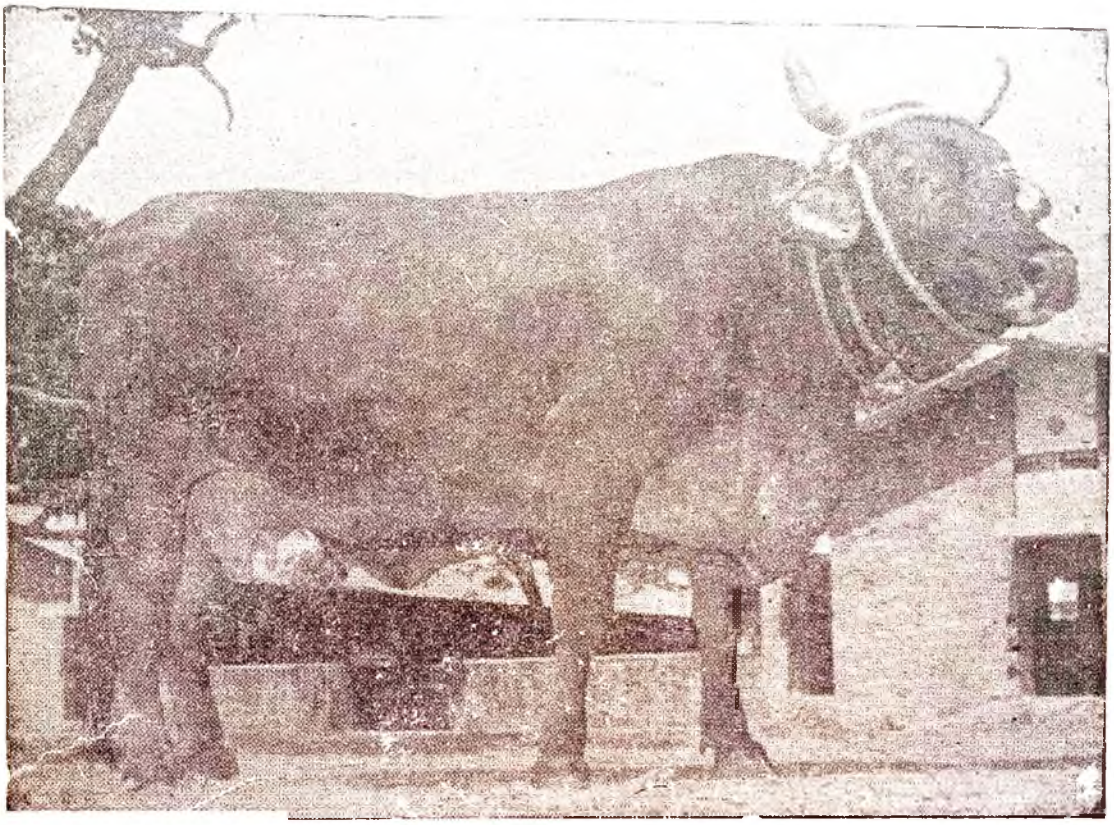
OUTLINES OF DAIRY HUSBANDRY



KERALA AGRICULTURAL UNIVERSITY

CONTENTS

CHAPTER I

DAIRY FARMING

Dairy farming has been a part of life since time immemorial in our villages. Along with the change of time, the living pattern had been changing and also the type of dairy cattle. The low yielding nondescript cows are being replaced by the higher yielding crossbred cattle. The crossbred bullocks are not so good working animals as the local bullocks. Since mechanisation has come in agricultural operations also the need of bullocks are also reducing. As the demand for milk is increasing especially in the urban areas, the dairy farming business engaging higher yielding crossbred cattle is becoming more and more lucrative.

Among all the different farm animals dairy cows of good productive capacity are unequalled producers of human food. Cow produces more human food for a given quantity of feed than is produced by any other farm animal. As producers of protein, hens are the nearest competitors of dairy cows, while as producers of energy pig rank second. However both hen and hog use human food resources to certain extend.

Milk is said to be a nearly complete food. No other single food is as nutritious as milk. It provides nutrients to man at all stages of life. This milk is produced by the dairy cow in an economical way utilising cheap roughage which are not directly needed for human consumption. The special value of the cow as a domestic animal arises from her ability to consume and digest large quantities of roughages and to convert it into milk and meat suitable for the nutrition of man.

Indian cattle belong to two distinct species, Bos indicus (ox or white cattle) and Bos bubalis (buffaloes or black cattle). Both have distinct characteristics and do not interbreed.

India possess the largest cattle population of the world. It comes to about one quarter of the total number. But in milk production they are very poor. The average annual milk yield per cow and buffaloes has been estimated at about 175 Kg and 491 Kg respectively. According to an old estimate the average annual milk yield per milking cow is 3710 Kg in Denmark, 3250 in Switzerland and 3250 in USA. This gives an approximate comparison of our animals with exotic cattle as far as milk production is concerned.

Cattle rearing in India is carried out under a variety of adverse climatic conditions. Cattle husbandry centres around the small cultivator, to the large majority of whom livestock raising is subsidiary to crop production. The cultivator is generally poor and resourceless. He lives in fragmented holdings maintaining 2-3 animals. Grazing during most of the year is poor except during monsoon and available feeds are not sufficient to sustain the existing population. Marketing facilities are inadequate and almost whole of the marketable surplus is produced in rural areas.

Indian breeds of cattle are usually known as Zebu in Europe and South America. In the USA, they are called the Brahman. In recent years these cattle have attracted great attention in foreign countries for cross breeding with local breeds and they have developed some new breeds out of this. The Zebu are prized for their qualities of endurance, docile temperament, resistance to tropical diseases and ability to utilise coarse fodder.

Importance of Dairy farming

The importance of dairy farming is mainly in the nutritive value of milk and milk products. Milk and milk products serve as one of the most important sources of food for all civilised nations. All countries which have highly developed agriculture have a developed dairy enterprise also. It may not be out of

place if we correlate the general health of a community and their per capita consumption of milk.

Milk is supposed to be an almost complete food because it contains all the components of food in the proper proportion at which it is needed in human body. The proteins of milk are of high quality and in addition it can supplement other proteins. The quality of supplementation is important as all proteins are not equally utilised in the body. The deficiency in certain other proteins can be made good by the proteins of milk so that the utility of the other proteins is increased when it is consumed along with milk.

The quality of the proteins are compared each other by the biological value of the protein. The biological value of the protein is a measure of the completeness of the protein as far as its capacity for building body tissue is concerned. All proteins are not of equal value since some of them do not contain all the important aminoacids required for the body tissue building. Out of the different proteins of food, egg protein has the highest biological value and milk proteins comes next to it. The proteins are made up of different aminoacids. Certain aminoacids are classified as essential aminoacids. This means they are indispensable for human body and should be supplied in food for proper health. Proteins of animal origin contains greater proportion of essential aminoacids than proteins of vegetable origin. The solids of milk are present in right proportion for nutrition and milk is highly digestible and palatable. Milk contains all important minerals needed by the body except iron and iodine. It is particularly rich in calcium which is likely to be deficient in ordinary diet. Milk also contains important vitamins necessary for the growth of the body.

Another major importance of dairy farming is the employment opportunity it offers. Large amount of employment potential exists in various stages of dairy farming and milk handling. The idle family labour also can be usefully deployed in the dairy farming. In addition, when large quantity of milk production exists, manufacturing of various milk products are possible and that also offers employment opportunities.

Characteristics

Dairy farming has certain peculiar characteristics. They may be arranged as follows:

1 Milk and milk products form a part of the daily diet of majority of people. Some consume fluid milk whereas others include dahi, butter, ghee and buttermilk in the menu. Milk also is an essential part of the drinks like tea and coffee which are consumed by most people every day.

2 It gives employment for many people. Many families keep one or two cows to provide milk for the family. Many farms are being started in which the owners derive a major part of their income from the sale of milk. These farms provide jobs for a large number of people and idle labour of the family is being utilised.

3 Capital investment in dairy farming is high. Dairy farming needs not only land for production of fodder crops but also an investment in buildings livestock and dairy equipments. Generally dairy farms need more capital than other farms.

4 Cash income from the sale of milk and its products are large. This is the main item of income in the business. As the milk has got good demand, especially in the towns, milk is sold for cash readily.

Advantage of dairy farming

The following are some of the main advantages of dairy farming:

1 Cheap roughages are changed to costly food. The feed of cattle consists of roughages and concentrates. Roughages consists of grasses hay and straw which are otherwise unutilised. The concentrates consists of oil cakes and agricultural by–products like bran etc. These items are not used for human food and as such does not produce a competition with human food resources. Thus by feeding cheap and other wise unutilised items of feed the cattle are converting them into costly human food like milk and meat. The dairy cattle has got the highest efficiency in roughage utilisation among ruminants.

2 Dairy farming aids in conserving soil fertility. Growth of plants utilises the soil nutrients. When a crop is harvested certain amount of soil nutrients are removed from the soil. Unless this is replaced into the soil next crop yield will be reduced when the crops are fed to the animals and the manure is returned to the soil the depletion of the soil nutrients are reduced. In addition the manure adds organic materials to the soil which increases the humus condition of the soil which keeps the soil in a better condition.

3 Dairy farming produces milk and meat. Milk is the major source of income in the farm. In addition considerable income is obtained by the sale of older cows which are replaced by the heifers raised in the farm. Similar income also is obtained by the sale of male calves also. These culled animals are a good source of meat.

4 Dairy farming supplies dietary essentials. Milk is described as a protective food as it supplies most of the dietary essentials including many minerals and vitamins. Even though many attempts have been made to produce milk artificially a product of the same quality cannot be produced till now. Dairy animals still remain as the only source of such a good quality food.

5 Dairy farming gives good return to the family labour. Considerable part of the labour in small dairy farms are carried out by school children and house wives who are having sufficient extra time. These idle labour when utilised for dairy farming gives good return.

6 Milk and its products have good market demand. This is especially so in urban areas. Products like cream, butter and ice-cream are foods with appetising flavours and good nutritive value. As such the producer does not find much difficulty in selling the products.

Limitations of Dairying

Dairy farming has many limitations due to the special nature of the work. The major limitations can be summarised as follows:

1 Dairy farming is a confining job. It requires long hours of work every day. Taking a day off may be difficult. The cows have to be milked and fed at least twice in a day. To do this some one has to be available throughout the day. In large dairy farms this need a large working force. In small farms feeding and milking is most often done by the owner himself before and after the regular days work and this prolongs the working day.

2 It is a skilled work and some amount of scientific knowledge increases the efficiency and profit.

3 Desired type of labour may be difficult to get because the cows have to be handled carefully. The labourers have to be selected from a group who are familiar with the work and they have to be paid more than ordinary wages.

4 The amount of capital needed is large in dairy farms. Capital is necessary for cultivable land, cattle sheds, good cows, equipment necessary for milk handling, etc. In addition recuring expenditure on feed and labour is necessary to run the farm.

5 The risk involved in dairy business is more. The produce of the farm, the milk, is a perishable commodity and it has to reach the consumer with in few hours, if chilled storage is not possible. Any delay in transporting will be dangerous. In addition considerable losses may occur due to diseases, accidents calving hazards etc. The milk production may be reduced due to poor feeding or breeding practices. Dairy farming is profitable only when there is a good herd of healthy cows which are being well looked after.

6 Dairy farming is not a flexible business. The capital expenditure involved in dairy farming cannot be diverted to any other business. The livestock, machinery or equipment cannot be disposed off profitably if he go out of business in a short period. The farm has to be run many years to make a fair return for the capital which has been invested.

7 Adaptability of cattle to the climatic conditions vary. The crossbred cattle are intended to produce more milk in the

warm humid tropical climates. Adaptability varies with breeds and also on the amount of exotic inheritance. Special attention is to be given to protect the cattle from climatic extremes.

Types of Dairy farming

Based on the intensity, the dairy farming business can be classified into different categories. Each type has its own peculiarities, even though sometimes it may be difficult to classify a particular farm into any category. The following types can be categorised.

1 Family cow: This is a situation where one or two cows are reared to meet the requirement of milk in the family. The family is assured of genuine milk. The cost of rearing may be high, as all feeding materials are to be purchased.

2 Part time dairying: The family rears few cows with the intention of deriving a profit to supplement the family income. Family labour is utilised and some amount of agricultural by-products if any, may be added to the feeding materials. This is the main source of production of milk in our country.

3 Commercial dairying: Large dairy farms falls under this category. Large number of cows are reared and capital investment is high. Forage production may or may not be taken up. Profit depends upon the forage production, cheap labour and good marketability of milk. Such large farms are very limited in our country.

4 Corral dairying: This is a system of rearing where only milking cows are reared. When they become dry they are sold and new milking cows are purchased. This type of farming is usually practised in urban areas where there is a high demand for milk. The cost of rearing will be high as all the feeding materials are to be purchased. But this will be compensated by the high price of milk.

5 Milk colonies: The idea of colonisation of cattle has come for cleaning the city by removing the cows from the area. Government has sponsored such colonisation and two such colonies were set up, one at Aarey (Bombay) and one at

Madhavaram (Madras). Owners of cattle have to reside in the colony were infrastructural facilities like housing, cattle sheds cultivating land, etc. are provided on rent. The milk produced has to be sold to the organising agency.

Planning of a dairy farm

While starting a farm there should be a clear cut idea on the aim of the enterprise. When it is started as a business enterprise the demand for milk and milk products should be known previously.

Usually the following targets are aimed at in the starting of a farm.

1 Production of a fixed quantity of milk for a particular area.

2 Organisation of a dairy to utilise the existing facilities like available land.

3 Organisation to provide self employment.

When the farm is planned to produce certain quantity of milk daily for consumers located in a colony of area, the number of animals needed to be raised can be determined on the basis of the expected average yield of cows in the herd. An additional number of 20-25% has to be added to take care of the dry animals. The farm should aim at maintaining the proportion of dry animals to milk at 1:4 or 1:5. A proportion of 1:4 means that 20% cows are dry and the rest milking on an average. A proportion of 1:5 means that about 16% of the cows are dry. After fixing the number of cows to be raised, physical facilities like cattle sheds, store house and other buildings are to be constructed. The buildings should include accomodation for calves of various age groups.

When the size of the farm is adjusted to that of the available land, the number of cows which can be maintained based on the amount of fodder which can be produced on the land has to be calculated. The calculations are based on the following assumptions. One acre of irrigated land will yield 50 tonnes of fodder per year. Unirrigated land will yield about 25 tonnes per year. Consumption of fodder by the cow

depends on the body size and quality of fodder. An average sized crossbred cow will consume about 35 kg fodder per day. In such case a cow needs 12.75 tonnes of fodder per year. Based on the total fodder production the number of cows to be raised can be calculated. These calculations are based on the assumption that the cows are fed only grass as roughage. Many times cows are fed with straw also. In such cases 5kg of grass can be replaced by 1 kg straw.

When dairy farming is started for self employment, the number of cows to be reared is determined such that it will give sufficient income to maintain a family. Such a unit can be described as an economically viable unit. For such a unit the number of animals required depends on the yielding capacity of cows. With the type of good crossbred cattle available in Kerala a unit of 5 cows can be considered as economically viable.

Establishment of Dairy Farm

Establishing a farm needs proper planning with regard to the location, procurement of cows, management, etc. These are to be planned in accordance with the aim of the farm.

The following points need special consideration while establishing a farm:-

1 Location: Whether the farm is is to be located in an urban area or in a rural area is important. In urban area marketing of milk will be easy as there will be higher demand for milk. But there the cost of land and labour will be high. If the farm is located in the rural area, milk has to be transported to the urban area for marketing and facilities for transport has to be arranged. In rural areas the cost of land and labour will be cheap. Fodder cultivation will be possible only in rural areas. These comparative advantages have to be evaluated before deciding on the location of the farm.

2 Site of buildings: This site where the buildings are to be constructed have to be a raised area. This avoids water-logging around sheds. Accumulation of water around sheds will cause bad smell and growth of mosquitos. The urine and wash

water from the cattle sheds can be utilised for gras[illegible] tion, if the buildings are located at an elevated [illegible] site of buildings and cattle sheds should have a hard [illegible] There should be sufficient provision for movement of air [illegible] free from heavy winds. Shade trees around would be advisable to keep the area cool.

3 Layout of buildings. A small scale farm when started near the owners house should be located in such a place that it is easily accessible from the house and the animals can be seen from the house itself. The dung pit and urine pit should be away from the houses.

In a large scale farm, living quarters should be away from the cattle sheds. The different buildings like cattle sheds, calf pens, store house, milk room etc. has to be located in such a way that they are easily accessible from each other. This will save labour and supervision of the works will become easy.

Budgetting

Budgetting is necessary for advance planning and adjusting the income and expenditure. Budget is actually an anticipated statement of income and expenditure. Budget can be prepared for one year or for longer periods. As the yield of milk from a cow is distributed for a period of nearly 10 months followed by a non yielding period which it variable from 2 to 10 months or more the budget has to be prepared for longer periods. Usually it is prepared for 5 years.

Budget includes anticipated income and anticipated expenditure for a particular period. On the expenditure side, capital expenditure and recurring expenditure are to be accounted. Capital expenditure includes cost of land, cows, buildings, equipments etc. These costs have to be assessed depending on the locality. Cost of buildings have to be worked out depending on the number of cows which are going to be reared. Recurring cost includes, feeding cost, labour, transport of milk and miscellaneous expenditure as taxes, electricity, etc.

Income from the farm comprises mainly milk yield. If 80% cows are expected to be in milk (dry : milk = 1:4) that number

x average yield x 365 will be production for that year. This multiplied by the cost per litre will be the income from milk. Another source of income from the farm is sale of old cows and young calves. If the dung is not utilised for fodder cultivation that also can be sold and accounted as income.

Items of Budget

Expenditure

1) Non recurring

Cost of land
Cost of cows
Cost of buildings
Cost of equipments.

2) Recurring

Feeding cost
Labour charges
Miscellaneous

Income

Sale of milk
Sale of animals
Sale of dung

Practical Exercises

Routines of the farm including cleaning, washing, etc. Care of calves & pregnant cows.

CHAPTER II

HOUSING

Animal houses are constructed to protect the animals from extremes of heat or rain. Large amount of attention had been paid to the type of houses necessary for the cows. The dairy cows are animals which require cold surroundings. As the climate becomes warm they become uncomfortable as they find it difficult to reduce the body temperature. Cattle are generally classed 'as non-sweaters'. Not that they does not sweat, but the amount of sweat produced is negligible and not sufficient to reduce the body temperature in a warm climate. Animals' discomfort will be more when the surrounding air is more humid. In tropical areas where the temperature is warm with high amount of humidity, the cattle houses should be planned in such a way that the stress due to warmth and humidity is reduced as much as possible. This will be possible by providing sufficient air movement inside the shed and providing shade trees around.

In tropics the animal need only protection from hot sun and heavy rain. So the cattle sheds have to be constructed to provide this facility. A shed with a proper roof and good concrete floor is sufficient for the cattle.

Housing system

Depending on the method of rearing of cattle few systems of housing are described. One of the system is the intensive system where the cows are tied up in the shed most of the time and feeding and milking are done in the same shed. In the day time they may be taken out by rope for grazing or walking. It is called intensive system as the space requirement is limited.

In semi intensive or loose housing system the animals are let loose in an enclosed area—paddock, and feeding and watering are done there. Paddocks are open grounds adjacent to the milking sheds where watering and feeding arrangements are done. It will have sufficient shade trees and roofed area. The floor is usually paved by bricks or granite stones. On areas where the soil is hard and dry, paved floors are not necessary. But in areas where the soil is loose, the soil becomes muddy with the admixture of dung and urine. This is especially so in heavy rainfall areas. In such areas paved floors are necessary. At the time of milking they are taken into the milking shed which will be at one side. Shelter is provided inside the paddock. This needs more roofed area and paddock and correspondingly construction cost is more. But there the labour is limited so recurring expenditure will be less.

In another range system the animals are let loose in the grass land through out. Milking also done in the field. Such systems are practised in countries where plenty of grass land is available.

Floor space

Approximately 3.5 meters floor space is recommended by the Indian Standard Institute for a cow. This area consists of space for manger, standing, dung channel and feeding and milking passages. The width in the standing for each cow is about 1 to 1.2 m. The width as well as length of the standing can be slightly variable depending on the size of the cows. The feeding passage and milking passage are optional in small units and they can be dispensed with to economise the construction cost.

Total floor area is worked out on the basis of the number of cows to be stationed. When there are only few cows they can be tied up in a single row. Usually not more than 20 animals are tied up in a row. When the number is more they can be arranged in double row. When cows are arranged in double row, they may be tied up "face to face", ie. one row facing the other row. Then the feeding passage for both the rows will be common. They can also be arranged as "tail to

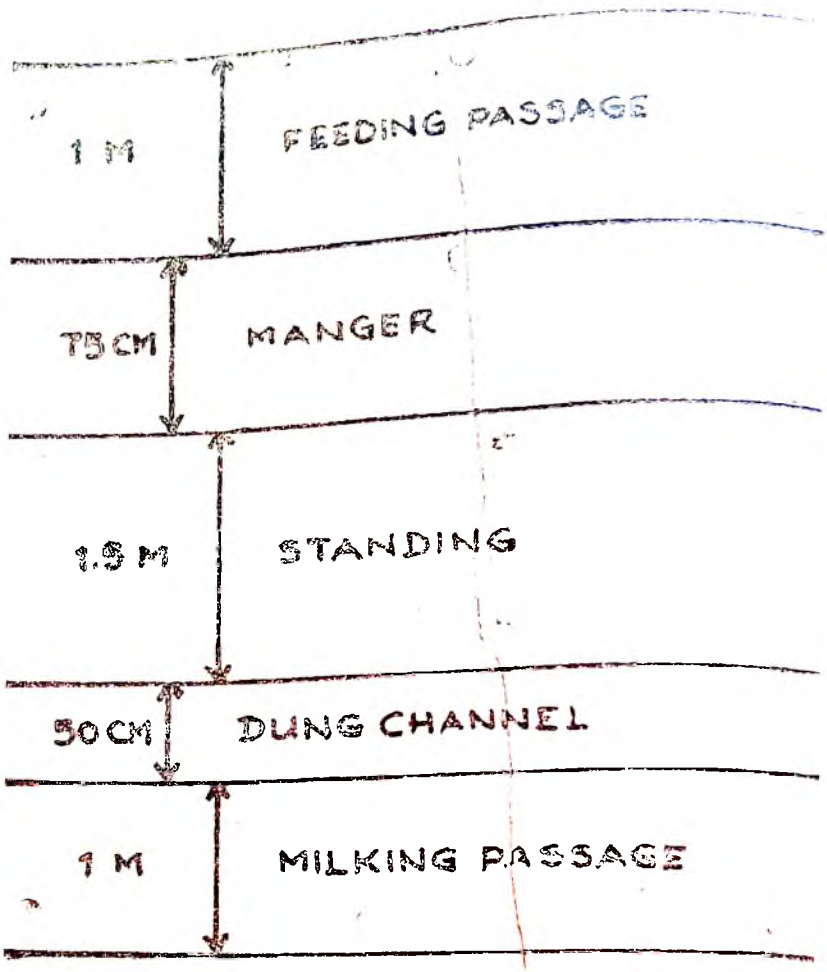


Fig. 1(a)
Requirement of Floor area for cattle sheds

tail", ie., animals facing away from each other. In this case the milking passage will be common for both rows. Tail to tail system is supposed to be having two main advantages.

1 The possibility of disease transmission from affected one row to another will not happen.

2 The common milking passage at the centre provides sufficient space for moving behind the animal. Majority of management practises need movement of the attender behind the animal like, milking, washing, removal of dung etc. So a wider passage makes the work easier. The only advantage which can be mentioned for the face to face system is that it gives a better view of the animals at a glance when viewed from the centre.

Construction

The basement should be only slightly raised from ground level. In an elevated place the basement need not be more than 1 foot above ground level. The standing space should have a slope of 1:50 from manger to the dung channel. The floor should be of concrete and made rough finish. This is necessary to avoid slipping of the cows legs. Sometimes grooves are provided on the standing to get a better foothold.

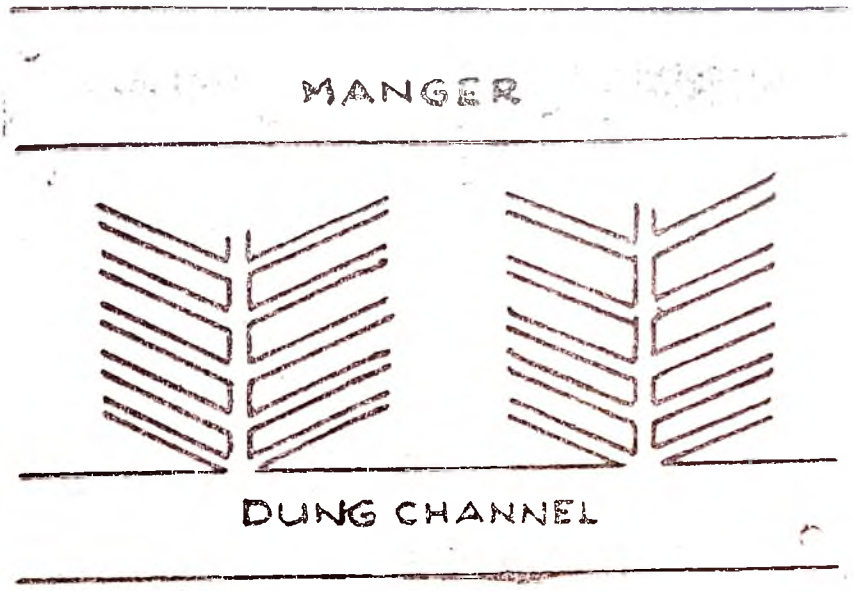


Fig 1(b)
A pattern of grooving on the floor

The partition between manger and standing can be concrete wall or wooden. The height can be about 70 cm. The floor of the manger can be raised by about 20 cm from the level of standing. When the manger wall on both sides are made of concrete, the manger can be used for feeding concentrates also. Iron rings can be provided in the concrete wall on the side of standing to tie up the animal.

Roofing material can be asbestos or tiles. Thatched roof will keep inside cool during hot weather but has the disadvantage of doing it every year. The roof is to be supported on pillars. Side walls are not necessary except when it is warranted by special reasons like protection from wild animals

etc. When side walls are provided the height [illegible] should be less than the height of cows. This enables [illegible] of wind over the animals to keep them comfortable during [illegible] weather.

Effect of climatic conditions on production

Milk production, like all other characters depends on the hereditary make up of the animal, environment in which it lives, and an interaction between heredity and environment. The primary necessity in the expression of a character is the genes and gene combinations present in the individual. These genes will be able to express its effect when suitable environment is provided. If the environment is adverse the expression of the character also becomes poor. High amount of milk yield in a cow requires genes for high milk production and a good environment suitable for the animal.

All animals have the capacity to adjust to changes in environment. This capacity varies with individuals, breeds, species etc. Cows are warm blooded animals and are able to maintain relatively stable body temperature despite changes in the external environment. This quality is called homeo stasis. This is obtained by adjusting the heat production and heat dissipation from the body.

There are two principal sources of heat production in the body of cattle. These are heat production by fermentation in the runen and by cell metabolism occurring throughout the body. Out of the total energy consumed by the animal approximately 20% is lost in the form of heat loss from the body. So cold temperature does not produce as much reduction in milk yield as a corresponding rise in atmospheric temperature.

Heat dissipation is done through two avenues, evaporative cooling and conduction. The principal type of evaporative cooling is evaporation of moisture from the lungs and moist surfaces of the respiratory passages. At an atmospheric temperature of 40-60°F the normal respiration rate of dairy cattle is 15–20 per minute. When the temperature increases from 60 to 100°F and above, the respiratory rate increases sharply. The second type of evaporative cooling is by sweating. The

proportion of total heat lost depends on the sweating capacity, the humidity of air and circulation of air around the body. The capacity of sweating is low in cattle because the amount of sweat glands in the skin is low.

Conduction of heat involves the transfer of heat through a medium. When the animal lies down, some amount of heat is lost by transfer to the floor. Some amount of heat is conducted through the skin to the thin layer of air adjacent to the body. Conduction of heat through skin to the surrounding air is increased by wind. Animal will be loosing the heat from the body until the temperature of skin equals temperature of air.

The ideal environment for dairy cows is between 30 and 60°F with low humidity level. As the air temperature increases above 60°F the animal dissipates more heat to keep the body temperature constant. Through normal avenues this will be possible only up to a certain level of atmospheric temperature. This level is called the critical temperature. Critical temperature is the air temperature at which the normal avenues of heat dissipation can no longer prevent an increase in the cows body temperature. For Indian Cattle the critical temperature is about 95°F and for exotic cattle it is 80-85°F. Beyond this temperature the animal resort to extra methods of heat dissipation like panting to control the body temperature. These methods have limitations and when they become insufficient the body temperature increases resulting in a condition similar to fever and in severe cases lead to heat stroke.

Increase in environmental temperature increases the respiratory rate which is the primary mechanism where by exotic breeds of cattle dissipate heat. The heat produced in high milk yielding cows is about double that of nonlactating cows. When the atmospheric temperature increases, milk production and feed consumption are reduced automatically in an effort to curtail body heat production. Actually it is the reduced appetite that causes reduction in milk yield. Heat stress will be affecting high producing cows more than low producing ones.

As large amount of heat is produced in the rumen fermentation and bodily activities of the cow, she is able to adjust the body temperature even at very cold climates. For this reason cows are quite comfortable at low temperatures of 40-60°F (5-16°C). When temperature increases above this, the body of the animal has to make suitable adjustments to keep the body temperature constant. This results in reduction of milk yield in lactating cows. The cows are able to sustain lower temperatures than higher temperatures because at lower temperature the animal can produce more heat to maintain the body temperature. But at higher temperatures dissipation of heat is a comparatively difficult process.

Summer management

Summer management of cows need special attention to provide water, shade, ventillation and other methods to keep the cows cool and comfortable. Dairy cattle require 2-3 Kg water to drink for every 1 Kg of milk produced and additional water for body metabolism and regulation of body temperature by evaporative cooling. As air temperature increases from 75°F to 90°F water consumption of milking cows increases. To meet this demand a continuous supply of drinking water should be made available to the cows. For cows which are tied up in the sheds water may be provided in buckets or the manger may be so constructed that a small water channel is provided over the manger wall through which water flows continuously.

Dairy cattle absorb heat by radiation from exposure to direct or reflected sunlight. Lactating cows especially the crossbreds, should not be exposed to direct sunlight during hot weather. Shade should be provided around the cattle sheds to reduce heat absorption by radiation.

Movement of air over the body of the animal increases heat dissipation. This will be facilitated if the sheds are constructed without side walls. If at all side walls are constructed the height should not exceed that of cows. Artificial air movement in the shed can be done by providing electric fans.

Feed consumption by milking cows decreases when the atmospheric temperature rises. This will cause a decrease in milk yield and general change in body condition. To overcome this effect the feeding practises should be so adjusted that the feeds are offered during the cool hours of the day. The animals should be taken for grazing in the morning as well as in the evening only when the sun is not too hot. The quality of the concentrates should be such that they contain more nutrients and are highly digestible. This will overcome the reduction of consumption of feed.

Sprinkling of water over the body of animal during hot days will be helpful to reduce the body temperature of the animal. This can be done few times in a day. In areas where hot wind is blowing gunny bags soaked in water can be hung around the shed during noon time.

Adaptation of cattle to climate

The capacity of animals to adjust themselves to a change of climate is called the climatic adaptation. In dairy cattle this phenomena is important as the high yielding animals are located in the subtropic and temperate regions of the world and these are being used for cross breeding in tropical areas. So in usual discussions climatic adaptation refers to adaptation to warmer climate.

Indian cattle has got a better heat tolerance. This is because of their inherent nature. Their critical temperature is high. In addition cows are low producers and so the metabolic heat production in cows are low.

Practical exercises:

Preparation of sketches of different types of dairy barns, Tail to tail system, Head to Head system, Floor plan for cattle shed etc.

CHAPTER III

DAIRY CATTLE

Selection of Dairy Herd

What type of animals are to be chosen for the herd needs serious consideration. As the basic consideration is milk production high producing varieties of animals are to be chosen. There are distinct indigenous breeds of cows like Sindhi and Sahiwal which are having comparatively good yield. But, their breeding tracts are in the north and the availability in South India is not much. Nondescript of indigenous cows are generally poor yielders even though there may be isolated cases having comparatively better yield.

In areas like Kerala where there are no distinct local breeds we depend upon crossbred cows. Kerala has large facilities for cross breeding of cattle. Cross breeding is being done using exotic (foreign) breeds like Brown Swiss and Jersey. Rarely Holstein freisian also is used. Each breed has its own advantages. Holsteins are heavy yielders in cold countries. Probably they are the highest yielders. Their crosses in our country produces nearly same level as that of Brown Swiss crosses. But the milk of Holsteins ars having low percentage of fat and this may create problems in selling milk. Legally the milk sold in the market should have at least 3.5% fat. The average fat percent in Holstein milk is around 3.5% only. This means that in some of the animals milk fat level may be below the legal limit. That is one of the reason why Holsteins are not preferred.

Brown Swiss crosses are heavy animals and produces nearly same as that of Holstein crosses. The fat percentage

In these animals are around 4-4.5%. These are heavy animals similar to Holsteins and need larger quantity of feed. But this is not a disadvantage because they produce more milk. In same genetic group, a larger animal will be producing more milk than a smaller one. So while choosing cows larger cows are to be preferred. The Brown Swiss crosses originating from the Mattupetty (Munnar, Kerala) farm have been named as "Sunandini".

The Jersey crosses are smaller animals produces reasonably well but it is slightly lower than the level of production of Brown Swiss crosses. As Jersey crosses are smaller cows and of more docile temperament many people prefer them. Their milk also have around 4-4.5% fat.

Out of the above three types of crosses Brown Swiss and Jerseys are having more adaptability to our climatic conditions.

In choosing the dairy animals the case of buffaloes also need serious consideration. Buffalo milk contains more solids and so fetches more value. They are sturdy animals and can utilise more rough fodder. The murrah buffaloes are the highest yielders among buffaloes. The limitations are the availability of the animals. It is to be noted that only very limited efforts were made in India for improvement of buffaloes compared to that of cows.

As the Murrahs are the best yielders among buffaloes, cross breeding programme is not done to improve the milk yield. Improvement can be brought about by selection- a process by which offsprings of higher yielders are choosen to become the parents of the next generation.

As far as dairy cattle are concerned milk production is the important character which is considered for selection. There are other characters also which are related to its economic importance. These are birth weight, age at puberty, age at first calving, intercalving period, etc. These also has to be considered while selection is done.

The weight at birth of a calf is important because a calf of higher birth weight will have a higher grown up body

weight. Generally a larger cow gives more
cow of similar genetic make up. As such a
Jersey crossbred calves will be about 20
Swiss crosses will be about 25 Kg

Age at puberty and age at first calving are
which come to puberty earlier, calves earlier
give more returns to the owner during its life time. So
are to be preferred over those which come to puberty later.
zebu cattle as a whole come to maturity by about four years
and the age at first calving will be about five years. This is
the case with buffaloes also. In the case of crossbred cattle
most of them come to maturity by $1\frac{1}{2}$—2 years and they calve
for the first time by $2\frac{1}{2}$—3 years. As such they will be able to
give more number of lactations during their life time. There
is no definite indication of the appearance of puberty in cattle
except the occurrence of heat. The symptoms of heat in heifers
may not be well pronounced and as such it may be missed.
As such it may be difficult to record the age of puberty in all
heifers. So age at first calving is usually given more import-
ance for record keeping.

Intercalving period—the interval between two successive calvings— is an important character which has to be consid-ered. If the intercalving periods are small in a cow it will give more number of calvings during its life time. This means more amount of milk from the cows and more number of calves. The minimum inter calving period recommended is 12 months. This means that the cow should calve once in every year. This will be possible only if the cow get pregnant between 2-3 months after a particular calving.

Pedigree Information

Information on the pedigree or parentage is a useful tool in choosing animals. Usually pedigree information of the parents are looked into. Sometimes information of grand parents also is assessed. Parentage beyond grand parents are not looked into usually because as generation passes, the relation to that particular individual is getting reduced. For

example, the relationship of one individual and one of its parents is 50%, where as it is only 25% with one of the grand parent.

In the case of cattle the milk production is a character which is expressed only in the females. So it is called as sex limited character. In such cases the information on the female parent only can be used. But it should be remembered that half of the genetic makeup had been transmitted by the male parent to the daughter. That is to say the milk producing potentiality of the daughter has been obtained from both the parents. There are methods by which the genetic potentiality for milk production of a bull is estimated. This is by studying the milk production of different daughters. Based on daughters production an index is given to the bull. It is called the sire index. The sire index of bull shows that the bull has the potentiality in its genetic make up corresponding to a production of that much of milk. When such records are available that information on sire also can be made use of in choosing a cow.

Pedigree records will be available only in organised farms. Small farmers may not be keeping the records of performance of cows. When such records are not available we resort to other methods for choosing or selection.

Phenotype and Selection

When cows are to be choosen from a group whose record of performance or pedigree is not available, phenotypic selection is resorted to. Mrlk yield is a character which is expressed only late in life. Cows come to lactation by 2 or 3 years of age. So when young animals are to be selected if pedigree information is not available, selection is to be done based on the external features of the animal.

Phenotype is the visible expression of a character in contrast to genotype which is the genic make up of the individual and cannot be seen. Phenotype can be appreciated in quantity and quality where as genotype has to be assessed based on the genotype.

When selection is done on young calves ... cows, whose producing ability is not known, ... on external features. This procedure has its own ... External features need not always represent its ... ability. Actually the producing ability of a cow ... judged by seeing any of the animals features. But such ... procedure is resorted to because there is no other possibilities ... In such situations certain characters which are described as ... "dairy characters" are examined and selection done on that ... basis. The important dairy characters are the sizes and uni-formity of udder, thickness and toruousness of milk veins, larger body capacity etc.

Judging

"Judging" of animals are usually conducted along with with cattle shows. These judgings are only an evaluation of external features of the animal or the beauty of the animal. A cow which is judged as the best need not be the best milk producer, for milking cows milk yield competitions are carried out separately.

In judging of cattle usually they are classed into different categories like calves, heifers, cows etc. and judged separately. For judging, "Score cards" are used. Such score cards designed by American Dairy Herd Improvement Association is used and is available for different categories. Score cards consists of enumerated characters classified into 4 divisions and maximum marks to be awarded for each division is given. These divisions with marks are, General appearance 30, Dairy character 20, Body capacity 20, and mammary system 30. For each division sub divisions and allocation of marks are given. In the judging process the judges examine the animal and marks for each sub division is entered in the score card and finally the total for that animal is worked out. In the similar way one score card has to be filled up for each animal. Finally, based on the total marks obtained for each animal prize winning animals are selected. This is a tedious process, especially when there are large number of animals in the competition.

Score card for judging dairy cows

The score card approved by the American Dairy Herd Improvement Association (DHIA) is generally accepted. A condensed version of the score card for dairy cows is given here. Some minor items and marks for sub divisions are omitted here.

1. *General appearance* Perfect score 30

(Attractive individuality with feminity vigour, harmonious blending of all parts and impressive style and carriage)

Breed characters.

Head—Clean cut, proportionate to the body, large open nostrils, bright eyes alertly carried ears.

Shoulder blades—Set smoothly and tightly against the body.

Back—Straight and strong.

Rump—Long wide and nearly level.

Tail head—Set level with back line and free from coarseness. tail slender.

Legs and feet—Bone flat and strong, pastern short and strong, feet short compact and well rounded, Forelegs medium in length straight wide apart and squarely placed. Hind legs—nearly perpendicular from hock to pastern from side view and straight from the rear view.

2. *Dairy Character.* Perfect score 20

(Evidence of mllking ability angularity. General openness freedom from coarseness, giving due regard to period of lactation).

Neck—long lean and blending smoothly into shoulders. Withers—sharp.

Ribs—wide apart, rib bones wide flat and strong.

Flanks—deep and refined. Thighs—wide apart from the rear view. Skin—loose and pliable.

3. *Body capacity* Perfect score 20

(Relatively large in proportion to the size of the animal providing ample capacity, strength and vigour)

Barrel –Strongly supported, long and deep ribs
depth and width of the barrel tending
towards the rear.

Heart girth –Large and deep with well sprung fore ribs
in to the shoulders. Wide chest floor

4. *Mammary system*

(A strongly attached well balanced capacious
fine texture indicating heavy production and a long
of usefulness)

Udder—symmetrical moderately long wide and deep strongly
attached showing moderate cleavage between halves, no
quartering on sides, soft pliable and well collapsed after
milking, quarters evenly balanced.

Fore udder—high wide slightly rounded fairly uniform width
from top to floor, and strongly attached.

Rear udder—High, wide, slightly rounded, fairly uniform width
from top to floor and strongly attached.

Teats — uniform size, medium sized, cylindrical squarely
placed. Mammary veins—large long and tortuous.

Usually in minor cattle shows judging is done without the score card. The judges keeping in mind the comparative importance of the different characters make an overall assessment of each animal. Selection of good animals are done in two or three rounds. In the first round some of the apparently good animals are chosen. They are evaluated again in the second round and a smaller number is selected. This process is continued till the selected animals are about 5-6. These are lined up for final evaluation and they are graded as first, second etc.

Grading up

This is practice for improving cattle by crossing the native female cattle with the sires of a given breed continuously for many generations. This produces offsprings having characters similar to the sires breed. As generation passes the offsprings become more similar to the sire's breed. For example by sixth generation the offspring will have about 98% characters of the sire's breed. Grading up was practised in Kerala

few decades back using Sindhi bulls. The improvement produced by this process is slow. Even after six generations, which may take about 25-30 years, the local cattle can be upgraded only to that of Sindhi. As such the programme was discontinued.

Cross breeding for milk production

Cross breeding is the crossing between two different breeds of cattle. It is done to produce new breeds or to improve certain qualities like milk production in the cross breds. Even though theoritically cross breeding is a crossing of two breeds, crossing of local cattle with exotic cattle as done in India is also referred as cross breeding.

Cross breeding is an accepted procedure for improvement of milk production. As the offsprings get half of the heritage from each of the parents, the offsprings will be having an average level of the qualities of the parents. That is to say, if a cow yielding 3 liters of milk per day is crossed with a bull originating from a herd having 15 liters of milk per day, then offspring is expected to produce $\frac{15+3}{2} = 9$ liters of milk per day. Each and every offspring may not produce the same quantity. Some may produce more and some less, but the average of a large number of such crossbreds will be giving an yield of about 9 liters.

Indian breeds and nondescript cows are having poor milk yielding capacity. The milk yield of exotic cattle is much high. At the same time Indian cattle have much of disease resistance and heat tolerance. The exotic cattle are poor in these respects. In the cross breds also these characters will be in medium is level. As the milk yield is increasing there is a reduction of heat tolerance and disease resistance. These disadvantages have to be overcome by better management of crossbred cows.

In the process of cross breeding the Indian cows are artificially inseminated using the semen of exotic bull. The first generation of crossbred will be having half inheritance from both the parents. These are called 50% cross. If a 50%

crossbred female is crossed with an exotic bull the ... generation crossbred offspring will be inheriting 7...% of ... inheritance, $\left(\frac{100+50}{2}\right)$. These are called 75% cross... Usually it is the amount of exotic inheritance which is being referred. Thus if exotic bull is used for crossing every gene... ration of crossbred cow, the exotic inheritance will reach about 98.5% in the sixth generation. This will be almost equal to the exotic breed in genetic make up. This type of "forward crossing" is not recommended in cross breeding of cattle. The crossbred animal has to have sufficient amount of Indian inheritance of heat tolerance and disease resistance. So exotic inheritance in a level of 50% or slightly more only is recommended in cross breding of cattle.

If 50% crossbreds are mated in between, the level of exotic inheritance remains at that level. It must be remembered that by seeing an animal nobody will be able to say exactly what is the percentage of exotic inheritance. So in practise a crossbred cow is to be crossed with a crossbred bull.

For cross breeding different exotic breeds are being used. In Kerala Jersey and Brown Swiss are the two breeds widely used for artificial insemination. Rarely Holstein also is used. In the northern districts Jerseys and in southern districts Brown Swiss are being used. It certain areas facility for storing the semen of both the breeds are available.

Heterosis

In crossbred animals there is a phenomena called heterosis, or hybrid vigour. This is a condition where the crossbred offsprings shows superior performance than either of of the parents with regard to certain characters. This is prominently seen in certain types of crosses. Typical example is the broiler chicken having high growth rate. The genetical explanation of this phenomenon is that in each parent there are some deficiencies in different characters. When two unrelated parents are crossed, in the offspring the deficiency of genes originating from one parent is being covered by the genes

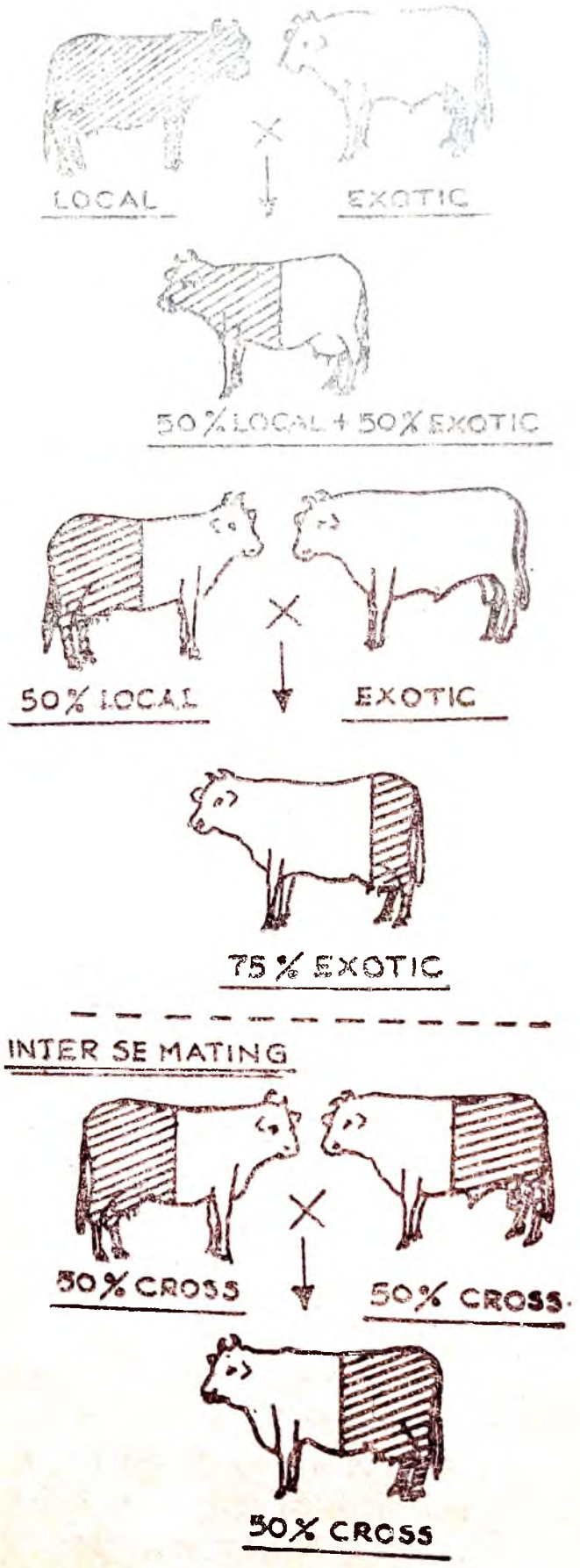


Fig 2
Inheritance of exotic germplasm in cross breeding

contributed by the other parent. Thus the offspring ... superior qualities than the parents. Heterosis effect ... seen in all the different crossbreds. The effect of heterosis will be reduced in the second generation and may cause a little deterioration in quality.

In the crossbred cattle there is no evidence of typical heterosis. But it is believed that it is present in the cross-breds to certain extend.

As the heterotic effect reduced from second generation onwards, a procedure of multiple crossing is sometimes practiced. In this, the second generation or third generation crossbreds will be crossed with a new breed, and later again with a new breed or to one of the original breed. For example, a Jersey—local crossbred will be crossed with a Brown Swiss, next generation, with, say, Holstein and later again with Jersey or Brown Swiss. Thus in each generation some amount of heterotic effect can be expected.

Development of new breeds

Cross breeding has been used as a tool for developing new breeds. As this method helps in mixing up of different characters from two breed sources it may be useful in certain combinations. For example, Kerala which does not have a typical breed may try to develop a breed having good milk production capacity and heat adaptability. A suitable exotic breed can be crossed with local cattle to produce cross breds. The level of exotic inheritance (50%, 62.5% or others) which should be there in the crosses has to be determined after studying their performances, for few generations. Once the desired level is finalised such crossbreds have to be produced in large numbers, they are to be bred between them (inter se mating) and animals with desired characters are to be selected. This process has to be continued for many generations till the desired characters are "fixed" in the population. At that stage such crossbreds can be said to be a new breed.

A move in that direction is being made at the Indo-Swiss project at Mattupetty, Munnar. They have evolved a group of cross breds by crossing local cattle with Brown Swiss bulls. These cross breds are now being called as "Sunandini". From that group a new breed can be evolved by suitable selection for few generations.

Typical example of new breed developed in foreign countries is the beef breed Santa Gertrudis originated by crossing Zebu cattle with Shothorn breed. It contain 3/8 zebu blood and 5/8 short Horn blood.

Practical exercises:

Study of characters of common Indian and Foreign dairy breeds.

CHAPTER IV

REPRODUCTION IN CATTLE

Male genital organs

The male genital organs consists of testes (testicles) epididymis, vas deferense, seminal vesicles, prostate gland cowpers gland and penis.

The testes, are two oval shaped glands placed out side the body cavity covered by skin covering called scrotum. These are suspended from the body by muscles which react to external temperature and keeps the testes close to the body in cold and hangs it away in warm temperature. The main function of the testes is to produce sperms (spermatozoa) which are the male germ cells. In addition it produces the male hormone testosteron which is responsible for the production of secondary sexual characters in male. Testosteron also causes proper growth of the penis and accessory sex organs.

Epididymis is a thickened tube attached to the posterior surface of the testes. It starts from the top portion of the testes comes to the bottom portion and then continues as the vas deferens. The sperms which are produced inside the testes is collected in the epididymis. They undergo some maturation process for some time here and then only sent out. The vas deferens starts from the epididymis and ends in the ureter inside the penis. The function of epididymis is to act as a passage for sperms during ejaculation of semen. The epididymis contains certain glands which produce some secretions so that the sperm cells can be carried in a liquid medium.

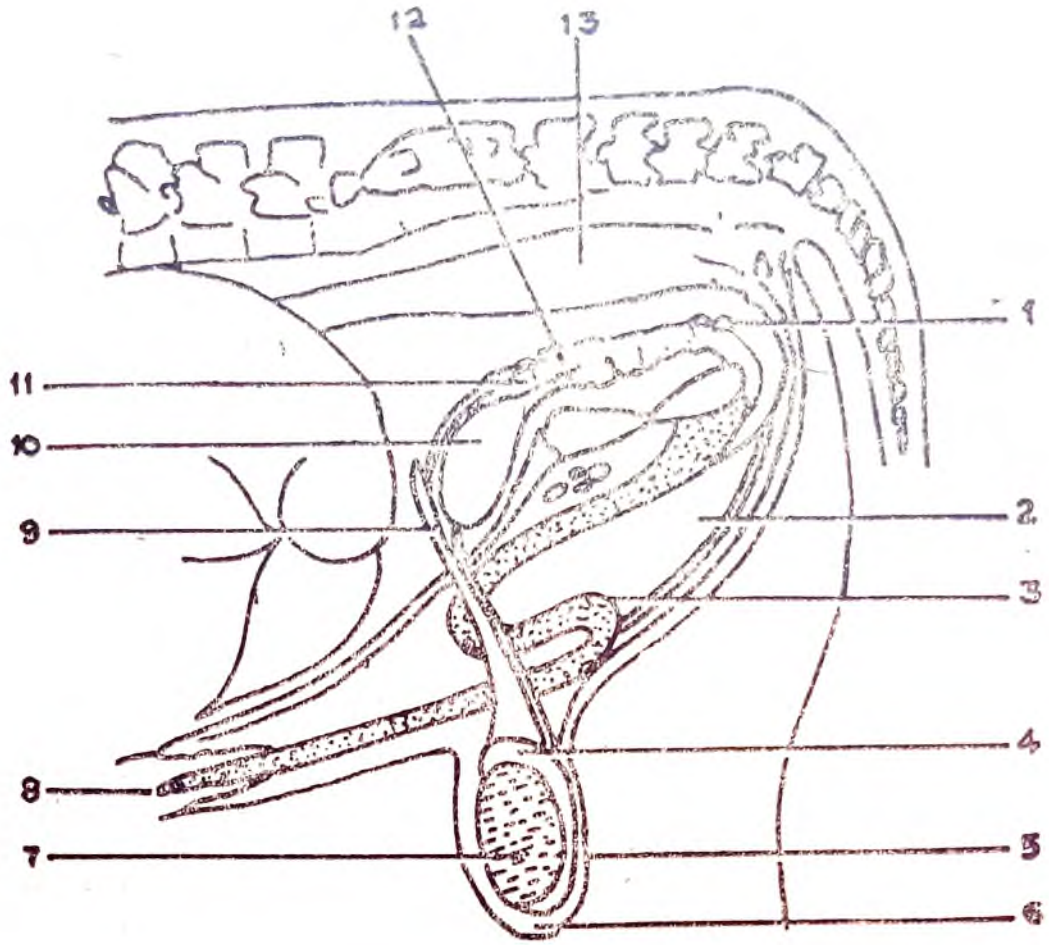


Fig. 3

Diagramatic representation of male reproductive organs of cattle

1 Cowper's gland
2 Retractor penis muscles
3 S-shaped curve of penis
4 Head of epididymis
5 Scrotum
6 Tail of epididymis
7 Testis
8 Glans penis
9 Vas deferens
10 Urinary bladder
11 Seminal vesicles
12 Prostrate gland
13 Rectum

The seminal vesicles which are lying across the produces a fluid which is being added to the sperms at the of ejaculation similarly the prostate glands also supplies secretion. These fluids mixes with the spermatozoa to form the semen during ejaculation.

The penis is the organ for copulation and it helps in depositing the sperms inside the female genital tract. The penis consists of tissues having empty spaces which get filled up by blood in response to sexual excitation. This filling up of tissue causes the organ to be turgid which is called erection. In the case of bulls the penis has a 's' shaped curve called zigmoid flexure. This curve is straightened by relaxation of the corresponding muscles at the time of erection and the penis is protruded out.

Semen is the fluid which is ejaculated into the female genital tract at the time of copulation. Semen contains sperms or spermatozoa and the liquid secretion contributed by the various accessory sex glands. The average volume of semen of an ejaculate from bulls is about 3–4 ml. This may contain about 1000 million sperms per ml.

Female genital organs

Ovaries

These are a pair of pea-shaped glands located inside the abdominal cavity on both sides of the vertebral column. The ovary of a fully grown cow will be having a diameter of about $\frac{3}{4}$ inch.

These organs produce ova and the female hormones which are responsible for the maintenance of reproductive function. At the birth of the individual itself the ovaries will contain numerous, but a fixed number of potential ovum cells which later develops one by one into mature ovum. These mature ovum are discharged from the ovary at each reproductive cycle of the female. During the reproductive cycle each of the potential cell develops migrate to the perifery, contain itself in a protrution filled with a fluid on the surface of the ovary, called the graffian follicle. The number of follicles which develop in a reproductive cycle depends on the type of

species. In cattle usually only one ovum is produced during a cycle.

The graffian follicle also produces a hormone "oestrogen". This is responsible for the exhibition of heat symptoms in the cow. The follicle breaks after about 12 hours after end of oestrus and the ova is released into the fallopian tube. This process is called ovulation. After ovulation, in the place where the follicle was growing, a small body called corpus luteum grows which acts as a temporary endocrine gland and secrete the hormone progesterone. This is responsible for the maintenance of the fertilised ova, especially attaching the fertilised ova on the internal surface of the uterine tract. In case fertilisation has not taken place the corpus luteum regresses in about 14-16 days after oestrus. This will be followed by the growth of a new follicle and the cycle repeats.

Fallopian tubes

This is a long thin tubular structure arising from the top of each horn of uterus and ending at the ovary. The ovarian end of the tube is a funnel shaped structure which enlarges around the ovary to receive the ova at the time of ovulation. The ovum which falls into the tube slowly travels downwards to the uterine horn. Fertilisation can happen during this journey at the anterior one third portion of the tube. If fertilisation has not taken place the ovum travels into the uterus and later excreted out of the uterus. If fertilisation had taken place in the tube, the fertilised ovum is carried slowly to the uterine horn for attachment to the internal surface of the uterus.

Uterus

It is a strong muscular organ having a body and two horns. This lies on the dorsal portion of the abdominal cavity on the median line. The horns are larger than the body in a mature cow. In pregnant animals the foetus grows in one of the horns and as it grows the horn is pushed forward in to the abdominal cavity on the right side. The posterior part of the uterus has a thick muscular mouth-os uterus. The os remains closed except during oestrus. During pregnancy the closed os

uterus is supported inside by a mucus plug. This plug is disturbed during pregnancy may cause abortion. On the inside of the uterus there are certain raised, button like structures called cotyledons which are highly vascular. During pregnancy the maternal (uterine) cotyledons attach tightly with similar cotyledons on the foetal placenta. This is the route through which the foetus get nutrients from the mother.

Vagina

This is a tubular structure connecting the uterus to the external opening, the vulva. The outlet of the urinary bladder opens on the floor of the vagina. The clitoris is a small projection of erectile tissue at the base of the vagina just inside the vulva.

Oestrous cycle

After sexual maturity or puberty the female cattle show repeatedly at fixed intervals the signs of oestrus or heat. These signs of oestrus are caused by the action of oestrogen liberated into the body from the graffian follicle. This causes many changes in the reproductive tract, the changes are mainly intended to receive the semen from the male and to accept the fertilized ova. Externally the symptoms of heat include a change in the behavioural pattern of the cow, as mounting on other animals or allowing to be mounted upon by other animals, mucus discharge from the vagina and bellowing. Signs of intense heat remains for about 12-18 hours. The ovulation occurs 12 hours after the end of the above stage. After ovulation the corpus luteum which develops on the ovary produces progesteron hormone. As long as this hormone is present in the body no further oestrus occurs. If fertilisation has not taken place the corpus luteum regresses and new graffian follicle grows and the cycle repeats.

Detection of heat

In mature heifers and cows oestrus or heat appears every 21 days till it becomes pregnant. Usually the heat remains for 24 hours. Detection of heat is important. If it is not done at the proper time, breeding of the animal is delayed and this will result in economic loss. Heat is generally detected by the

signs exhibited by the cows. The usual signs are bellowing, mounting on other animals, allowing other animals to be mounted upon it, discharge from the vagina etc. The intensity of each sign is varied in different animals for example, some of the cows do not bellow at all. Such cases are called silent heat. In some cases the discharge may be scanty and may be found dried up on the tail and thigh region.

Artificial Insemination

It is a technique in which the semen of bulls are collected, processed suitably for storage and inseminated at the proper time of the heat period of the cow. This is an important tool in animal production. It has enabled the cattle breeders to breed the cows with superior bulls, thereby improving the producing capacity of offspring.

The main advantages of artificial insemination are as follows:–

1) Increased utility of superior bulls. In the normal course a bull will be used for serving 200 cows in an year and may produce about 100 calves. When Artificial insemination is adopted, as the semen is diluted, the semen collected from a bull during the period of an year can be used to inseminate 30 to 40 thousand cows. As the bulls are used extensively the number of bulls can be reduced and only few of the available best bulls need be reared. When superior bulls are used the offsprings of the next generation will be superior.

2) Bull's genetic capability can be proved earlier. The genetic potentiality of bulls are evaluated on the basis of the milk yield of its daughters. As more number of daughters are necessary for a reliable evaluation, it becomes possible in a short period of time when artificial insemination is adopted.

3) Transport of semen over long distances as well as storage of semen for long periods are possible.

4) Transmission of diseases by the bull during service can be prevented.

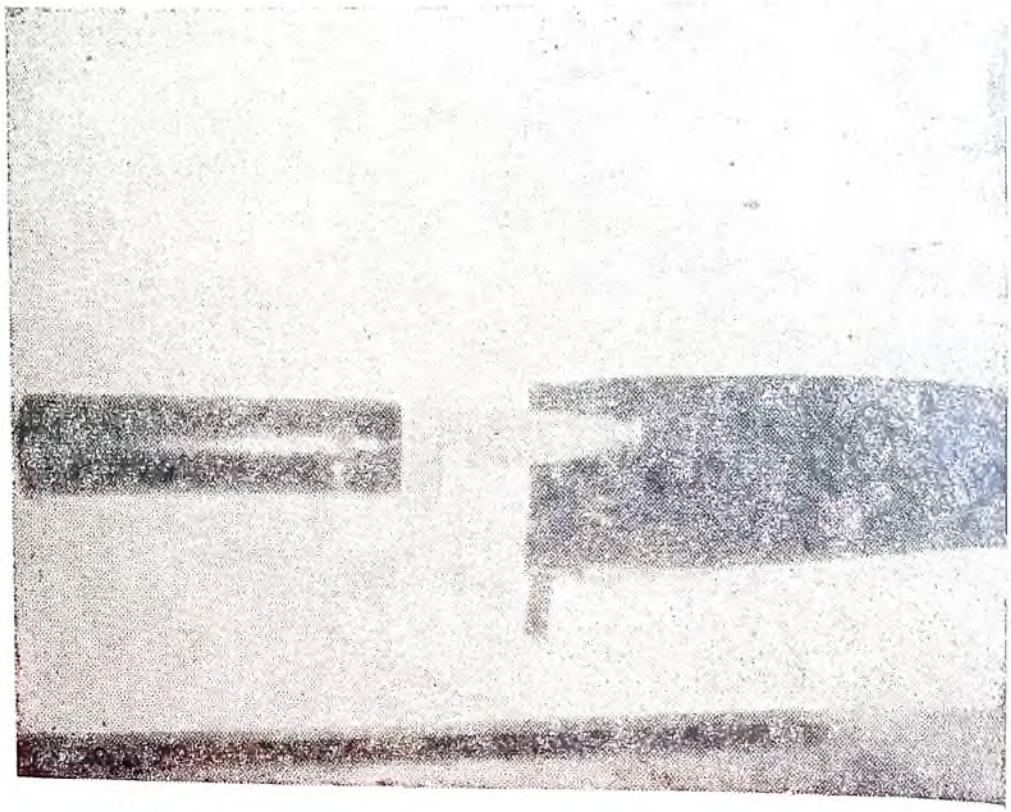


Fig. 4
Artificial vagina for collection of semen from bulls

The technique of artificial insemination consists of collection of semen from bull, examination and dilution of semen, storage of semen and insemination.

Collection: The common method of collection of semen is by use of an artificial vagina. It consists of a hard rubber cylinder of about 4 inch diameter and 14 inch long, fitted with a tap. A smooth rubber liner is put inside and the ends of the liner are folded over the edge of the cylinder. Warm water and air is filled in the space between liner and outer cylinder. A rubber cone is attached to one side of the cylinder. At the end of the cone a graduated tube is fitted to receive the semen. Once the artificial vagina is made ready the bull is allowed to mount on a cow. When the penis protrudes out it is directed into the artificial vagina. If the temperature and pressure inside the artificial vagina is correct ejaculation is made and the bull

dismounts. The semen which collects inside the tube is protected from direct sunlight and sudden change of temperature.

Examination of semen: Semen is checked for the volume. colour and consistancy. The usual volume is 3-4 ml. The colour is dull white, but in Holsteins the colour will be creamy or yellowish. Consistancy may be thick or thin. A drop of the semen is examined under miscroscope to determine the 'mass activity'. If it is good it is then diluted.

Dilution of semen: Semen is usually diluted with 'Egg–Yolk-Citrate' diluter. It consists of 3/4 quantity of sodium citrate solution of 1.96% and 1/4 quantity of fresh hens egg yolk. In addition small quantities of antibiotics are also added to prevent bacterial growth. Maximum amount of dilution recommended is 50 times, ie, 4 ml semen can be diluted to a maximum of 200 ml. The diluted semen is transferred to small containers and cooled slowly to 4-5°C and stored at that temperature. When transported, it is done in ice filled thermos flasks. This storage method is called chilled storage and the diluted semen is called chilled semen.

In another method of storage the diluted semen is frozen and stored in liquid nitrogen at a temperature of—196°C. For this the diluter includes 7% glycerol also. The diluted semen is filled into small straws of 1/2 ml capacity and slowly frozen by liquid nitrogen vapour. After freezing the straws are filled in special containers are kept dipped in liquid nitrogen to reduce the evaporation. The containers are to be refilled at intervals, usually once in about 2 weeks. This method is called deep freezing and the semen is called deep frozen semen. It has got many advantages. The semen can be stored indefinitely in the container. It can be transported to long distances. As it can be stored for long time wastage of semen does not occur as in the case of chilled semen. The only disadvantage is that the technique is costly as it need liquid nitrogen in large quantities and the costly containers.

Still another method of storage is the room temperature preservation. In this method the diluter consists of egg yolk–citrate solution and coconut water. In addition to antibiotics

antifungal agents and an enzyme catala
semen after dilution is filled in small
and transported at ordinary temperatur
this method is evident, as no cooling is
been found that the fertilising ability of sem
and the fertility rate after 48 hours is very

Insemination: For insemination the se
long narrow pipette to which a syringe is
case of frozen semen a special 'insemination
which can hold the straws. The pipette is intro
vagina into the os uterus and the semen is
pressing the syringe. For locating the correct
hand of the inseminator is introduced through
This method is called the rectovaginal method o
nation.

Correct time of insemination: As the ova is release
about 12 hours after the intense heat period, the insemination
time has to be so adjusted that the sperms are available at the
anterior part of the oviduct by the time the ova reaches
there. This can be assured by inseminating the cow at the
latter half of the heat period. In cases where the heat period
is prolonged than the usual time a second insemination also
may be tried.

Pregnancy diagnosis

Diagnosis of pregnancy in cattle is done by feeling the size of the uterus through the rectum. The method is called rectal examination. The hand (with gloves) is lubricated with soap and slowly pushed into the rectum of the animal after controlling the animal properly. By pressing the palm on the lower wall of the rectum the uterus can be felt. The enlargement of uterus due to pregnancy can be felt by about third month of pregnancy. An expert may even diagnose the case at 2–2½ months.

Pregnancy

The gestation period in cow is about 280 days with a variation of 5 days on both sides.

Calving

Calving occur at the end of pregnancy. Many days ahead of calving symptoms of approaching calving are visible. The udder becomes swollen and enlarged. The vulva and surrounding region becomes swollen 2-3 days ahead of calving. The muscles and ligaments on the pelvic region becomes relaxed. This will be evident by the drooping of skin on the part around vulva.

During calving the foetal coverings—the placenta—is pushed first which bulges out with the fluid inside. This is also called the "water bag". It breaks, releasing the fluid and then the foetus slowly comes out. The normal position of the foetus is with stretched out fore legs with the head resting on it. The hooves of the fore limbs will be seen coming out first. This will be followed by the face and head. The calving process is slow till the chest region comes out. The rest of the calf's body is pushed out in a short time.

Normally the calving process takes less than half an hour from the time the water bag comes out. If the calving process is prolonged beyond a reasonable time veterinary help is to be sought.

After the calving is over the placenta will be usually expelled within ½–1 hour. If it is not expelled with in 2-3 hours a veterinarian's help should be sought to remove the placenta manually.

During the process of calving naval cord breaks which connects the foetus with the mother through the placenta and it is through this cord the foetus gets the nourishment while it is inside the womb. If this cord does not break by its own at calving it has to be cut at a length of 2-3 inches from the body. End of the cord attached to the naval of the calf may be dipped in tincture of iodine to prevent the entry of any disease producing organism. Just after calving the nostrils of the calf is to be cleaned of any mucus which is sticking on. The calf is to be observed for its conditions especially the breathing. If it does not breath artificial respiration is to be tried by pressing the chest alternately.

Pulling the tongue will help in this process. The calf's body is to be cleaned with a dry towel or gunny bag.

The new born calf usually does not need any help. It starts walking with in few minutes of birth, find out the udder and starts suckling the teats.

Practical exercises

Demonstration of collection of semen, dilution, examination storage and insemination. Detection of heat in cows

CHAPTER V

MILK PRODUCTION

Even though the females of all the mammals produce milk in the mammary gland to nourish their young ones, the quality and the quantity of the milk varies in different species. Dairy cattle produce large quantity of milk which is more than sufficient for their young ones. This was made possible by the human effort over many generations by suitable methods of breeding programmes and selection of cattle.

The qualitative changes in the milk of different species probably indicate the nutrient requirements of the young one of the species. Within the species itself there will be difference in the composition of milk. The average composition which is described should not be taken as a value which is constant. The detailed composition of milk is discussed in chapter VIII.

Milk production in cows is a process controlled by the genetic make up of the animal and environmental conditions in which it is maintained. Genetic make up is the inherited potentiality of the cow, inherited from parents. The environmental conditions include the nutrients obtained by the cow the managemental practices and climatic conditions. When all these factors are favourable the cow is able to produce more milk.

Milk formation

The milk may be defined as the lacteal fluid obtained from healthy lactating mammary glands, and obtained after a complete milking. The milk is formed in the gland. The process of milk formation consists of synthesis of many components

utilising the raw materials detained from the blood and by a process of selective absorption of the rest of the components. The synthetic capacity of the mammary cells are evident considering the fact that most of the components present in the milk are not present anywhere else in the body than the udder. This is the case with major part of the protein, lactose and milk fat. Thus the udder of a cow which produces 20-24 litres of milk a day will be working as a very actively metabolising gland.

The udder of the cow consists of four mammary glands combined together by a skin covering. Each gland is independent in function. It means that each gland has independent supply of blood vessels and nerves and the secreted milk is drained by its own teat opening. The milk is formed in the alveoli which are hallow sac like structures. The diameter of an alveolus is about 0.1–0.3mm. Each alveolus has a duct which joins with similar ducts to form bigger ducts. Finally these ducts open into a cavity called gland cistern at the base of the gland. The gland cistern is connected to a smaller cavity inside the teat, called teat cistern. This opens out through the teat opening. Teat opening remains closed by a layer of circular muscle fibres called the sphincter muscles.

Milk removal

The milk which is formed inside the alveoli flows in to the ducts and into the gland cistern and stored there during the interval between milking. The milk has to be brought to the teat cistern for milk removal either by the calf or by milking by human agency, This is effected by the process called "letting down". It is a reflex action produced by the nervous stimulation caused by the handling of udder, like washing, etc. and by the routine followed during milking. This stimulation causes letting down through the action of a hormone called oxytocin released from the posterior part of the pituitary gland. On letting down the milk fills the teat cistern and externally it can be seen that the teat becomes turgid. Milk can be taken out only after letting down, whether it is done by suckling of the calf or by hand milking or by machine milking.

It is important to note that the letting down process is transitary, that is to say, that it remains only for a short time. Usually the effect remains for 6-8 minutes. So milking has to be completed during this period to get the complete milk from the udder. If the cow is not milked during this period, the milk which has come to the teat cistern slowly flows back to the storage spaces. The animal has to be made to let down again to do milking.

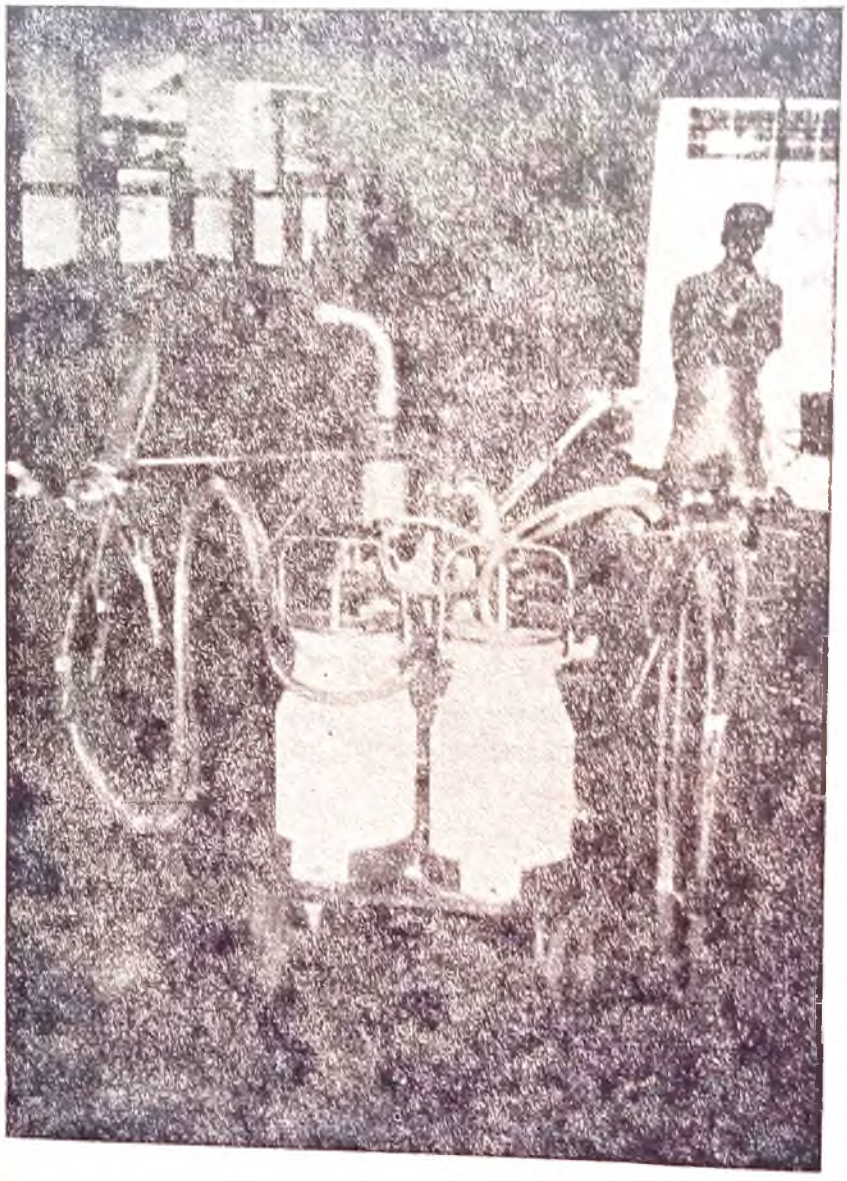


Fig. 5
Machine milking of cows
a) Portable milking machine in operation

Fig. 5
Machine milking of cows
b) Udder showing the teat cups of machine in position

It has to be born in mind that milking process cannot be done without the co-operation of the cow. If the cow is frightened or made nervous or beaten, the letting down process is inhibited. If it happened after letting down, the process is reversed. This is due to the release of a hormone called adrenaline during fright or pain.

The letting down process can be enhanced by providing comfort to the animal and by following the normal routines,

which are usually associated with the milking operation. The letting down is a reflex action, which is promoted by the usual conditions associated with milking. These conditions are the place where the cow is tied up for milking, the sounds of bucket or even music if the cow is accustomed to that, feeding of the cow just before milking, handling of the udder etc. If the conditions are changed suddenly the animal may not let down properly.

When the milk is removed by hand milking, it is done by exerting external pressure over the teat. The teat is held in the palm, the upper portion is pressed by the thumb and fore-finger and then with rest of the fingers the teat is pressed downwards. The milk which is trapped inside the teat cistern overcome the contraction of the teat sphincter and flows out. Then the thumb is released to allow flow of milk into the teat cistern. This process is repeated. For efficient milking the milking process has to be fast and the milker has to do the milking with both hands. Usually a good milker will be able to milk out two litres of milk per minute. If the milking is slow it is evident that the whole milk available in the udder of a high yielding cow cannot be milked out completely. The process of hand milking has to be done with sufficient care. Pulling the teat downwards during milking has to be avoided. The method of milking can be described as full hand milking and stripping. This may be fisting or thumbing. When the teat is pressed against the palm by the fingers the method is full hand milking. Usually the thumb is used to press the teat against the fore-finger. This method is fisting. This is the recommended method. Some milkers fold the thumb and the teat is pressed against the palm with the thumb and forefingers. This method is thumbing. It gives more pressure to the teats and in the long run may do harm to the teats. Stripping is the method of milking by thumb and forefingers. This is done at the close of milking. This is also the method when the teats are very short.

For milking the cows, machines are also available. By machine, milking is faster and large number of cows can be

milked at shorter time. It works by sucking action due to negative pressure or partial vacuum. There are four teat cups which are applied on the teats after letting down of milk. Then negative pressure is applied around the teat and it causes flow of milk into the teat cups. The milk is collected in suitable containers.

Lactational characteristics

Normally lactation is a consequence of pregnancy. During pregnancy period the udder grows and at the maturation of pregnancy the udder starts lactating. The normal lactation in cows continues for about 10 months. Some times it may prolong for longer periods. The daily yield increases during the initial period till it reaches the maximum which is called the peak yield. This is usually reached by 6-8 weeks. Later there is slow decrease in yield up to the end of lactation.

The cows are usually milked 2 times a day. It may be better if it is milked three times as there will be an increase in the daily yield. Three times milking will give about 20% more milk than two times milking, where the intervals are equal. But as three times milking needs 50% more extra labour than 2 times milking, this will be useful only in high yielding animals.

Clean milk production

Milking and milk handling has to be done in proper hygienic conditions.

Milk is a good nutritious food. It is also a good medium for bacteria. During milking and milk handling there are plenty of chances for bacteria to enter the milk. Along with that it is possible that harmful bacteria (pathogenic) also may get access to milk. Thus the milk may act as a source of spread of diseases. As such milking and milk handling has to be done with proper hygienic precautions.

Milk as it is drawn from the udder, even when proper precautions are taken may contain some amount of bacteria. This is because the udder itself may be harbouring bacteria. In addition large number of bacteria get into milk during handling

of milk. These may not be disease producing but they can make changes in the milk which will result in spoilage. Bacteria can bring about these changes faster when the milk is kept in warm atmospheric temperature. As such, in tropical areas the milk get spoiled easily. For better keeping quality of milk the bacterial load in the milk has to be reduced by reducing the contamination of milk as well as the milk has to be stored in cooled conditions. Cooling will reduce the bacterial multiplication and corresponding changes which they may bring about.

The bacteria in milk during favourable conditions converts the lactose of milk to lactic acid as a part of their metabolic activity. This causes increase in acidity of the milk and at higher levels causes coagulation of milk. Even at lower levels of acidity the milk will coagulate on heating. Such milk cannot be used for normal uses. That is the reason why bacterial load of milk has to be reduced.

The source of entry of bacteria into milk are varied. The udder itself is one of the main source. Inside the udder there will be always some amount of bacteria. These come along with the milk especially in the first few strips. Discarding the first few strips of milk will reduce the bacterial load. The external surface of the udder usually remains dirty and naturally will be having plenty of bacteria. So, before milking the udder has to be washed with clean water or some antiseptic solution and mopped with a towel. For washing udder bleaching powder solution or iodophore solution can be used.

The hands of the milker also will contribute large amount of bacteria. This is especially so if he is not having clean practices. Milkers' hand also is to be washed with antiseptic solution before milking. If the milker is a diseased persons he may also contaminate the milk, as when sneezing or spitting etc. As far as possible diseased persons should not be allowed as milkers.

The dust particles, and particles of dung and urine which may accidentally fall into milk will contribute a large amount of bacteria. This can be prevented to certain extend by using a hooded milking pail.

Fig. 6
Handmilking done into a hooded milking pail

The vessels used for milk handling like milking pail, milk can, milk bottles etc: are the main sources of contamination of milk. These vessels have to be properly washed and kept dry in between use. Milk fat will stick to the surfaces of vessels. The vessels have to be washed with suitable detergents. The common detergents are sodium bicarbonate (washing soda), disodium phosphate, sodium hexametaphosphate etc. Many detergent powders are available in market

which are usually a mixture of few of the powder detergents. Examples are, "Vim", "Biz" etc. Liquid detergents are available, as Teepol. For the bacteria on surfaces some sanitisers (antiseptics) are to be used. These should not have any smell or colour and should not be toxic to human even if some quantity is retained in vessels. Such a suitable antiseptic is bleaching powder solution. The chlorine content in the bleaching powder will destroy the bacteria. Now a days a compound called iodophore is available which has got antiseptic and detergent properties. It is a compound of iodine combined with synthetic detergent. It is deep brown thick solution which has to be diluted with water, usually 200 times. The dilution rate will be given on the bottle. This compound is now marketed in the trade names of "polysan', "Asiphore", etc.

Milk produced and handled with such precautions will contain comparatively less number of bacteria. Such milk can be kept in atmospheric temperature for longer time. The keeping quality can be still increased if the milk is kept cooled preferably at a temperature of 5-10°c.

Induction of lactation

Lactation in mammals are usually preceded by pregnancy and calving. Certain cows do not become pregnant because of infertility. The cows may be genetically superior but due to infertility they become uneconomic. In such cases we may adopt a procedure to induce them to lactation by injection of suitable reproductive hormones. This is a new advancement in Dairy Husbandry.

The cows are given the hormone injection for a period of seven days. Due to this the udder grows and within two weeks after the end of the treatment period the growth of the udder become almost full. Then milking is started. Almost normal level of milk is obtained and the lactation continues sufficiently long. The composition of milk from induced lactation has been found to be same as that of normally calved cows. There are large number of factors which influence the

result of treatment. Even though in majority of cases they produce almost normal amount of milk, in some cases response is poor.

Milking disorders

Cracks on the teats: This occurs due to rough handling of teats during milking or due to dry weather. When the cracks are deep it may become painful and the cow will evince pain and may kick when milking is attempted. Because of this complete milking may not be possible and corresponding loss ensues. This can be cured by local application of antiseptics preferably in an oil base. Care should be taken to wash off completely the antiseptic from the teat before milking is done.

Swelling over the udder: Swelling of the udder especially towards the front side of the udder occurs sometimes just before calving. This slowly disappears 8-10 days after calving. Rarely it remains for longer time. Normally this does not need any treatment.

Hard milkers: When teat opening is very small it is difficult to milk out the available milk from the udder. The milk comes in very narrow streaks and it takes too much of time for milking. In such cases the cows are called hard milkers. As this condition is not easily curable the 'milkability' of the cow is to be checked when a milking cow is purchased. The condition may occur in one or more teats. The usual treatment done is to introduce sterile teat plugs or sterile flexible tubes into the teat opening and keeping it there in between milking. This has to be done carefully as there is the risk of introducing bacteria into the teat causing mastitis.

Practical exercises

Practice of milking, procedures for clean milk production.

CHAPTER—VI

CALF REARING

The calf is the future cow. So to improve the future generations of the cows, present generation of calves are to be looked after well. This is especially so in the case of crossbred cattle as the rate of growth of the calves are faster than that of nondescript cattle. This is evident from what can be observed easily that well fed and well maintained crossbred calves come to maturity by 1–1½ years where as nondescript ones will come to maturity only by 3-4 years of age. As the growth rate of crossbred calves are faster, correspondingly it needs better nourishment and management.

Care of the calf should start from the stage of foetus onwards. The pregnant cows should be fed additional ration from about 5th month of pregnancy. Half a kilo concentrate may be given additionally at that stage and slowly increased to one kilo at the end of pregnancy. The cow has to be dried out before 8 months of pregnancy, so that, the cow will get at least 2 months of rest period before next calving. This is necessary for the better growth of foetus as well as health of the cow. The cow will be able to reccup her health before next calving.

Cows which are nearing calving, the down calvers, should be separated from other cows and tied up with sufficient space to move about. It will be better if a room or a shed can be spared for the cows. Immediately after calving the new born calf will be covered with a slimy matter which is the remains of foetal membranes and fluid. This has to be wiped dry with a dry towel or gunny bag. Even though the cow may lick and remove the slimy material, it is better

that the cow is not allowed to do so, as [illegible] materials may impair the digestion of the cow. There will be some mucus material in the nostrils of the calf which also has to be removed. The calf may be watched for the signs of breathing. If it does not breath attempts should be made to stimulate breathing. This can be helped by opening the mouth pulling the tongue, tickling the lower part of the tongue etc. Artificial respiration also can be tried by alternately pressing and releasing the chest.

Weaning

In organised farms a system of rearing calves separated from their mothers is practised. This is called 'Weaning'. The calves are removed immediately after calving and looked after separately. Mother's colostrum is fed by placing the colostrum in wide mouthed vessels. Most of the calves will start drinking from the pails without difficulty. For those who hesitate, the mouth is slowly dipped into the pail of milk for a moment. When it get the taste of milk they will start drinking. For still stubborn calves, allow them to suckle the thumb and then dip the mouth along with the thumb into the pail. As it suckles the thumb they will get the milk into the mouth.

Colostrum

The milk which is present in the udder at the beginning of lactation is called the colostrum. This is a thick yellowish fluid with large amount of nutrients. The colostrum contains large amount proteins, the majority of it is the globulins. These globulins are mainly the antibody structures which when absorbed into the blood circulatory system of calves can give resistance to the calves against many enteric diseases. These antibodies were those originally present in the mothers blood which had been accumulated in the milk during the milk formation in the udder. It is one of the way of natures protection of the newborn calf. The new born calf has to get the colostrum as early as possible. In the early hours of life, the calf can absorb the antibodies which are present in plenty in the colostrum, directly into the system. This capacity of absorption

slowly disappears as time passes. That is why it is recommended that the calf should get the colostrum within ½ hour after birth. The colostrum also has a laxative effect which helps in removing the 'meconium', which is the dung present in the rectum at the time of birth.

In the first few months the entire food of the calf is milk itself. It will not have the capacity to digest other foods properly. After 1-2 months it will slowly develop the capacity to digest other foods. The typical digestive patten of cattle is by the fermentation in the rumen. In the calf the rumen is not developed. By about 4-6months the rumen activity develops. The rumen development can be stimulated if the calf is allowed free access to forages. The calf may eat pieces of straw even at 2-3 weeks of age. Even though it will not be digested at that stage it will help in the rumen development.

Milk replacers and calf starters

In western countries special feed preparations are available which can be used instead of milk. This is called milk replacers. This is given after the colostrum feeding. The major constituent of milk replacers is skim milk power which are usually available cheaply in western countries. After few months milk replacers are replaced by calf starters, which is highly nutritious concentrate feed having higher digestibility than the ordinary concentrate feed.

Calf starters can be prepared by selecting necessary feed items which are locally available. One example of such a mixture is as follows.

Groundnut cake	32 parts
Tapioca chips	15 ,,
Yellow maize	10 ,,
Wheat bran	25 ,,
Fish meal	10 ,,
Molasses	5 ,,
Mineral mixture	2 ,,
Salt	1 ,,

Additives like Vitamin B complex (dried yeast) and Vitamin A (shark liver oil) in small quantities.

Dehorning

Removal of horn buds at early days is called dehorning. This is usually done in female calves. In the males many of owners would like to have the horns, as it gives a better appearance to the animals. Animals when dehorned can be handled easily when they grow up. It avoids injury due to fighting between them especially when they are let loose in pasture.

Dehorning can be done either by caustic potash or by electric dehorner. In both the cases it has to be done during the first two weeks of life. Better it is done in the first week itself. In caustic potash method the hairs around the horn bud are clipped and small quantity of vaseline is applied around the area. It is to prevent the caustic from flowing over the skin. The caustic potash stick is rubbed on the bud for few minutes till the bud become soft and fine drops of blood starts coming. The stick is rolled in a piece of paper and held by hand. Care is to be taken not to rub the caustic on the skin around. Caustic

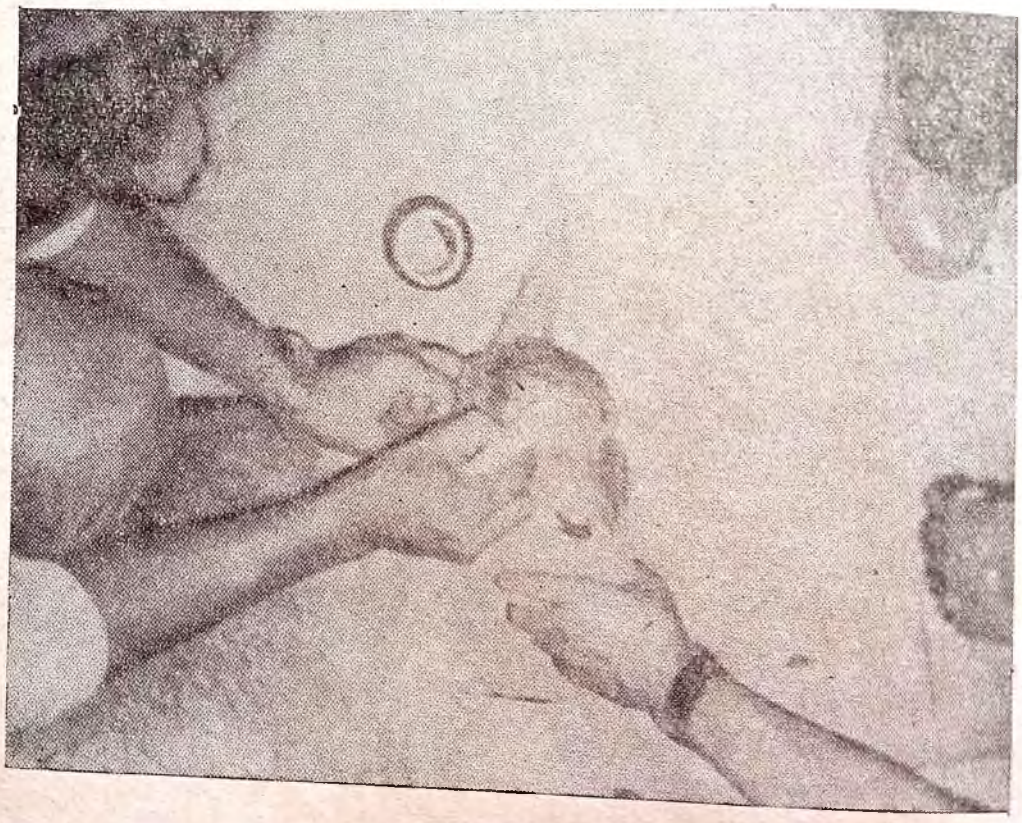


Fig. 7
Dehorning of cattle
a. Dehorning by caustic potash

Fig. 7

Dehorning of cattle

b. Dehorning by electric dehorner

potash is hygroscopic and so on the applied area moisture accumulates and may flow down. It can be moped with cotton. There will be severe irritation on the horn bud due to the caustic. So the calf may rub the head against some objects. To prevent it rubbing against other calves, the treated calves may be isolated for a day. Instead of caustic potash electric dehorner can be used. This is a tubular iron piece heated by electricity. This is made red hot and applied over the horn bud area. It causes burning of skin around the horn bud and later the horn bud sloughs and get removed.

Removal of extra teats

Supernumerary teats are usually seen in many calves When the calves grow and start lactating supernumerary teats give a poor appearance. It may also interfere with milking process if they are very close to the teats. So supernumerary teats are usually removed while the animal is in the calf hood. It is to be done in the first week of life itself. The calf is laid on its back, the supernumerary teat is pulled by a forceps and cut off by a pair of scissors. On the cut surface a bit of tincture of iodine is applied. There will not be much bleeding as the blood supply will be meagre at that time.

Identification

Tattooing is the usual method used for identifying the animal. It is a method of affixing a permanent number on the inside of the ear. Tattooing machine consists of different numerals made of fine needles and a machine in which the numerals are to be arranged to be pressed on the ear. Usually the numbers are put on the left ear. Inside of the ear is cleaned with cotton to remove the wax. Then the necessary number is arranged on the machine and checked the correctness by pressing on a thick paper or on a leaf. Tattooing ink is applied on the surface of the ear, on the middle area and the ear is placed in between the jaws of the machine and pressed. It causes pin point breaks on the skin surface in the shape of the numerals. The machine is removed and the ink is rubbed hard on the broken skin. The ink particles which goes into the broken skin remains life long in the shape of the number.

Ear tags are some times used as identification marks. These are metal badges in which a number as well as the name of the farm is engraved. This can be screwed on the ear through a hole made in the ear. The disadvantage with this method is that it may get dislodged when the animal rubs the ear against some objects.

Hot iron branding is the age old system of putting identification marks on the animal. This is done by burning the skin by red hot iron, which is shaped in the form of numbers. It is usually branded on the thighs. Hot iron branding is almost discontinued now a days. Even though the marking is permanent it has many disadvantages. It is painful to the animal. The continuity of the skin is lost in that area and so hide value is reduced.

A newer method of branding is becoming popular now a days. It is called freeze branding. In this method branding is done by brands made in the shape of numbers and frozen by liquid nitrogen. The frozen brands are applied on the body usually on the side of abdomen for few seconds. This will cause death of the pigment producing cells on the skin. Later, after about two weeks, when fresh hairs comes up the hairs on the branded area will be colourless. Thus white hairs will be seen in the shape of the brands. This has many advantages. There is no injury to the skin and it is not painful. It gives a permanent marking visible from a distance. The limitation is that it cannot be practiced on animals having a white coat.

Castration

This is the method by which the testes of the males are removed. It is done surgically or otherwise. Castration in bulls are usually done nonsurgically, with the help of a burdizzo castrator. The cord connecting the testes with the body which includes the blood vessels and nerves, is crushed by pressing the cord in between the jaws. Even when it is completely pressed, the skin will not be broken. For doing the castration the bull is laid on its side and the legs are tied up. The cord of each testis is placed in between the jaws of

the castrator and pressed to crush it. As the blood and nerves are crushed the testes become dead and regress and in few weeks the testes get reabsorbed. This results in the disappearance of all male secondary sexual characters and the animal will not show any sex drive. Then the bull becomes a bullock.

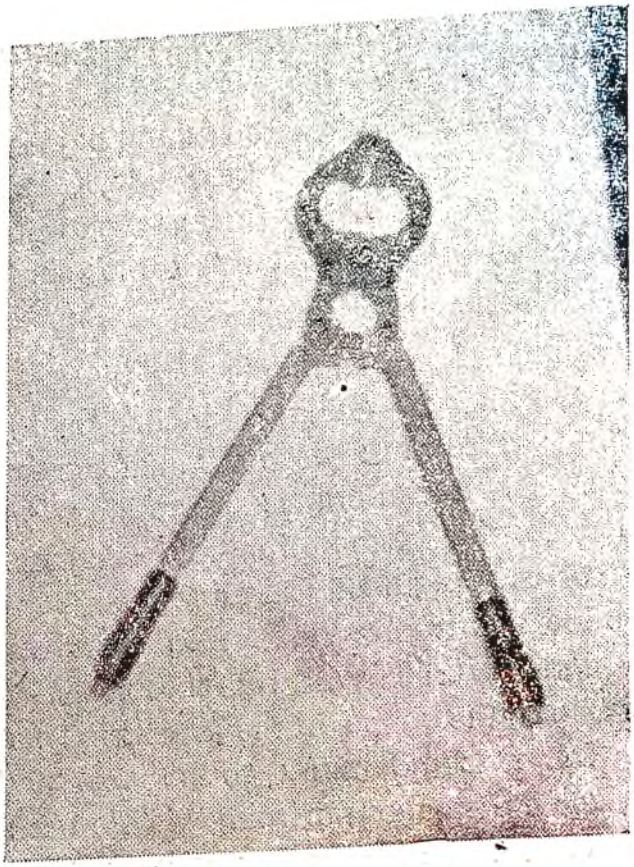


Fig. 8

Burdizzo Castrator for cattle

Castration can be done at any age. Usually it is done between 1–3 years of age. Early castration may retard the muscular development and as such it is better to do castration at about 2-3 years of age.

Herd replacement

Herd replacement is the process of replenishing the stock. From a herd of animals some animals are removed

at intervals. This process is called culling. Culling is done for various reasons:-

1 Old age—Old animals become poor yielders and uneconomic. So they may be culled usually at an age around 10-12 years.

2 Some cows may be poor producers and as such they may be culled.

3 Some cows may become uneconomic or may die off due to diseases.

For such various reasons usually about 25% of the cows are to be culled every year. This means that every year that much of animals are to be added to the herd. This is herd replacement. Replacement is done either by purchasing new cows from outside or by growing the calves born in the farm itself. Replacement by farm grown calves will be better, as their pedigree is known. Usually this method will be cheaper than purchasing cows.

The important point in herd replacement is that there should be sufficient number of calves available from which necessary number of calves can be selected for replacement. It necessitates that the number of calves born every year should be high. If all the cows calve every year, that is the optimum availability of calves. The intercalving period in such a case will be 12 months. That is difficult to achieve in large herds but intercalving period of 14-15 months can be achieved in well managed herds.

The importance of availability of larger number of calves can be understood from the following example. In a herd of 100 cows if the culling rate is 25%, 25 cows are to be culled every year. That means 25 new animals are to be added to the herd every year. This can be done from grown up heifers available. The available number depends on the yearly calving rate. In well managed herds we can expect 90 calvings every year from 100 cows. Out of this, half will be female calves. (say, 45 numbers). Out of this 5% may die off at different stages, (say, 2 numbers). The remaining will come to heifer stage which can be used for replacement.

That is to say, from available 43 heifers 25 heifers can be selected and added to the herd. Thus there is more opportunity of selection, and as the superior 25 out of 43 is selected, next generation will be superior in its quality.

Consider a case where the intercalving period is larger resulting in lower birth rate per year. If the average intercalving period is 18 months the number of calves born every year will be about 75 only. Deducting 50% males and 5% mortality from this, the number of heifers which may be available every year will be about 34. Out of this 25 are to be selected for replacement. In this case selection will not be as efficient as the previous case and so improvement over generation also will be less.

Improvement of cows over a district or state also necessitates production of more number of calves, so that selection can be applied on the future animals. Unless this is practised improvement will be impossible.

Thus in calf rearing two aspects need to be stressed.

1) rearing of calves in a better way.

2) producing more calves by reducing the intercalving period of cows.

Genetic improvement by selection

Selection is a process by which future parents of the stock are selected. In other words a good cow is selected and their offsprings are preferred to be added to the herd. Generally that is considered as a slow process because of the various factors involved in the genetic improvement.

Genetic improvement can be calculated on the basis of the following formulas:-

$$\text{Yearly Genetic improvement} = \frac{h^2 \times SD}{\text{Generation interval}}$$

where h^2 = heritability of the character

SD = selection differential

Out of the three factors in the formula, if the values for nominator increases or if the value for denominator decreases, then the genetic improvement will be more.

Heritability of a character is the fraction of the genotype which is transmitted to the next generation. We know that all the characters of the parents are not transferred to the off-springs. The amount of the character transferred is variable. Some characters are transmitted in larger proportion than others. For example, the coat colour pattern of Holstein cattle are transmitted to offspring in large proportion. If a sire and the Dam has the same colour pattern the offspring also will have the same colour pattern. Other characters like milk yield is not transmitted in such large proportion. This is mainly because the number of genes involved in the character are many (about 3-4 pairs, for milk yield) and they segregate during gametogenesis. In addition characters like milk production are too much influenced by environment.

Mathematical methods are available to estimate the proportion of genetic transmission of characters from one generation to other. Such an estimate is called the heritability of the character. Generally the value is expressed as a quantity between 0 to 1. If the character is completely heritable the value is 1 and if it is not heritable the value is 0. Characters which are partially heritable get a value in between. In the case of milk yield it is around 0.3 to 0.4. This is a factor which can not be altered by human agency. The selection differential is the difference between the average of the selected animals and the herd average. If the average milk production per cow in a herd is 10 litres and few of the selected cows give an average of 15 litres, the selection differential is 5 litres. Selection differential can be increased if the selected number is small. If only 10 animals are selected from a group of 100 cows the selection differential will be high. On the contrary, if 90 cows are selected out of 100 cows the selection differential will be small. This means, for effective improvement there must sufficient animals from which selection is to be made. For example if milk production in Kerala is to be improved by selection there should be sufficiently large population of cattle in kerala from which good cows are to be

selected and reared. In order to produce a large pr... there must be optimum birth rate, which means that the ... calving period should be minimum for each cow. The optim... birth rate is 85-90 calvings for every 100 cows and optimu... intercalving period is 12 months. The intercalving period o... cows can be controlled by human agency. Thus one of the action needed for improvement of cattle is to produce more offsprings by reducing the intercalving period.

The generation interval in the case of crossbred can be put as 3–3½ years. In the case of zebu cattle it is about 5-5½ years. As the generation interval reduces, the annual progresses which can be made will be more. Generation interval can be reduced if the animal comes to maturity at an early age. Early maturity is partially controlled by genetic make up and partially by management. So selection has to be done on the basis of early maturity also and such animals are to be fed and managed properly in the growing stage to attain early maturity in the calves.

Practical exercises

Demonstration of dehorning, tattooing, castration

CHAPTER—VII

FEEDS AND FEEDING

The nutrients contained in any feed stuff can be classified as proteins carbohydrates, fats, vitamines and minerals. In addition there is varying amount of water in all feed stuff. The nutrients and water contents can be estimated by chemical methods. As the water content in feeds varies it may not be possible to compare the quantity of nutrients in different feeds if they are expressed as such. So usually the chemical composition of feeds are expressed on "dry matter basis". This expresses the percentage of the nutrients present in the feed stuff when the water content is removed. In other words the nutrients are expressed as a percentage of the dry matter content. For example, Berseem grass contains 2% protein on wet basis. The water content in it is 90%. That is to say, the dry matter is 10%. When the protein is expressed on dry matter basis it is $\frac{2 \times 100}{10} = 20\%$ Different grasses may contain different amount of water. So it becomes easy for comparison when the nutrient is expressed on dry matter basis.

The approximate chemical composition of some of the common feeds are given below (on dry matter basis as percentage)

Feed	Protein	Carbohydrate	Fat	Minerals
Rice Straw	3	79	1	15
Gram Straw	6	78	0.5	8
Groundnut cake (decorticated)	52	35	8	6
Coconut cake	24	58	10	8
Peas	25	69	1.5	4.5
Grass	5	82	1	12

Digestion

The chemical composition of feed stuffs does not give correct picture of its nutritive quality as the digestion and absorption of the nutrients present in the feed stuffs vary in different animals. The nutrients in the feed, like, proteins carbohydrates fats, etc has to be absorbed from the intestinal canal through its wall and get mixed up in the blood. Most of the nutrients of the feed will not pass through the intestinal wall as such. They have to be broken up into simpler compounds by a process of "digestion". The digested material passes through the wall of the intestine into the blood by a process of absorption'. These absorbed nutrients are distributed in the body through blood. The body tissues get the nutrients through the blood and they utilises the nutrients for the different body functions. The activity is "metabolism". Metabolism results in production of some unwanted end products which are removed from the body through the process of excretion.

The digestion of feed stuffs may be carried out either by enzymes or by microbes. In monograstic animals having only one compartment in stomach the digestion is enzymic. Different enzymes are secreted into the stomach and intestine and they cause the splitting up of nutrients into its component parts. Small amount of microbial digestion may also take place in posterior part of the intestine. In ruminants, which are having four compartments in the stomach digestion is mainly by the microbes residing in the cavity of the abdomen. These microbes can utilize the cellulose of straw, grasses etc and produce certain volatile fatty acids. In addition, the large number of microbes themselves become digested when they die off.

Ruminant stomach

The stomach of ruminants consists of four compartments, rumen, reticulum, omesum and abomesum. The feed material remains in the rumen for long time and it get fermented by the action of microorganisms present there. These include many species of bacteria and protozoa. These are responsible for the

microbial fermentation prior to the gastric and duodenal digestive process. The suitable products of fermentation especially the volatile fatty acids are removed frequently from the rumen to the other compartments and to the intestine and and absorbed during this process. The rumen microorganisms degrade the complex polysacharides like cellulose and hemicellulose to volatile fatty acids which supply more than half of the energy need of the animal. The microorganisms also synthesise all the essential amino acids and B-complex vitamins which are required by the animal.

Feeds

The different animal feeds available are grouped in different categories based on their bulkiness and chemical composition. The bulkiness of the feed is due to its fibre content. The feed material containing more than 18% crude fibre is called roughage. They contain relatively low level of energy giving nutrients. These include straw green grass, hay silages etc. The feed stuffs containing lesser amount of crude fibre and higher amount of energy yielding nutrients are called concentrates. These include, cereal grains, oils seeds and their by products, like wheat bran, rice bran, coconut cake groundnut cake, gingelly cake etc.

The concentrated feeds are usually prepared by mixing suitable quantities of different feed stuffs based on their chemical composition. Generally a mixture is prepared by mixing suitable quantities of feed items available. So that the protein content of the mixture is about 20%. Nowadays different feed manufacturing companies are producing concentrate feeds. Such feeds are called compounded cattle feeds. In this case it is easy for the farmer to feed the cattle as he need not purchase the different feed items. The quality also can be maintained at a reasonably constant level.

The compounded cattle feeds are usually available as course powder. This form is called 'mash'. Such feed is also available in the form of 'pellets'--small cylindrical pieces. It is made by suitable processing in the factory using steam. The advantage of pellet form is that adulteration with cheap

materials are not possible by other people. In addition it can be fed to cattle without moistening with water. This can save a lot of labour in large farms.

Roughages are available as greens like different grasses or dry like straw. The green roughage include grasses like guinea, napier, fodder crops like maize, barley and leguminous fodder like cowpea, lucerne or berseem. These contain 80-90% moisture. The grasses contain 1–2% proteins where as the legumes contain 4–5% protein.

The different types of grasses which can be cultivated in Kerala climatic conditions are Napier ('Giant' and Ordinary) Guinea, Para etc. They are perennial grasses but for better growth they have to be replanted after 3-4 years. Maize also is cultivated as a seasonal crop for fodder and the yield is very high compared to grasses. It needs wet and drained soil with good sunlight. It cannot tolerate waterlogging. Two crops can be taken under rainfed conditions in Kerala. Ordinary crop variety of cowpea or fodder variety of cowpea can be grown. It grows well in moist soil with good sunshine.

Silage making

Silage making is a method of conserving the green fodder without loosing much of their water content from the fodder by certain amount of fermentation by bacteria. The main advantages of silage making is that the fodder grasses which are available in plenty during rainy season can be conserved for use during summer when fodder is scarce. During rainy season when grass cannot be dried to make hay, it can be silaged. The leaves and thick stem of fodder grasses will become little soft due to ensilaging and this makes it more palatable to cattle. During silaging bacterial fermentation occurs and this produces certain volatile fatty acids as it occurs in the rumen fermentation. The volatile acids can be utilised by cattle.

Methods: Silage is made in different types of silos. These may be drenches, pits or towers. Drenches may be dug below ground level when the soil is sufficiently hard. These

are rectangular in shape and the depth may be varying. Sometimes it is made in such a way that tractors can be brought into the silo to unload the fodder inside. When the soil is not hard and if there is possibility of water oozing into the drench, then the drench can be built above ground by constructing hard walls on three sides. Roof can be constructed above the drench to avoid rain. But it will be costly. Rain water can be avoided by covering with plastic sheets. Pit silos can be dug in hard soil. The site should be sufficiently elevated so that water will not ooze into the pit during rainy season.

The side of the silo has to be lined by plastic sheets or some kind of broad leaves like banana leaves of teak wood leaves. This is not necessary if the walls are made in stones or brick work. The grass is filled in the silo at a stage when the water content is about 65%. Ordinary cultivated grasses like maize, guinea napier etc. may contain about 80-85% moisture when cut in rainy season. Such grasses have to be slightly wilted under shade for a day or so before ensiling. It is better to chop the thick grasses into small pieces. Special machines called chaff cutters are available for chopping the fodder into pieces of about 1 inch long. Chaffing help in packing the fodder properly. The fodder is put in the silo and pressed down properly so that it is packed properly without much of air in between. It can be done by moving the tractor over the grass when the trench is sufficiently large. Otherwise it can be pressed down by people walking over it. After properly pressing the fodder it is covered with plastic sheet or leaves and then layered with a thick layer of mud.

Sometimes certain additives are sprinkled over the fodder during packing. This may be 5% solution of molasses or 1% solution of salt or 1% solution of urea. Molasses will help the fermentative bacteria to multiply in the beginning. Salt solution will give a better taste to the silage. Urea will increase the nitrogen content of the silage.

The chemical changes which occurs in the silage is responsible for its preservation. The plant tissue continue to respire even after it is cut. When the silo is sealed with mud

the fodder does not get oxygen from outside and
available oxygen in between the grasses. Ca
released which dissolves with the moisture avail
carbonic acid. This increases the acidity. Due to
of the plant leaves temperature inside also increases.
hydrate fermenting type of bacteria which are avail
plies and this result in the production of lactic acid
along with certain fatty acids which are also produced
responsible for the preservation of the grass. The colo
the chlorophyl changes and the grasses get a greenish or
colour. Well preserved silage has a peculiar pleasant smell.

When the packing is not done properly large amount of air will be available in between the grasses. This will lead to putrifactive changes resulting in bad smell and the grass become putrified. This will also happen when there is air gap at the top or on sides.

Good quality silage will be having an appearance of greenish brown colour with a pleasant smell. The leaves and stems will be in tact. The stem becomes soft and so there won't be wastage in thick stemmed fodder, like maize. Nutritive value of the silage will be same as that of the grasses but it may increase when additives are added during silage making.

Hay making

Hay making is one of the method of preserving the grasses by drying under sun. The crops should be harvested at the preflowering stage so that maximum amount of nutrients are conserved. The moisture content should be less than 15%. Otherwise mould growth and fermentation may occur during storage. The nutritive value is not affected much during hay making. The carotene content is almost completely lost.

Feed materials

The concentrate feed of cattle include oil seed cakes, cereal grains (maize, bajra, etc) and their byproducts, pulses and their byproducts, etc. (Horse gram, Bengal gram, Black gram etc.) The cereal grains generally are rich in starch and

low in fibre. They are low in calcium and phosphorus but their byproducts are rich in phosphorus.

Maize

Yellow maize is a good source of starch and energy for livestock. Protein content is about 8-12%. It is deficient in essential aminoacids lysine and methionine.

Groundnut cake

It is an important source of protein in livestock. The protein content is about 40-45%. The oil content varies with method of oil removal. In ghani pressed cake the oil content is about 10-12%, in expeller pressed it is 6-8% and in solvent extracted it is less than 1%. Many times large amount of the hulls are also mixed up with the kernals during oil expellation. Such cakes will have higher fibre content and lower protein content.

Gingelly cake

This is similar to groundnut cake. The protein content is about 38%. The oil content may vary according to the processing. It has a better palatability than groundnut cake.

Cotton seed cake

This is the main source of feed protein for livestock in cotton cultivating areas. It contains about 30-40% protein. It contains a toxic material called gossipol which is injurious to swine, poultry and young calves.

Cotton seed is usually fed to cattle either as such or after grinding. In cows this produces milk with harder butter. So churning will be easy and the milk also appears thick even though the fat % in milk may not be more.

Coconut cake

This is the common feed for cattle in Kerala. The expeller cake contains 6-7% oil but the solvent extracted cake contains less than 1% oil. The protein content is about 30%. It is more palatable than other cakes.

Bajra

It has similar feeding value to that of maize. The crude protein content is about 8–10%.

Wheat

Wheat contain 8–14% protein. The grains as such is not used for livestock feeding but the bran is extensively used. It contains 12-14% crude protein.

Rice

Rice polishing contains 3% fibre, 12% fat and 12–14% protein. It is excellent source of energy and Vitamin B complex. Other materials which are available in certain areas are also used for cattle feeding. Such materials are Tamarind seed, Rain tree seed, Rubber seed, Mango seed kernel, silk cotton seed, tapioca waste, etc.

Quantity of concentrate and roughage to be fed.

Good quality roughages are the main stay in cattle feeding. When quality of roughages are mentioned main items considered are the palatability and the protein content. Palatability depends on the stage of maturity of the grass. Young grasses are more palatable and cows will eat more quantity than mature fibrous grasses. In cultivated fodders early stage of flowering is the stage at which the grasses are to be cut. A large sized cow will eat nearly 40 Kg of grass in a day if it is palatable. Long and thick grasses have to be chopped in small bits to avoid wastages. This is the case with maize, guinea grass, etc.

The protein content of roughages are negligible. It can be increased by mixing it with leguminous fodders. Fodder variety of the cow pea is the main leguminous fodder which can be grown in Kerala conditions. Cow yielding 3-4 litres of milk can be maintained on fodder alone if it is mixed with leguminous fodder also.

Concentrates are fed to cattle to supplement the nutrient content of the roughages. Common measures of nutrient which are considered are energy value, protein content and minerals. There are different methods of expressing the

nutrient requirement of animals. The common method is by calculating the total digestible nutrients (TDN). The TDN requirements of cows have been worked out. It will be possible to calculate the amount of concentrates needed for cows when the composition of feeding stuff is known.

The protein content is the nutrient which may become insufficient in many of the feeds. So when feed is prepared care is taken to have sufficient amount of protein. It is insisted that the concentrate feed of a lactating cow should contain at least 20% protein. The protein content should be slightly higher, about 22%, in the feed of high yielding cows. For dry cows feeds with about 16% of protein will be sufficient.

Quantity of feed to be given every day is important. Scientifically this is worked out on the basis of the TDN and protein content of the feed available. For practical purposes the following thumb rule is used in working out the quantity of feed. The requirement is calculated separately for production and maintenance. The production ration is worked out as 1Kg of a good concentrate mixture for every 3 Kg of milk produced per day. For maintenance 1.5 Kg concentrate is allotted for an average size cow. This is the ration for a day. This can be fed at two times in a day.

Practical exercises

Familiarisation with common cultivated grasses and feed stuffs. Silage making.

CHAPTER—VIII

MILK AND MILK PRODUCTS

Milk can be defined as the natural secretion of the mammary gland. It is intended for the young one of the species. But from the beginning of the civilization man had found that milk of animals can be used as food for human young ones as well as adults. In this process he had selected the cows and goats which have better yield. This process of selection when continued over many generations had resulted in certain breeds of cows which yielded large quantity of milk. This excess quantity could be utilised as human food, as liquid milk as well as different types of products. Thus we have now different types of high yielding breeds of cattle and different types of traditional milk products.

General characteristics of milk.

Milk is a liquid in which different components are distributed in a water base. The amount of solid contents varies in the milk of different species. Correspondingly the total nutrient content of the milk also will be variable. As the milk from one species is different in composition from that of another species, there is differences in the composition of milk of individuals of the same species. Even the milk of one individual will be variable in composition in different periods of lactation. As such the composition of milk which is described will be only applicable in a general sense. The discussions which follow will be mainly only the cow milk.

Composition of milk of different species

	Water	fat	Protein	Lactose	Minerals
Human	88.3	3.1	1.2	7.2	0.2
Cow	87.2	3.8	3.5	4.8	0.7
Goat	87.8	3.8	3.2	4.5	0.5
Sheep	80.8	6.9	6.5	4.9	0.9
Buffalo	82.3	7.6	4.3	4.8	0.9
Mare	90.7	1.2	2.0	5.7	0.4

Generally, the solid contents of milk, which is described as total solids, are classified as fat and solids not fat (SNF). The classification is useful because the fat content varies much where as the SNF is not so variable. SNF consists of protein, lactose and minerals.

Legally certain standards are prescribed for different categories of milk, which is sold in the market. Accordingly cow milk should contain not less than 3.5% fat and 8.5% SNF. Buffalo milk should have not less than 5% fat and 9% SNF.

Colour

The colour of milk varies from bluish white to golden yellow. The yellow colour is due to the presence of carotene which is the yellow pigment of carrots. This pigment is present in all green leaves including grasses. Cattle fed on green grasses absorb the carotene to the body and converts it into Vitamin A. In cattle some of the carotene is secreted into milk and this gives the yellow colour to cows milk. In Buffaloes the carotene is not secreted into milk and as such the buffaloe milk will be pure white in colour.

Water in milk

Milk consists of certain solid materials which are distributed in water. In cows milk the water content of milk is about 87%. That means, 100Kg of milk, contains 87 Kg of water and the rest the milk solids. The components of milk are distributed in different patterns in the water content. The lactose and minerals are distributed as solution. The protein is distributed in colloidal form and the fat as emulsion form.

Specific gravity of milk

Milk is heavier than water. The specific gravity ranges from 1.028 to 1.032. In individual cows variations beyond this level may be found. The specific gravity is influenced by the amount of different solid components of the milk.

The specific gravity is measured using a lactometer. The lactometer has got graduation from 10 to 40. In India "Zeal" type lactometers are commonly used which are calibrated at 29°C. The lactometer is allowed to float freely in the milk and then the reading at the surface of milk is read. The specific gravity of the milk is given by $1+\frac{\text{Reading.}}{1000}$ For example a reading of 28 is equivalant to a specific gravity of 1.028. As the specific gravity varies with change of temperature, it has to be read at 29°C itself. If the temperature of milk is different a correction is to be applied to the lactometer reading. For every 1°C rise in temperature 0.3 division is to be added to the reading. Similarly for every 1°C fall of temperature subtract 0.3 division from reading.

Specific gravity can be used as a rough guide for detecting addition of water to milk. As water is being added to milk the specific gravity becomes lower. As there are other factors also which causes variation in the specific gravity, this alone cannot be taken as a sure indication of addition of water. For example the evening milk will have a higher fat percentage and this will cause a reduction in specific gravity.

Fat of milk

The fat content of milk is distributed in the form of small droplets. The method of distribution is called emulsion as water in oil emulsion. As the specific gravity of fat is less than that of the rest of the portion these globules slowly rise to the top of milk if it is kept stationary for some time. This property is called the creaming property of milk. As the movement of globules to the top surface is dependent on the size of the fat globules in addition to other conditions of milk. The size of fat globules varies between different stages of lactation as well as in different species. The globule size is

minimum at the end of lactation. So it will be difficult to churn butter from late lactation milk. Similarly in goat milk globule size is small.

There is wide variation in the level of fat in milk. It can vary from about 2.5% to 6%. In rare cases even wider variation may be found. The following are some of the important factors causing variation in fat percentage.

1 Breed: Certain breeds like Holstein Friesian has got lower fat level than others. The fat percentage in Holstein is about 3-5% while those of Jersey and Brown Swiss the level will be about 4.5%. In general when the yield is high the fat percentage will be lower. This relationship is evident in the case of nondescript cattle which yield only small quantity of milk but with high percentage of fat.

2 Stage of lactation: At the beginning of lactation the milk is very thick having about 28% total solids. At this stage it is called the colostrum. It slowly changes to normal milk with in 6-8 complete milking. The colostrum clots on boiling as it contains high amount of globulins. As the lactation advances the quantity of milk increases and correspondingly the total solid content slowly reduces. Around 6-8 weeks the yield of milk is maximum and during this stage the total solids are at the minimum level. Later as the lactation progresses the quantity slowly reduces and slight increase in the total solids occurs. This change continues up to the end of lactation.

3 Interval between milking: When the interval between milking is short the milk will have a higher percentage of fat. This is due to the fact that milk when secreted during the period when intra mammary pressure is less will have a higher fat content. This is the reason why evening milk contains more amount of fat than the morning milk of the same cow.

4 Variation during milking: The milk drawn at the end of a milking will be having higher fat % than that was drawn at the beginning.

5 Season: During summer the quantity of milk is reduced due to adverse climate as well as scarcity of green fodder. The

milk during summer season will be having slightly high unt of total solids.

Proteins of milk

Milk contains approximately 3.5% protein. The major portion of the protein is casein. In addition there is small quantities of lactalbumin, lactoglobulin, etc. The casein of milk is of high nutritive value. In addition the casein has commercial purposes like, plastics, sizing of paper, water paints etc.

Carbohydrate of milk

Lactose is the carbohydrate of milk which is also called the milk sugar. This is important nutritionally. The lactose can be fermented by bacteria to produce lactic acid. This reaction is utilised for the preparation of many fermented milk products like "Dahi" (curd).

PROCESSING OF MILK

Pasteurisation

It is a process by which the milk is heated to a higher temperature for a fixed period of time and then cooled. The commonly used temperature-time combination is 71.1°C for 15 seconds. This time-temperature combination destroys most of the bacteria present in milk including disease producing organisms. So the milk after pasteurisation become safe for consumption and it can be stored for longer time if kept cold.

Reconstituted milk

This refers to the milk prepared by dispersing whole milk powder in water in approximately 1:7 proportion (one part of milk powder with 7 parts of water). This will have similar properties as that of whole milk.

Recombined milk

This is milk obtained by mixing butter oil or butter with skim milk powder and water in suitable proportion. Suitable mechanical treatments are necessary to mix the three items properly. This process is usually adopted in dairies to cover up the deficit in milk collection during summer season.

Tonned milk

This is milk obtained by mixing water, skim milk powder and whole milk together to produce milk with 3% fat. Usually buffalo milk is used for this. It is produced in the dairies of large cities of India with the intension of selling milk at a low price.

Sterilised milk

This is the milk which has been heated to about 110°C for about 30 minutes using steam under pressure. Usually the milk is filled in bottles, closed by crown cork and then sterilised. This can be kept for about 7-10 days at room temperature. Such milk is produced and sold in Kerala by the "Milma".

MILK PRODUCTS

Cream

Cream is the portion of milk in which the milk fat is in higher concentration. This separation of cream from milk is possible because fat, having low specific gravity and distributed as globules, moves towards the top when milk is kept stationery for sometime. This property is called the creaming property of milk. Cream can be separated from milk utilising this property, by allowing the milk to remain stationary for some time and then removing the accumulated cream from the top. It may not be possible to remove the milk fat completely by this method. As few hours of time is involved in the separation, the milk has to be kept cooled, otherwise acidity of milk will increase due to the multiplication of bacteria in the milk.

Cream can be separated fastly and efficiently by mechanical separators called cream separators. This works by centrifuging or rotating the milk at high speed during which the heavier particles moves towards the perifery and the lighter particles remains at the centre. Thus the skim milk collects at the periphery and cream remains at the centre. These two are taken out through separate outlets without remixing.

The portion of milk which remains after the cream is separated is the skim milk. It contains all the constituents of milk except the fat.

The separator consists of few 'discs' which are funnel shaped but without the tail. When these discs are kept one above the other there will be a small space in between. Milk is spread in between the discs while it is rotating at high speed and the separation is effected.

Ordinary cream will be having about 25% milk fat. Cream having higher fat percent also can be prepared. Cream is used to be converted to butter. Cream also is used for ice cream making as well as for adding to coffee or tea.

Butter

Butter is the concentrated form of milk fat collected by churning either cream of dahi. At home butter is prepared by churning dahi. Churning is usually done by hand. In dairies where large quantity is handled the cream is separated from milk. It is slightly fermented (soured) by addition of suitable bacterial culture of previous days sample of cream. Souring produces typical flavour. Soured cream is easy to churn than fresh cream. In dairies churning is done mechanically by 'butter churns'. The working of the churn causes agitation resulting in clumping of fat globules which when becomes sufficiently large floats on the top of the liquid, as 'butter granules'. These are collected by draining off the butter milk through the bottom of the churn. The butter is then 'washed' by adding cold water. This removes the remaining butter milk and curd particles. After 2-3 washing the butter is collected and the moisture content is adjusted by 'working' the butter. When salted butter is preferred, powdered salt is sprinkled during working at the rate of 1.5 to 2% of the butter.

As per the prevention of food adulteration act creamery butter should contain not less than 80% milk fat and desi butter, not less than 76% milk fat.

Butter can be stored in cold condition for few weeks. In warm temperature it gets spoiled easily. At home when

Fig. 9

A wooden butter churn

refrigerator is not available butter is stored in a vessel of water, preferable in an earthern ware pot. The water is to be changed every day. It can be better stored if stored in brine. The buter has to be immersed in brine. So the butter is placed in the dry clean vessels and then brine is poured over it. In this case the butter will stick to the bottom and it will not float. The brine is to be changed once in a week only.

Ghee

Ghee is prepared by heating the butter to remove all the moisture. Ghee usually contains about 99.5% milk fat. Ghee has a peculiar flavour. The consistancy is usually granular and partially liquid in the case of cow ghee. Buffalo ghee is more solid (granular) and the colour will be almost white.

At home, ghee is prepared by heating butter in wide mouthed open vessels. Butter melts and moisture slowly escapes. When most of the moisture had escaped the bubbling stops and the temperature increases beyond 100 C. When temperature reaches 110°C—115°C the peculiar smell emenates. The curd particles will be light brown in colour. At this stage it has to be removed from the fire and allowed to cool slowly. In dairies butter is heated in steam jacketed vessels. This allows controlled heating. The cooled ghee is filtered through cloth filter and packed. The ghee residue originates from the curd particles which are precipitated casein. The ghee residue is nutritious and can be used to be added to biscuits etc.

Agmark grading is practised in some ghee factories This is a type quality testing organised by the Central Government. It assures the consumer proper quality and also provides the manufacturer better market for good quality ghee. Two types of grades are allotted after testing. "Special grade" and "general grade". In the case of special grade which is of superior quality a red coloured label will be affixed on the container. Similarly for general grade a green label will be affixed. These labels are issued by the Government of India and properly accounted.

Butter oil

This is an oily product prepared from butter, by heating under reduced pressure and evaporating the water content completely. The pressure is reduced to the extent that the melted butter boils at about 60°c. After complete evaporation of water content it is suddenly cooled to low temperature. In composition it is similar to ghee but consistancy is

that of a thick oil, like palm oil. As the evaporating temperature is low there is no structural change occurring to the fat. As such this can be used for making recombined milk.

Milk powder

Milk powder is prepared by evaporating the water content of milk. The powder can be stored easily for long time for use later. Basically there are two methods of milk powder making: Roller drying and spray drying. In roller drying process large hollow cylinders heated to 150°C by steam under pressure is used for drying. Preheated milk is poured on to two cylinders kept close by and which are rotating in wards against each other. Because of the heat, milk is dried up instantly. Dried milk film is scrapped by blades before the rotation of the drum is completed. The dried milk is powdered seived and packed hermetically In spray drying the milk is sprayed as minute droplets into large drying chambers where they mix with a current of hot air at 130-140°C. The water content is immediately lost as vapour and the milk forms into powder. The spray dried milk powder is superior in quality as it has got better colour, flavour and solubility.

Condensed milk

It is the product obtained by evaporating part of the water from whole milk and adding sugar to preserve the milk. This product is referred as "full cream-sweetened-condensed milk". It is a very thick fluid with not less than 9% milk fat, 31% total milk solids and 40% cane sugar. It is prepared from high quality milk with necessary quantity of added sugar and condensing it to the desired level of total solids. Condensation, consists of removal of water from milk by boiling under partial pressure. Vacuum pans are used for this purpose which are maintained at about 25 inches pressure and heated. Then the boiling point is reduced to 55°-60°C. After condensing it is cooled quickly with some agitation and packed in tins.

Cheese

Cheese is a coagulated milk product consisting of mainly the fat and protein of milk. It may be cured for different periods of time varying from 3 months to 1-2 years or more under

low temperature. Depending on the type of processing large varieties of cheeses are available. They are usually classified as hard and soft variety depending in the amount of water content. Different types of bacteria as well as moulds are used in the curing process. During the curing (ripening) process the proteins are broken down to simpler compounds. Fat break down also take place to certain extend. The compounds which are resulting in this process gives a pleasant smell and taste to the cheese. Because of the break down of fat and protein the digestion of these compounds are also made easier, thus increasing the nutritive value as compared to that of the milk from which it was prepared. Some of the common varieties of cheese are, cheddar, Swiss, Roquefort, Brick, Limberger, Camembert, cottage, etc. Out of this the cottage cheese is an unripened variety.

In general the preparation of cheese consists of the following steps: The milk is coagulated by fermentation with bacteria or by the addition of rennet, or both. The rennet is an enzyme preparation obtained from the stomach of calves. It contains the enzyme rennin which has got the capacity to coagulate milk. The coagulum is cut into pieces and then heated for varying time to remove the whey–which is the liquid portion. The coagulum consists of protein and fat. The lactose and minerals are lost in the whey. After removal of whey the coagulum is put in suitable moulds and pressed. This removes little more whey and the material forms into a solid mass having the shape of the mould. Later, in certain varieties spores of fungus are applied. This raw cheese is then ripened by storing in cold temperature having high amount of humidity. The ripening period varies from 3 months to 1 year or more.

Ice cream

It is a frozen dairy product made from suitable blending and processing of cream and other milk products. together with sugar and flavour. It should contain not less than 10% milk fat. 3–5% protein and 36% total solids.

The main ingredients are the milk fat and milk solids not fat. These are obtained from calculated quantity of cream

and milk. In addition sugar flavour (Vanila essence, Ice cream essence, Fruit juice, Chocolate etc.) and stabiliser are added. If desired, suitable colour also added.

A typical mix for ice cream is as follows:-

Sweet cream (25% fat)	300g,
Fresh whole milk	500g,
Whole milk powder	80g,
Sugar	150g,
Stabiliser	2g,
Flavour	few drops.

The mix is prepared in suitable proportion. It is pasteurised and homogenised. Then it is stored for ageing at 4-5°C for 6-24 hours. This process helps to increase the viscosity resulting in smoothness of ice cream. After ageing it is frozen in suitable ice cream freezers. In this process the mix is cooled and at the same time agitated. Agitation causes incorporation of small air bubbles into the mix. The stabiliser present in the mix helps in retaining the air bubbles. Final effect is that the Ice cream become soft. Ice cream is filled in paper cups and stored at about—20°C for few hours for hardening.

Dahi (curd)

Dahi or curd is the product of milk which had been produced by bacterial fermentation. These bacteria grow in milk utilise the lactose of milk for their growth and this results in the formation of lactic acid. This acid when produced in sufficient quantity causes coagulation of milk. This coagulum is called dahi or curd. The term dahi is preferred, as curd is a general term. Milk will coagulate (curdle) by the addition of any acid. This curd has to be differentiated from the coagulum formed by bacterial fermentation. So the term dahi is used for the coagulum formed by bacterial fermentation. The common types of bacteria are streptococcus lactis, S. cremoris, Lactobacillus acidophilus and L. bulgaricus. These are acid producers. In addition, certain other bacteria ferments the citrates of the milk and produce the typical flavour of dahi. In ordinary dahi the acid producers and flavour producers are necessary in proper proportion.

Sometimes other bacteria also enter [illegible] contaminants. These produce undesirable changes [illegible] production, wheying off (removal of watery [illegible] coagulum), etc.

Yoghurt

It is a product similar to dahi. It is a [illegible] product in Bulgaria. The long life of Bulgarian tribes is supposed to be due to the effect of consumption of yoghurt. Yoghurt is prepared from milk of high solid content, prepared by evaporating some quantity of water from milk. Then milk is fermented by special type of bacteria (Lactobacillus bulgaricus) to get a product which is quite thicker than Dahi.

Paneer

This is a coagulated product made from milk. It is also called surti cheese, probably because it has originated in Surat. This product is common in Northern India.

The milk is heated to near boiling and then coagulated by adding lime juice, 1 % citric acid or sour whey which was obtained from paneer prepared few days back. After complete coagulation the coagulated material is poured into a cloth and hung to remove the liquid portion, the whey. When it is cooled the coagulum mats together to form a solid mass. If a rectangular or cylindrical mould is used instead of cloth bag the coagulum is obtained in the shape of the mould. This block of coagulum is paneer. Paneer is used for preparing sweets like Rasagola or preparation of dishes like "mutter-paneer" (green peas with paneer).

Khoa

Khoa is concentrated product from milk. Milk is concentrated by heating in open shallow vessels. Milk has to be continuously stirred during evaporation. When it becomes semisolid in consistancy it is removed from the fire and allowed to cool. This product is used in the preparation of sweets like dooth peda and gulab jaman.

1. Estimation of specific gravity

The usual specific gravity of milk varies around 1.030. The variation is due to the variation in the solid contents of milk. As the specific gravity of fat is 0.96, the specific gravity of milk reduces as the fat content of milk increases. This happens in the afternoon milking where the fat content will be more than that of morning milk. Solids not fat (SNF) contents do not vary much in individual animals but it varies in different breeds. Addition of water to milk reduces the total solid contents of milk. As such the specific gravity is also reduced. So reduction in specific gravity is usually taken as an indication of adulteration of milk with water. As the specific gravity is normally slightly variable this test cannot be taken as a sure test to detect and adulteration with water.

The specific gravity is determined using a lactometer "Zeal type" lactometer which are calibrated at 29°C is used in our country. This has marking from 0 to 40 or 10 to 40. The lactometer is allowed to float freely in a quantity of milk usually taken in a cylinder and the reading of the meniscus of milk is taken. The reading corresponds to the second and third decimals of the specific gravity. For example if the reading is 32, the specific gravity is 1.032. The specific gravity is also given by $\frac{\text{Lactometer reading}}{1000} + 1.$

2. Estimation of fat in milk

The fat content of milk is usually estimated by Gerber's method. Special Gerber's butyrometer tubes are used for this. It has graduation from 0 to 10 on the stem which directly corresponds to the percentage of fat of milk when the test is done.

The test is done as follows: Keeping the butyrometer tubes in a stand add 10 ml of gerbers sulphuric acid (sp. gr. 1.82–1.84). Then add 11 ml of well mixed sample of milk from

a pipette through the sides of the tube. The milk should form a separate layer on the acid without mixing. Then add ... of Amyl alcohol. Close the tube with a rubber stopper and shake thoroughly till no white particles of milk are seen. After mixing hold it with the mouth downwards and see the level of the fluid in the stem. If the level is low keep it again in the stand, open the cork and pour sufficient dilute acid to bring the level nearer to the graduation of 10. Close the tube tightly and centrifuge. After centrifugation take out the tube holding the mouth downward and read the fat column. If the fat column is with in the graduation, reading of the top meniscus minus the reading of the bottom of the fat column will give the percentage of fat in the milk.

3. Estimation of solids not fat

The solids not fat (SNF) can be determined by a formula. Even though this value will not be very accurate it will be sufficient for ordinary purposes. There are different formulae. The one accepted by the Milk Marketing Board of Kerala is $SNF = \frac{LR}{4} + 0.2\,F + 0.5$ Where LR is lactometer reading and F = fat percentage.

4. Determination of total solids

The total solids can be determined by evaporating and drying a small weighed quantity of milk. The weight after drying is expressed as a percentage of the original weight of sample. This is an accurate method.

The total solids can be calculated by a formula also, when lactometer reading and fat percentage are available.

$$\text{Total solids} = \frac{LR}{4} + 1.2\,F + 0.5$$

Pricing of milk.

Usually the milk is priced on the basis of the volume. But in organised dairies the milk is being priced on the basis of the total solids contained in the quantity of milk supplied. In other words the price is based on the quality. The fat and SNF is tested and based on this the value per litre of milk is

calculated. Usually charts showing the price to be given for different levels of fat and SNF will be prepared and will be available at the collection centre.

This system is useful in avoiding adulteration of milk with water because when water is added the total solids of milk is reduced and the price also will be correspondingly less. This method is called quality pricing or two axis pricing of milk.

Practical exercises

Estimation of fat, specific gravity and calculation of SNF by formula. Determination of acidity of milk. Demonstration of preparation of: dahi, butter, ghee, cheese, ice cream, paneer and khoa.

CHAPTER–IX

DISEASES

The diseases may be caused by various agents like bacteria, rickettsia, viruses, fungi, protozoa, helminths or arthropod insects. These are diseases caused by malnutrition as well as metabolic disorders. The control measures are varied depending upon the causes. Some diseases are preventable by suitable vaccinations, while such types of prophylaxis is not available for some others.

Animal diseases causes heavy economic losses to the farmer either due to death of the animal or due to reduced productivity of the animal. There are certain diseases which are transmitted among animals as well as from animals to man, which are called zoonoses or zoonotic diseases. Rabies may be considered as the most serious zoonotic disease as there is no effective treatment for this once the symptoms are manifested. Other important zoonotic diseases are tuberculosis, Brucellosis, Anthrax and some parasitic infestations. Some of the parasites have to live in one or two animals before they can infest man. In those cases such animals are called intermediate hosts and man is the final host. In some other cases man is the intermediate host and animals are the final host. Unless we are aware of this danger to human health and take necessary precautions to check the spread of the disease from animals to man, the animals will become a source of danger to man.

The common disease producing agents are the bacteria and viruses. They enter the body through various routes like, skin, respiratory tract, alimentary canal etc. Once they enter the body they try to multiply in the body tissues. The body

tries to destroy the disease producing agents through the defense system of the body. It consists mainly of the white corpuscles and the antibody system. The white corpuscles tries to destroy the disease agents by engulfing them and killing. The antibodies reacts with the disease agents and try to destroy them. This reaction is "specific", in the sense that the antibody of a particular disease reacts only with the causative agent of that disease. In this process if the defensive system of the body fails, then the disease ensues.

Prevention of diseases

Quarantining: This refers to a procedure of keeping the animals which are imported to a new area at the point of entry itself, in an isolated place for a prescribed period of time. This is to keep the animals under observation and to allow time for any latent infection to develop into disease condition. If after the quarantining period the animal has not shown any disease it is allowed entry into the area. In India we do not have definite rules of quarantining for imported animals. Many countries which have controlled many of the animal diseases have formed definite rules for quarantining. So that further introduction of diseases are prevented.

Vaccination

This is a method of protecting the animals against certain diseases. Vaccination causes the production of antibodies in the animal body against the disease. Vaccines are prepared by suitably treating the disease producing organisms. Here the vaccine acts as an antigen—an agent which causes production of antibodies. Vaccines have been developed for many of the animal diseases like Black quarter, Teatanus, Rinderpest, Brucellosis and Foot and mouth disease.

Vaccine is only one of the many biological products intended for protection of animals. Others are antiserums, antitoxins, etc.

Treatment

The treatment of a disease is done by administering drugs which may be chemicals, antibiotics (penicillin, streptomycin, etc.). The choice of the drug depends on the effectiveness by which it removes the causes. If the cause is

[illegible] which [illegible] organism is used. Dosage of the drug is [illegible] in animal treatment.

Diagnosis of disease

Detection of diseases in animals need [illegible] and care. The complete history of the animal has to be extracted from the owner. The feed taken before the onset of disease, the nature of any preliminary treatment done by the owner, behaviour of the animal etc, has to be enquired. Some of the diseases might have caused by the feed taken like tapioca leaf poisoning or diarrhoea caused by fresh supply of straw. Inadvertent drenching of animals by quacks may produce pneumonia due to the liquid entering the respiratory tract. After the history is collected a preliminary examination is to be made based on the external manifestation. This will be followed by a systematic examination of the animal. This involves examination of different systems of the body like respiratory, circulatory etc.

MASTITIS

This is an inflammation of the udder which usually occurs in heavy milking cows due to infection of the udder with micro-organisms. Infection usually occurs due to insanitary conditions of the cattle shed, or due to spreading of infection from other infected cows through the hands of the milker. This may occur in any one quarter or in more than one quarters.

The disease may develop in acute or chronic form, in acute case the symptoms develop fast. The affected quarter will be swollen and warm. The skin may be reddish. The milk is reduced in the beginning and clots appear in the milk. The animal will evince pain during milking. In later stages milk will get yellowish and then blood tinged. The amount of milk obtained from the affected quarter will be very small. In serious cases the animal develops fever. The symptoms sometime develop overnight or it may take 2–3 days.

If detected early and treatment done, complete cure can be expected. If serious symptoms have developed before treated some amount of secretory tissue would have been lost.

In such cases even after curing the disease, amount of milk obtained will be less than that before the disease. If all four quarters are affected simultaneously the animal may go dry even after treatment.

Control of mastitis depends on sanitary precautions and early detection of affected cases. Small white clots of milk which may appear before the swelling is evidenced can be detected by a 'strip cup'. This is a wide mouthed cup with a black platform. A black cloth tied over a cup also be used. Milk from the suspected quarters may be milked directly over the black surface to find out the presence of clots. Another method of testing for mastitis is by using special test papers, which are filter paper strips impregnated with indicators like bromthymol blue. As mastitis milk is slightly alkaline in reaction, when a drop of milk is poured over the paper the colour changes to dark green. Many other tests are in vogue to detect mastitis sufficiently early.

Treatment of mastitis is done by antibiotics. Special preparations of antibiotics for infusion into the teats are available. The effectiveness depends upon the type of organisms and the stage of development of the disease. Before infusion of the medicine the udder is completely milked out. The medicine after introduction into the udder is allowed to spread properly by massaging the udder.

MILK FEVER

Milk fever is a deficiency disease involving calcium of blood in high yielding dairy cows. Usually it occurs in cattle which have recently calved—often in the first few days after calving. It is characterised by partial paralysis of limbs and partial or complete loss of consciousness. The animal is not able to rise and lies down with head bent over the body. The posture of lying is characteristic.

The condition is produced by lowering the blood calcium level because of high drainage for production of milk. There is also decrease in the phosphates of milk. As the parathyroid gland is closely associated with calcium metabolism it has

been postulated that the basic cause of deficiency of calcium is the disfunction of the parathyroid gland.

The disease can easily be diagnosed by the symptoms. The name milk fever is a misnomer as there will not be any rise of body temperature. The temperature may be sometimes subnormal. The owner may not notice or recognise the earlier stages of the disease. The animal may be dull and reluctant to move. The first symptom may sometimes include excitment and spasm of hindlegs. Afterwards paralysis begins and the animal lies down. The animal becomes unconscious and the head will be bent and placed over the side of the chest. Pulse may be fast and breathing heavy. After lying down for sometime the stomach becomes filled with gas and the animal stretches its legs.

The usual treatment is to give calcium solution intravenously. Preparations of calcium gluconate solutions with other additions are available. It has to be given with suitable precautions. In most of the cases the result is immediate, with in few minutes the animal shows recovery and will be on its legs.

KETOSIS

Ketosis in cattle is a condition occuring due to metabolic disorder. There will be an inbalance between the nutritive intake and nutritive requirement for the body. The condition usually occurs in high producing dairy cattle. There will be low blood glucose level and depletion of glycogen reserves, of the liver. As a result protein is mobilised from the body to be converted into glucose in the liver. Stored fat of the body is also mobilised. Production of Ketone bodies is increased and it appears in the blood and urine. Body weight rapidly reduces and milk production is lowered.

The animal shows decreased appetite and blood glucose level goes down. Milk yield suddenly decreases. The urine has got peculiar smell, similar to that of ammonia.

Treatment consists of intravenous injection of glucose or fructose. Propionic acid can also be given as sodium proprionate. Glycerol or propylene glycol is satisfactory when given orally.

To prevent the condition in cows proper care should be taken in the feeding. Sufficient good nutrients should be available just before calving and also during lactation. When the milk yield goes down suddenly with out any indication of other diseases ketosis has to be suspected. It can be diagnosed by checking the urine for ketone bodies.

ANTHRAX

It is an acute and febrile disease having rapidly fatal course. It is the oldest disease known in cattle. It is the first disease of animals whose causative agent was proved to be a micro organism. It is the first disease against which bacterial vaccine was found to be effective.

Anthrax is caused by a bacteria, Bacillus anthracis. They are highly virulent organisms and affects almost all animals including man. When they gain entry to the body they multiply rapidly, invade the blood stream to produce a rapidly fatal blood infection. When the organisms are exposed outside they form into spores by developing a hard covering outside the cell. The spore is highly resistant and remain viable for many years in soil, water etc. Cattle usually get the disease by grazing in contaminated pasture.

Symptoms depends on the severity of the disease. Very severe (acute) cases occur at the beginning of outbreaks. In such cases the onset is sudden, there will be staggering, breathing difficulty, trembling, collapse, convulsive movements and death. Death may occur before the symptoms are noticed. In less severe cases which is the common occurrence, there will be rise of body temperature respiratory and cardiac distress and finally convulsions and death. During the course of the disease there will be high rise of temperature. Rumination ceases, milk secretion is reduced and pregnant animals may abort. The disease may last for 3-4 days.

In animals died of anthrax there will be usually an oozing of blood from the nostrils and anus, rapid decomposition and marked bloating of the stomach. The blood fails to clot rapidly and will be darker than normal. The stiffening of muscles after death (rigor mortis) is absent or incomplete.

Many may get the disease by handling diseased animals or carcasses and handling hides of infected animals.

Diagnosis is based on history, clinical symptoms and laboratory examination. Anthrax should be suspected when animals die suddenly in a localised area. When anthrax is suspected it is not advisable to make a postmortem examination because opening the body or removal of skin may result in spreading of the disease to the operator.

Treatment of animals showing advanced symptoms are of no use. In mild cases treatment may be done by antibiotics. Anti anthrax serum may be used to give immediate protection to the animals in the face of an out break.

Annual vaccination of livestock may be done in places where out break of disease usually occurs. Vaccination of all animals around an exposed area will reduce losses and help control out break. For comprehensive control programme the following steps may be recommended. (1) strict quarantining of infected premises and preventing animal movement into and out of the infected area. (2) prompt disposal of dead animals by cremation or deep burial (3) destruction of contaminated materials like bedding manure etc. (4) isolation of sick animals and immediate treatment with anti anthrax serum and antibiotics (5) vaccination of apparently healthy but exposed animals. (6) cleaning and disinfection of contaminated stall and changing the contaminated pastures.

BLACK QUARTER

It is also called black leg. (the thigh region of cattle is called quarter) It affects usually young cattle and sometimes sheep. It is a rapidly fatal infectious disease caused by a bacteria, Clostridium chauvoei. It is an aerobic bacteria which grow only in the absence of oxygen. So bacteria entering the animal body through minute punctured wound which exclude air get a favourable environment to grow. The infection usually enters through food, water and soil contaminated with Black quarter organisms.

The disease is characterised by high fever. (105-107°C) and formation of gasseous swellings under the skin, especially

on the hind quarters or shoulders. Swelling may cause stiffness or lameness and sometimes complete paralysis of the affected part. The swellings will be first painful and later become cold and painless. There will be crepitating sound, that of air bubbles inside the swelling. The animal will loose appetite, it will not ruminate and its breathing will be rapid. As the disease progresses the animal will become weak. Most of the affected animals may die in 12-36 hours after the symptons are shown.

Diagnosis is based on symptoms, postmortem examination and examination of specimens in the laboratory. The swelling on the leg will contain dark red fluid. The muscles underneath will be blackish in colour and hence the name black quarter.

Treatment in early stages is done by antibiotics, peniciline as well as broad spectrum antibiotics like terramycin and aureomycin are good. In advanced cases treatment will be of no avail.

Animals can be protected by suitable vaccination. Vaccine produce immunity in 10–12 days and lasts for about an year.

Recognised control measures when an outbreak occurs are as follows: Animals which are showing symptoms should be isolated and treatment done for those showing early symptoms. Apparently healthy but exposed animals should be vaccinated and if possible removed to another place. Dead animals should be promptly disposed of by burning or burried deep and covered with quick lime, contaminated bedding. manure etc, should be burned off. Contaminated floor should be properly disinfected. When a suspected case is noted it should be reported to the veterinarian.

RINDERPEST

This is also known as cattle plague. It is a rapidly fatal disease affecting large number of animals and caused by a virus. It affects mainly cattle and other cloven footed animals, as buffaloes, goat, sheep, pigs and wild ruminants. The rinderpest virus lives in the WBC of affected animals.

The virus is excreted through the saliva or discharge from the nose and eyes and the urine and faeces of affected animals. Outside the body the virus is rapidly destroyed by sunlight and disinfectants. Cold preserves the virus.

The disease spreads through air, contaminated utensils, attendants etc. It may be introduced into a herd by the addition of infected animals or animals in the incubation stage of disease. Incubation period is 3-7 days. The symptoms are high fever, difficulty in breathing (dyspnoea) congested conjunctiva, lachrymation. dry muzzle, arching of the back and loss of appetite. At the beginning there will be constipation but later diarrhoea with foul smell and sometimes blood. There will be ulcers in the mouth and gum. Similar ulcers will be found in the intestinal mucosa also during post mortem. The animal may die in 7-10 days from the onset of symptoms.

Common control measures: As there are chances of spreading the disease through common grazing grounds and at cattle shows, sufficient precautions are to be taken. The affected animals are to be segregated. Newly added animals are to be quarantined for 10-14 days. Proper vaccination of animals by Rinderpest vaccine is to be done. This is especially done around an area where a disease outbreak is noticed.

FOOT AND MOUTH

It is a disease caused by a virus called foot and mouth disease virus. Indian cattle have some amount of natural resistance to this disease. They rarely get the disease. Even when they are affected, it passes off without much lesions. Imported cattle as well as crossbred cattle are more susceptible.

The symptoms produced are high fever and blisters or vesicles in the mouth and feet. Because of the vesicles on the mouth there will be saliva dripping from the mouth, and the animal will refuse to take feed. The vesicles on the feet will make the animal to limp. The vesicles break with in a day or two and the wound may heal with in few days, but extraneous organisms may enter the wound and cause complication. This is more so in the feet.

The death rate is very low in the grown up animals but more in young calves. As a result of the disease pregnant cows may abort or develop mastitis, or become sterile. Most of the males severely affected with the disease may become sterile.

Treatment of the disease is not effective as the virus is not distroyed by the usual drugs available. The symptoms can be reduced by suitable treatment. Hoofs may be painted with carbolic acid. Boric acid mixed with glycerin may be applied on the mouth. Antibiotics may be given to reduce any secondary infection.

The disease can be controlled by proper vaccination. The immunity lasts for about 6 months. As the out breaks in Kerala usually occurs during the start of summer months the vaccination may be done by December and repeated every year.

Eradication of the disease can be done by restricting the movement of animals, vaccination, quarantining, isolation or slaughter of the diseased and disinfection. Many western countries have eradicated the disease resulting in economy.

BRUCELLOSIS

This is a bacterial disease mainly affecting cattle goats and swine. Man may contact the disease by mingling with affected animals. The disease is caused by organisms of the Genus Brucella. Cattle are mainly affected by B. abortus and man and goats are affected by B. melitensis. Human disease is called malta fever which is characterised by intermitant fever which is not susceptible to common drugs for fever.

Brucellosis in cattle is also known as bangs'disease or infectious abortion. It is characterised by abortion in pregnant cows usually in the later half of pregnancy. Some times calves may be born weak, placenta may be retained and vaginal discharge may be present. This may be followed by temporary or permanent infertility. Affected bulls may not show appreciable symptoms. One or both testicles may be enlarged and the bull may become infertile.

The disease is usually transmitted from another diseased animal or from contaminated environments. Infection probably takes place through the alimentary tract. Brucella may enter the body through the skin or mucus membrane of the body. The incubation period which is the time lapsing between the entry of the organism into the body and development of symptoms, may vary from 7 days to 7 months.

The disease can be diagnosed reliably by suitable tests using the blood serum or milk. The basic principle involved in the test is that the infected animals will have in their blood serum some amount of antibodies against the bacteria. When this serum is mixed with a suspension of brucella organisms (the antigen) agglutination or clumping occurs. The test is done with diluted serum to check the concentration of antibodies. If agglutination occurs in dilutions of more than 1:100 it is considered as positive for the disease. In milk ring test, the coloured antigens are mixed with the milk. In positive cases coloured ring appears as a result of agglutination.

Treatment of affected cattle is not very successful. Antibiotics are the drugs of choice. The disease can be prevented by calfhood vaccination. Control of the disease can be done by doing diagnostic tests in problem herds followed by isolating and treating the positive reactors.

TUBERCULOSIS

It was Robert Koch in 1882 who had discovered that tuberculosis is caused by a bacteria–Micobacterium tuberculosis. He had proved that the disease is specific one caused by a specific organism and also it is infectious. In 1890 he had developed a test to detect the presence of the disease. He produced a sterile liquid containing the growth products of tubercle bacilli which was called tuberculin. This injected into the skin causes specific reaction in diseased individuals. With tuberculin test the tuberculosis can be detected even before any of the symptoms starts showing. Robert Koch was awarded Nobel Prize for this discovery.

The tubercle bacilli enter the body usually through food. Sometimes they are directly breathed into the lungs. The diseased animal may contaminate the drinking water and vessels. The excreta, like faeces, urine, sputum etc. of the diseased animal may contain the bacteria.

The organism may settle in different parts of the body and produce disease. It may be in the lymph node, lungs, skin, bone, brain etc. In animals the lungs is most commonly affected. In cows the udder may get affected and the bacteria may get excreted in the milk.

When tubercle bacteria get lodged in a part of the body the bodys protection machanism tries to kill them-by the swallowing action of the white blood cells. More and more cells concentrate on the site. The bacilli have a waxy coating which resists the distruction. Other cells also congregate on the area and form a protective wall to arrest the spreading of the bacilli. Thus a small tubercle, a small nodule is formed If the protective wall is sufficiently strong the nodule remains stationary, calcium salts get deposited and it forms into a gritty mass. If the nodule is small it may get absorbed. later.

When the tubercle is not properly covered it enlarges on the outside and slowly spreads. Bacilli may escape from the tubercle and spread to other places resulting in fresh tubercles. The tubercle in lungs may break open into the wind tubes and the bacilli may come out in the sputum during coughing.

The number and size of the tubercle vary in different animals depending on the resistance offered by the individual. Usually the tubercle remains in the body walled off from surroundings but when the body resistance is lowered by poor nutrition or general weakness, it flares up and spreads to other parts. Usually once the bacilli get a foot hold in the body it slowly spreads.

Usually the human type of bacilli causes the disease in man. Bovine type also may cause the disease in man. Man

is very resistant to avian type of bacilli. Small children are more susceptible to bovine type of bacilli than elders. Milk from affected cows when used without proper pasteurisation or boiling can cause the disease.

Diagnosis is based on the sensitisation or allergic reaction of the animal's body due to products formed during the growth of the infective agent. The test is called the tuberculin test. Tuberculin is produced by growing the bacilli in liquid media sterilizing the media by steam, and filtering off the bacilli. To this phenol and glycerine is added. This product is called the tuberculin. It is injected into the skin on the side of the neck. In affected animals a marked swelling occurs on the site of injection within 24-72 hours which is due to the body's reaction towards tuberculin.

Treatment of diseased animals is not very effective. Control of the disease is based on the detecting the affected animal by tuberculin test and removing them from the herd. From the public health point of view animal products like milk and meat will become safe for consumption if it is properly cooked. Bacteria suspended in a liquid if heated to a temperature of 45°C (the warmth of hot tea which can be sipped) will be destroyed in a couple of minutes.

JOHNE'S DISEASE

This is also known as paratuberculosis. It is produced by microbacterium paratuberculosis and is characterised by persistant diarrhoea having bad smell. The affected animal develops on unthrifty appearance and a rough coat. The body temperature will be normal. The animal looses condition and becomes extremely thin.

The causative organism is excreted with faeces and will remain alive for long period. This will cause spread of disease to other animals.

Diagnosis of the disease can be made by finding out the causative bacteria in stained preparation made from small bits of mucus membrane picked from the intestinal walls, it

can be diagnosed by Johnin test-a skin test using the diagnostic reagent Johnin. This is injected into the skin on the side of the neck. In infected animals there will be an increase of more than 3 mm at the site of injection after 48 hours.

Treatment of the disease is not successful. The control is based on isolating the diseased animals. All animals in a suspected herd should be tested by Johnin to find out the extend of the disease.

INFERTILITY

Infertility is a condition where there is difficulty in getting the animal pregnant. It is a partial condition and in extreme cases it becomes a case of sterility. Usually it is a condition which is described in the cow. But theoritically infertiltiy may exist in the bulls also. In cows infertility may be due to anatomical defects or physiological abnormalities like failure of ovulations, delayed ovulation, abnormal ovum obstruction of the oviduct, Hormone inbalance, and nutritional disturbances. Many diseases cause infertility. The animal has to be examined to find out the cause of infertility. And necessary treatment has to be done. A cow has to be suspected to be infertile when the cow does not conceive even after three or four inseminations. In such cases the animal has to be examined clinically and necessary treatment adopted.

Some of the specific disease may cause infertility in cattle. These may be classified as venereal diseases and other bacterial or virul diseases. The venereal diseases are widespread in nature and are transmitted through service or insemination. Examples are Brucellosis, Vibriosis, Trichomoniasis etc. These diseases can be eliminated by proper treatment and control measures.

As the reproduction is a complex phenomena associating many hormones in the body any inbalance of the hormones involved may lead to infertility. The important hormones related to reproduction are follicular stimulating hormone (FSH) Lutinising hormone (LH), and prolactin secreted from

the anterior pituitary, oxytocin secreted from the [illegible] pituitary and oestrogen, progesterone and androgen secreted by the gonades. In the body function the levels of each hormone as well as the proportion between them is important. Some of this conditions which occur due to the disturbance in hormone levels are as followes:-

Anoestrus:– The development of ovaries are not optimum. The follicle stimulating hormone is inadequate and the follicle does not develop. The oestrogen which is to be produced from the graffian follicles is not produced and so oestrus symptoms are not shown.

Practical exercises

Dressing of wounds,

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