounts of wheat flour and baking powder and kneaded into uniform dough. It is then rolled into small balls and deep fried in ghee. The balls are then put in 60% sugar solution and soaked for few hours before serving.
3. **Kalajamun:** Similar to gulabjamun but darker, it can be prepared either from channa or khoa. The kneaded balls are deep fried to black colour and then soaked in 60 % sugar solution for few hours.
4. **Kalakand:** Made from granular khoa, it is light caramel in colour with a granular texture and firm body. Some citric acid is added during khoa making process to get grains, then sugar is added and stirred to mix the sugar. Flavourings and nuts maybe added and allowed to set, which is latter cut into pieces.
5. **Peda:** The base material is khoa, where it is mixed with sugar and flavourings. Khoa is mixed with sugar in the ratio of 3:1and then gently heated till the mixture forms firm balls. Peda is whitish yellow in colour and has a coarse, grainy texture. Kesar peda is one in which saffron is mixed along with flavour and colour.
6. **Chumchum:** A sweet prepared from channa, it has a firm body, a close knit texture and is coated with sugar or khoa. Channa is kneaded, made into balls and cooked in 50% boiling sugar syrup. Then they are taken, cut into half and a layer of khoa is sandwiched in between two halves of the balls and its surface is coated with sugar or khoa and decorated with silver foil.
7. **Pantooa:** A product similar to gulab jamun, it has channa as the base material as compared to gulubjamun which used khoa. Channa is mixed with baking powder and wheat flour, and the mass in kneaded, made into balls and fried in 60% sugar syrup solution.

8. **Rasagolla:** This is prepared using fresh and soft channa as the raw material, in the form of small round balls, which is cooked in sugar syrup for 15 minutes and transferred to sugar syrup of 45-50% concentration.
9. **Sandesh:** A channa based sweet, which has firm body and smooth texture. Channa (30-35%) and sugar are mixed together and kneaded and then heated after addition of colour and flavour.
10. **Rabri:** A concentrated and sweetened milk product, containing several layers of clotted cream.

10.3 Channa and Channa Based sweets

Chhana: Channa refers to the milk- solids obtained by the acid coagulation of boiled hot whole milk and subsequent drainage of whey. The acids commonly used are lactic or citric, in both natural or chemical form.

According to PFA Rules (1976), Chhana or paneer is the product obtained from cow or buffalo milk or combination thereof by precipitation with sour milk, lactic acid or citric acid. It should not contain more than 70 per cent moisture, and milk fat content should not be less 50.0 per cent of dry matter.

Methods of production:

There are two methods for making chhana which are adopted by commercial manufacturers.viz. The batch and bulk methods.

Batch method:

Usually all milk for chhana – making is brought to boil by heating it directly in a large iron karahi over an open fire, all the while stirring it with a khunti, and later keeping it simmering hot in karahi. This hot milk is ladled out in batches of 0.5 to 1 Kg into a separate coagulation vessel, either already containing, or to which is promptly added the required quantity of coagulant. The later is normally cleansed sour chhana- whey which is maintained in large earthen vessel from day to day. The mixture of milk and whey is stirred with ladle until complete coagulation takes place; the contents are poured over a piece of clean muslin cloth stretched over another vessel. The process is repeated till all the milk is used up. The cloth containing the coagulated solids is then removed, tied up into bundle without applying pressure and hung up not only to drain out the whey completely but also to cool the chhana-pat.

Bulk method:

All the milk (5-15 kg) is brought to boil as above in the karahi, which is then removed from fire. The coagulant is then added slowly and gradually in required quantity to the entire lot of milk and stirred with ladle so that it mixes properly and clear coagulation takes place. The chhana is collected by straining through a cloth as described above for batch method.

Improved method:

The milk is heated in the stainless steel jacketed-kettle by admitting steam into the jacket, the stirring cum-scraping usually being done with khunti. When the milk reaches first boil, the steam intake is stopped, the condensate is removed and cold water circulated in the jacket. Coagulation is simultaneously effected by adding the requisite amount of coagulant in thin stream within 0.5 to 1 minute and mixing it into the milk with the stirrer. When the whey is clear, it is removed by straining it through a cloth and chhana is collected.

In order to obtain desirable body and texture of chhana with cow milk the pH of coagulation should be around 5.4, the temperature of coagulation about 82 C and time in which coagulation should be effected about 0.5 to 1 minute. A satisfactory strength of the coagulating acid solution is 1-2 per cent. While lactic acids produce granular texture suitable for rossogolla, citric acids tend to produce a paste one suitable for sandesh.

For Chhana preparation, cow milk is preferred since it yields a soft-bodied and smooth – textured product and produce good quality chhana sweets. The chhana from buffalo milk is slightly hard body and a greasy and coarse texture and does not produce good quality chhana sweets.

Large scale/continuous method:

Fresh, sweet, buffalo milk is filtered and standardised to 6 per cent of fat. It is heated in a cheese vat to 82 ºC for 5 minutes and cooled to 70 ºC. The milk is coagulated by the addition of the requisite amount of acid solution sour whey. When it has coagulated completely the stirring is stopped and the curd is allowed to settle for 5 minutes; the whey is drained out through a muslin cloth. During this period the temperature of the whey is not allowed to fall below 63 ºC. The coagulated mass is collected and filled in hoops with cloth lining and pressed for 15-20 minutes. The pressed paneer is removed from the hoop, cut it into required sizes for sale and immersed in chilled water (4-6 ºC) for 2-3 hours to make it firm. The pieces are then removed from the water and placed on wooden planks to remove the free water. Later, they are wiped with a clean cloth and packaged in polythene bags for refrigerated (5-10º C) storage or marketing.

Physical quality of cow and buffalo chhana

Particulars	Cow	Buffalo
Colour	Light yellow	Whitish
Appearance	Moist surface	Greasy surface
Body	Soft	Slightly hard
Texture	Smooth	Slightly coarse
Flavour	Mildly acid	Mildly acid
Suitability for sweets	Highly suitable	Not suitable

Yield: The yield of chhana containing 49 to 54 per cent of moisture ranges from 16 to18 per cent for cow and from 22 to 24 per cent for buffalo milk.

Keeping quality: The keeping quality of chhana under ordinary packing is on average 2, 3 and 12 days at 37ºC, 24ºC and 7ºC respectively.

10.4 Paneer

Paneer refers to the indigenous variety of rennet-coagulated, small sized, soft cheese. Examples are surati panir, bandal cheese etc.

Method of preparation: The improved conventional method and a commercial method in organized dairies are discussed below.

Improved conventional method: This is for use on cottage industry scale using indigenous utensils and wicker baskets.

Materials required:

i) Milk coagulating water-jacketed pan;

ii) Basketing ladle

iii) Bamboo wicker baskets

iv) Draining rack

v) Whey collecting tray

vi) Cheese- soaking basin

vii) Salt sprinkler

viii) Other accessories, such as thermometer, acidity testing outfit, weighing scale, starter, rennet etc.

Technique of production:

Fresh buffalo milk, standardized to 6 per cent fat, is pasteurized by heating it to 78ºC (172ºC) of 20 seconds and promptly cooling it to 35º C (95ºC).About 0.5 to 2 kg. of this milk is placed n the coagulating pan and the temperature maintained at 35ºC (95 ºF) by circulating warm water in the jacket. Good quality lactic starter @ 0.5 per cent of milk is now added to the milk and thoroughly mixed into it. This is followed by addition of rennet @ 6-7 ml /100 lit. milk. The rennet being previously diluted with about 20 times its volume of water. The quantity of rennet added should be such as to give a clean cut in the curd at the end of about 60 minutes. After mixing it adequately, the renneted milk is allowed to set till a firm coagulum fit for basketing is obtained. The temperature during this time is maintained at 35 ºC or 95º F.

The curd is then ladled out with a vertical slant in thin slices, and filled into bamboo/wicker baskets. These baskets are prepared by cleaning them with scalding water, keeping them soaked in a 10 per cent lukewarm salt solution for about 10 minutes, and then thinly dressed with salt. Each successive layer of curd put into the baskets is uniformly sprinkled with salt. Salting is done @ 4-5 % of the green cheese. After filling the baskets are placed on the draining rack to allow for drainage of whey. Generally, at the end of 50-60 minutes, the individual pieces of cheese are firm enough to be handled without breaking. At this stage, they are carefully turned upside down in their respective baskets. This is known as ‘First turning’. After draining them for a further 30-40 minutes, the cheeses, on attaining the desired firmness and consistency, are subjected to their ‘Second Turning’. The collected whey is then strained through a muslin cloth and kept in the cheese soaking basins. The pieces of cheese are removed from the baskets and carefully submerged in the whey. They are then left steeped in whey for 12-36 hours till disposed of or used.

Commercial method:

This is for large scale production in organised dairies. Milk(cow, buffalo or mixed) is standardized to a casein/fat ratio of 0.7, the average percentage of fat and total solids should be 4.0 and 13.25 for cow milk and 4.7 and 14.5 for buffalo milk respectively. The milk is pasteurized at 71.5 ºC for 5 minutes and then cooled to 35 ºC in the cheese vat. Good quality lactic acid is now added at 0.04 per cent and thoroughly mixed into it. This is followed by addition of rennet@7.5 g/100 lit. Milk, which is pre-diluted with about 20 times water. After thoroughly mixing, the milk is allowed to set at 35 ºC. The amount of rennet should be such that the setting time of curd is about 30 minutes.

When the curd is ready to cut, it is cut into cubes with standard cheese knives. Five minutes after cutting the curd, dry cheese salt @ 2.5 per cent of milk is added and mixed by agitating it gently. The whey is drained off after 30 minutes of cutting the curd. The curd cubes are then put in standard brick-cheese hoops without any application of pressure. The first turning is given after 30 minutes of hooping and the second turning after 30 minutes of the first. After 30 minutes of second turning, the cheese is taken out of the hoop. It is then sliced into the desired size, steeped in whey and stored at 4-6 ºC.

Yield: The yield of surati panir is approximately 28.5 per cent for cow and 34.0 per cent for buffalo milk.

Keeping quality: This is normally 1-2 days for the traditionally made product; and up to 6 days for the standardized product under refrigerated storage (5-10 ºC), although the freshness is lost after 3 days.

10.5 Kheer

Kheer is a rice pudding, originating from the Indian subcontinent, made by boiling with milk and sugar one of the following: rice, broken wheat, tapioca, vermicelli, sweet corn, etc. It is flavoured with cardamom, raisins, saffron, cashews, pistachios, almonds or other dry fruits and nuts. It is typically served during a meal or as a dessert. It is also known in some regions as meetha bhaat, payasam, payasa, and phirni.

Kheer is a heat concentrated milk based confection with added cereals, sugar, nuts and dry fruits. The different varieties of kheer and payasam are

Rice kheer
Saboodana payasam
Semya / Semolina payasam
Kaddu- ki- kheer
Khas-Khas kheer

Rava - payasam

Coconut - kheer

Lauki-ka- kheer

Green gram dal payasam

Bengal gram dal payasam

Method of Preparation:

Buffalo milk is preferred for both payasam and kheer preparation. Standardized buffalo or cow milk with 4.5%-5.5% fat and 8.5 to 9% SNF is taken in a pan and boiled on a non smoky fire. Good quality rice is taken, washed and added to milk @ 2.5%. Gentle boiling accompanied by thorough stirring cum scraping of the contents is undertaken. When the ratio of concentration of milk reaches 1: 1.8, sugar is added @ 5-7.5% of the milk taken. Further heating with stirring is continued until the rice is properly cooked and approximately when the concentration reaches 2 to 3 times. Powdered cardamom (@0.02%) is mixed as flavouring at the end of heating.

Chemical composition of kheer depends on

1.Kind of milk (cow/buffalo/mixed)

2.Quality of milk

3.Ratio of concentration

4.Quality and type of cereals/pulses/optional ingredients

5.Keeping quality of Kheer

6.The average shelf life of kheer at 37°C ± 1°C is 2-3 days and 10-15 days at 4°C ± 1°C.

7.Extension of shelf life of kheer

8.Successful attempts made to improve the shelf life of kheer are given below:

9.Addition of nisin

10.Addition of Nisin at the end of preparation could extend the shelf life of kheer upto 8-10 days at 37°C ± 1°C and 100-150 days at 4 ± 1°C.

Sterilization:

Kheer packed in tin cans when heat treated by immersing in boiling water for 20 minutes, could keep well for 3-4 days at room temperature and 60-70 days at 4 ± 1°C. The shelf life of canned kheer manufactured, cooked and sterilised simultaneously was extended to six months at 30°C.

Dried Kheer Mix: Production of kheer in a dry form suitable for ready reconstitution will extend the shelf life of the product.

Method of preparation:

Fresh buffalo milk is standardized to 6.9 % fat and and 9.5% SNF. The milk is preheated at 60°C for 15 min in the preheater of triple effect evaporator and then concentrated to 35% TS. Homogenisation of milk concentrate is done at a pressure of 183 bar in the first stage and 36 bar in the second stage. Then it is mixed with ground rice and sugar and slurry is heated to a temperature of 80°C for gelatinizing of rice in as steam jacketed vessel. Using a fluidized bed dryer the slurry is dried and instantized. The product is packed in metalized polyester LDPE bags. Reconstitution of kheer mix involves rehydration of instant rice in boiling water for 10 min followed by dispersal of the powdered component into the rice water mixture. Then the product is garnished with dry fruits, flavors etc.

10.6 Kulfi (Qulfi)

It is a frozen dairy dessert originating from the Indian subcontinent during Mughal India. It is often described as "traditional Indian ice cream. It is popular throughout India, Sri Lanka, Pakistan, Bangladesh, Nepal, Burma (Myanmar), and the Middle East, and widely available in restaurants serving cuisines from the Indian subcontinent around the world.

Kulfi has similarities to ice cream in appearance and taste; however it is denser and creamier. It comes in various flavours. The more traditional ones are cream (malai), rose, mango, cardamom (*elaichi*), saffron (*kesar* or *zafran*), and pistachio. There are newer variations such as apple, orange, strawberry, peanut, and avocado. Unlike ice cream, kulfi is not whipped, resulting in a solid, dense frozen dessert similar to traditional custard-based ice cream. Thus, it is sometimes considered a distinct category of frozen dairy-based dessert. Due to its density, kulfi takes a longer time to melt than Western ice cream.

Preparation:

Kulfi is traditionally prepared by evaporating sweetened and flavoured milk via slow cooking, with almost continuous stirring to keep milk from sticking to the bottom of the vessel where it might burn, until its volume is reduced by a half, thus thickening it, increasing its fat, protein, and lactose density. It has a distinctive taste due to caramelization of lactose and sugar during the lengthy cooking process. The semi-condensed mix is then frozen in tight sealed moulds (often kulhars with their mouths sealed) that are then submerged in ice mixed with salt to speed up the freezing process. The ice/salt mix, along with its submerged kulfi moulds, is placed in a matka or an earthen pot that provides insulation from the external heat and slows down the melting of ice. Kulfi prepared in this manner is hence called *Matka Kulfi*. Kulfi, thus prepared by slow freezing, also renders a unique smooth mouth feel that is devoid of ice crystals.

An easier version is to boil the milk and add bread crumbs, mawa (dried whole milk), and sugar while stirring. The cream layer formed on the boiling milk is scooped initially and added in the end to thicken the milk. More recently Kulfi is prepared from evaporated milk, sweetened condensed milk and heavy (double) cream. Then sugar is added and the mixture is further boiled and cornstarch-water paste is added. This paste thickens the mixture, although it is boiled for an additional few minutes. Then flavourings, dried fruits, cardamom, etc. are added. The mixture is then cooled, put in moulds and frozen. If frozen in individual-portion custard bowls for service with a spoon, bowls are removed from the freezer 10–15 minutes before serving to allow for melting at the edges.

It is garnished with ground cardamom, saffron, or pistachio nuts. Kulfi is also served with faloodeh (vermicelli noodles made from starch). In some places, people make it at home and make their own flavours.

In India, kulfi is sold by vendors called *kulfiwalas*, who keep the kulfi frozen by placing the moulds inside a large earthenware pot called a *matka*, filled with ice and salt. It is served on a leaf or frozen onto a stick. It is the traditional sweet from the Indian subcontinent.

Short answer type questions:

1. Enumerate indigenous concentrated whole milk products
2. Enumerate indigenous coagulated whole milk products
3. Define khoa as per PFA rules
4. What are the types of khoa and specific sweets produced from khoa
5. Define chhana as per PFA rule?
6. Define paneer as per PFA rules?
7. What is the difference between in physical quality of cow and buffalo khoa
8. What is the difference between in physical quality of cow and buffalo channa
9. What are the different varieties of kheer

Long answer type questions:

1. Write about the preparation of khoa by improved method
2. Write about the preparation of chhana by continuous method
3. Write briefly about the other traditional khoa and channa based sweets
4. Write about the preparation of paneer by commercial method
5. Write about the preparation of kheer
6. Write about the preparation of Kulfi

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UNIT 11

PACKING AND STORAGE OF MILK PRODUCTS

Structure:

11.1Packing – Definition and objectives of packing

11.2Packing materials

11.3Packing of Milk products

11.4Storage of Milk products

11.1 Packing – Definition and objectives of packing

Packaging is the science, art and technology of enclosing or protecting products for distribution, storage, sale, and use.

OR

Packaging also refers to the process of designing, evaluating, and producing packages.

Objectives (Purpose):

1. Physical protection:

The objects enclosed in the package may require protection from, among other things, mechanical shock, vibration, electrostatic discharge, compression, temperature etc.

2. Barrier protection:

A barrier to oxygen, water vapour, dust, etc., is often required.

3. Containment or agglomeration:

Small objects are typically grouped together in one package for reasons of storage and selling efficiency.

4. Information transmission

Packages and labels communicate how to use, transport, recycle, or dispose of the package or product.

5. Marketing

Packaging and labels can be used by marketers to encourage potential buyers to purchase a product.

6. Security

Packaging can play an important role in reducing the security risks of shipment.

7. Convenience

Packages can have features that add convenience in distribution, handling, stacking, display, sale, opening, reclosing, using, dispensing, reusing, recycling, and ease of disposal

8. Portion control

Single serving or single dosage packaging has a precise amount of contents to control usage.

11.2 Packing materials

Packaging material	function
Paperboard	Paperboard is the main material in our cartons. It provides stability, strength and smoothness to the printing surface.
Polyethylene	Polyethylene protects against outside moisture and enables the paperboard to stick to the aluminium foil.
Aluminium foil	Aluminium foil protects against oxygen and light to maintain the nutritional value and flavours of the food in the package in the ambient temperature.
Retort packaging	A retort pouch is a flexible package in which prepared food is hermetically sealed for long term unrefrigerated storage. Retort is process that uses heat and pressure to cook food in sealed packages.

11.3 Packing of Milk products

Packaging of Cream:

The exclusion of light is important as light can initiate auto-oxidation of milk fat resulting in the production of rancid flavours. Table cream is packaged for retail sale in units similar to those for milk such a glass bottle, paper carton, low density polyethylene sachet, plastic bottles etc.

Pasteurized cream:

1. Retail packaging: cartons and bottles.

2. Bulk packaging: plastic (polyethylene) bags contained in plastic crates (or) cardboard.

   Sterilized cream: tin cans and glass bottles.

   UHT cream: plastic (polyethylene), paper and foil laminate cartons.

Butter: Parchment paper wax coated paper, cellophane, cardboard boxes and teak wood drums lined with food grade plastic, aluminium foil laminates and lacquered tin cans.

Techniques of packaging

1. Manual moulding and wrapping
2. Mechanical moulding and hand wrapping

GHEE:

Requirements for packaging material:

1. Good fat resistance
2. Barrier properties against oxygen and moisture
3. It shall be temper proof

A major portion of ghee is packed in lacquered tin plate

For short shelf-life:- 200 ml, 500 ml and 1 lit capacity pouches made of polyethylene film, multilayer co extracted films of LDPE/HDPE are used.

For long term storage: – stainless steel containers (or) tin plate cans are desirable.

Packaging of liquid dairy products: It includes milk products like butter milk, whey, lassi, recombined milk, toned milk and vitaminised milk etc.

Plastic: Fresh and pasteurized milk

Metal: Evaporated milk and sweetened condensed milk

Wood: sweetened condensed milk, butter milk

Evaporated milk: is a concentrated milk product with a dry matter content of at least 25%.

The barrier properties of the pack are the same those of the tin can and by convenience of opening exceed it.

Eg: polyamide hose and industrial containers

Dried milk products packaging

Milk powders are readily take up moisture from the air leading to a rapid loss of quality and caking (or) lumping. They are often packed under N_2 gas to protect the product from the oxidation and to maintain their flavour and extend their keeping quality.

Packaging of frozen products

1. Multi service (tinned / steel can)

2. Single service (carton)

Ice cream sticks and cones are most common types

Ice cream sticks come individually in flow pack bags. The ice cream sticks in flow pack bags are packaged into cartons which are the case-packed for distribution. In case of cones, subsequent to the freezing process, these are prepared on trays with various units which are later packed into cartons.

11.5 Storage of Milk products

These items should be kept in the refrigerator, though cheeses benefit from a little extra TLC. Place soft once, like brie and mozzarella, in an air tight container once open. Wrap semi hard and hard cheeses, once open in wax or parchment paper then stow in a resealable plastic bag.

Product	Refrigerator	Freezer
Butter milk	2 weeks	Do not freeze
Butter spreads and dairy spreads	3 months	Do not freeze
Butter, sticks	3 months	6 months
Cheese (Block cheese	4 months	6 months
Greated cheese	1 month	4 months
Semi hard cheese (block)	6 months (unopened) 1 month (opened)	6 months
Semi hard cheese (slices)	1 month (unopened) 1 week (opened)	Do not freeze
Soft cheese	2 weeks	1 week
Cottage cheese	1 wk	Do not freeze
cream	10 days (light cream), 1 month (heavy and whipping cream)	Do not freeze
Cream cheese	2 months (unopened), 2 weeks (opened)	Do not freeze
Sour cream	3 weeks	Do not freeze
Whipped cream	1 month	Do not freeze
Yoghurt	2 weeks	2 months

Short answer type questions:

1. Define packaging
2. Enumerate packaging materials for milk and milk products
3. What is retort packaging
4. Write about packing of butter
5. Write about packing of ghee
6. Write about packing of frozen products
7. Write about packing of cream
8. Write about packing of liquid dairy products

Long answer type questions:

1. Write about packaging of various milk products
2. Write in detail about the storage of milk products

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REFERENCE BOOKS

1. A text book of Preventive Veterinary medicine by Amalendu Chakrabarti 4th Edition, Kalyani Publishers, New Delhi.
2. Veterinary obstetrics and Genital Diseases(Theriogenology) StephenJ.Roberts CBS publisher and distributors
3. Hand book of Animal Husbandry, I.C.A.R, New Delhi.
4. Farm Animal Management and Poultry Production by Sastry,N.S.R, Thomas,C.K. and Singh, R.A. Vikas Publication.
5. Outlines of Dairy Technology by Sukumar De, Oxford Press

LIVESTOCK MANAGEMENT AND DAIRYING

II YEAR

PART-B, VOCATIONAL COURSE

PAPER-I THEORY

Livestock Health Management

Periods/Week :04 **Periods/Year:110**

Time Schedule Weightage And Blue Print

S.No	Name of Unit	No.Of Periods	Weightage In Marks	Short Answer Questions	Essay type Questions
1	Signs of Health	03	02	1	0
2	Bacterial Diseases	20	12	1	1
3	Viral Diseases	16	10	1	1
4	Protozoan Diseases	10	07	1	1
5	Helminthic& external parasitic diseases	11	07	1	**1**
6	Mycotic diseases	8	5	1	1
7	Production and Systemic diseases	12	6	1	1
8	Diseases of New born	6	4	1	0
9	Reproductive disorders	12	7	1	1
10	Principles of Disease control and prevention	6	5	0	1
11	First Aid	6	5	1	0
	Total	**110**	**70**		

LIVESTOCK MANAGEMENT AND DAIRYING

II YEAR

PART-B, VOCATIONAL COURSE

PAPER-II THEORY

Dairy Economics, Extension and

Quality control of milk

Periods/Week :04 **Periods/Year:110**

Time Schedule Weightage And Blue Print

S.No	Name of Unit	No.Of Periods	Weightage In Marks	Short Answer Questions	Essay type Questions
1.	Dairy Economics	10	10	2	1
2	Milk procurement	10	10	2	1
3	Dairy development programmes	10	10	2	1
4	Dairy Cooperatives	10	10	2	1
5	Marketing	10	10	2	1
6	Extension	10	10	2	1
7	Composition of Milk	10	10	2	1
8	Physic chemical properties of Milk	10	10	2	1
9	Adultrants and preservatives	10	10	2	1
10	Microbiology of milk	10	10	2	1
11	Estimation of Microbes in milk	10	10	2	
	Total	**110**			

LIVESTOCK MANAGEMENT AND DAIRYING

II YEAR

PART-B, VOCATIONAL COURSE

PAPER-III THEORY

Milk Processing & Milk Products

Periods/Week :04 **Periods/Year:110**

Time Schedule Weightage And Blue Print

S.No	Name of Unit	No.Of Periods	Weightage In Marks	Short Answer Questions	Essay type Questions
1	Milk Reception	10	8	1	1
2	Filtration and cream separation	10	8	1	1
3	Heat Treatment to Milk	10	8	1	1
4	Cleaning and Sanitization	10	8	1	1
5	Liquid Milks	10	8	1	1
6	Fat Rich Milk Products	10	8	1	1
7	Ice Cream	5	6	0	1
8	Fermented Milk Products	10	8	1	1
9	Concentrated and Dried Milks	10	8	1	1
10	Indigenous Milk Products	20	16	2	2
11	Packing and storage of Milk Products	5	4	2	0
	Total	**110**			

LIVESTOCK MANAGEMENT AND DAIRYING
II YEAR
PAPER I Livestock Health Management

TIME: 3 Hours **Max. Marks: 50**

SECTION-A

Note : (i) Answer all questions.
(ii) Each question carries 2 marks **10x2=20**

1. Definition of Health
2. Name any four bacterial diseases
3. Name any four viral diseases
4. Name any four protozoan diseases
5. What is deworming
6. What is vaccination
7. What is bloat
8. What is acidity
9. Name two parasitic diseases
10. What is pyometra

SECTION-B

Note : (i) Answer any 5 questions.
(ii) Each question carries 6 marks **5x6=30**

11. What are the signs of ill health
12. Write short notes on H.S and Black quarter
13. Write about Foot and Mount Diseases
14. Write about mastitis in dairy animals
15. Write short notes on milk fever and ketosis
16. Explain about the causes of infertility and their prevention
17. Write short notes on round worms, and liver flukes
18. Write about calf scours and piglet anaemia

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LIVESTOCK MANAGEMENT AND DAIRYING

II YEAR

PAPER II Dairy Economics, Extension and Quality control of milk

TIME: 3 Hours **Max. Marks:50**

SECTION-A

Note: (i) Answer all questions.
(ii) Each question carries 2 marks **2x10=20**

1. Expand NDDB and NABARD
2. What is milk shed area
3. Define white revolution
4. What are the aims of village milk cooperative system
5. What is ICDP
6. Define milk
7. Fat and SNF per cent of buffalo milk
8. Write the purpose of Hamsa test
9. What are the common adulterants in milk
10. What is the purpose of MBRT test

SECTION-B

Note : (i) Answer any 5 questions.
(ii) Each question carries 6 marks **5x6=30**

11. Write about the pricing of milk
12. Explain the role of extension in dairy development
13. Write about the Anand pattern Dairy co-operatives
14. Write briefly about operation flood programmes
15. Write about the role of advertisement for market promotion of milk and milk products
16. Write briefly about extension methods
17. Explain the estimation of fat per cent in milk by Gerbers' method
18. Explain the factors affecting the composition of milk

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LIVESTOCK MANAGEMENT AND DAIRYING
II YEAR
PAPER III Milk Processing & Milk Products

TIME:3 Hours **Max. Marks:50**

SECTION-A

Note : (i) Answer all questions.
(ii) Each question carries 2 marks **2x10=20**

1. Define Pasteurization
2. Define homogenization
3. Objectives of packaging of milk and milk products
4. Define toned milk
5. Define butter
6. Define Ice cream
7. Name two khoa based sweets
8. Name two Channa based sweets
9. What is over run in Ice cream
10. Define cream

SECTION-B

Note : (i) Answer any 5 questions.
(ii) Each question carries 6 marks **5x6=30**

11. Write about the methods of cream separation
12. Write about the methods of milk transport
13. Write about the Desi method ghee preparation
14. Write about the HTST pasteurization
15. Explain the preparation of Khoa
16. Write about the preparation of Channa and paneer
17. Write about method of preparation of Ice-cream
18. Write about the method of preparation of Chadder Cheese

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