

COURSE CODE:	APH506
COURSE TITLE:	Dairy Production
NUMBER OF UNITS:	3 Units
COURSE DURATION:	Three hours per week

COURSE DETAILS:

Course Coordinator:	Dr. O. S. Sowande
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COURSE CONTENT:

A survey of dairy industry in Nigeria. Production systems and breeds used in dairy production. Management of dairy animals. Physiology of milk production. Feeding of dairy animals. Dairy chemistry. Specific disease of dairy animals. Establishment and maintenance of a dairy enterprise.

COURSE REQUIREMENTS:

This is a compulsory course for all 500 level students in the College of Animal Science and Livestock Production except students in 500 level in the Department of Animal Physiology who could choose the course as an elective. Students are expected to participate in all the course activities and have minimum of 70% attendance to be able to write the semester examination.

READING LIST:

C. D. Hunt and F. H. Nielsen. 2009. Lactose, Water, Salts and Minor Constituents. In: Advanced Dairy Chemistry, (McSweeney, P.L.H. and P.F. Fox, eds) Vol. 3, , 3rd edn., Springer, pp. 392-398.

Cristina Sola-Larranaga and Inigo Navarro-Blasco. 2009. Chemometric analysis of minerals and trace elements in raw cow milk from the community of Navarra, Spain . Food Chemistry, 112 (1), 189-196.

Sanders F.S. 2000. Dairy Production: Best Management Practices, Louisiana State University Agricultural Center, Pub. 2823 (1M) pp.3-5.

Gold, Mary V. 2005. DAIRY CATTLE PRODUCTION Organic livestock production: a bibliography. Special reference briefs; NAL call no. as21.D27 S64 no. 2004-05. pp. 43-68.

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LECTURE NOTES

INTRODUCTION

The current status of dairy production in Nigeria shows that there are 16 million heads of cattle of which 85% are managed by 12 million indigenous pastoralists. Over 415 grazing reserves exists all of which are grossly underdeveloped. About ₦75 billion is spent annually on importation of milk and dairy products. The consumption level of dairy products is low estimated at 2kg per caput annually while cattle production system is largely smallholders' with little or no purchased input. Cattle productivity is low due to high reproductive wastage, low calving rate as well as low milk yield per lactation.

It is also important to note that the main dairy products in the Nigerian market are made from reconstituted milk powder from Europe, United States of America, South Africa, New Zealand, etc, which differ in taste, flavour and nutrient profile compared with fresh milk. Majority of indigenous dairy farmers lack basic education, which preclude them from making contribution on policy issues affecting their production. Furthermore, urbanization and

expansion in arable farming activities deny them access to grazing lands. Even with grazing reserves being developed by Government, limited infrastructural resources including water, pastures, health facilities and market facilities diminish accessibility by majority of producers.

A SURVEY OF DAIRY INDUSTRY IN NIGERIA

Dairy industry implies the production, the processing and the distribution of milk and milk products. By this definition, the industry is yet to be fully developed in this country and in other West African countries. There is a need develop the industry because there is a high demand for milk and dairy products due to increasing population and increasing knowledge on nutrition. However, there must be trained personnel to collect, process and distribute the milk while there must be a continuous supply of milk to sustain the demand of the markets.

Dairy Schemes in Nigeria

The dairy schemes in Nigeria can be classified into three categories viz: those whose herds are settled, those whose herds are unsettled and those without herds.

a) Dairy schemes whose herds are settled:

Settled dairy schemes are those whose establishments are highly organized and permanent on one site. Most settled dairy schemes are government owned. Dairy schemes in this category are the urban dairies, dairies on schools of Agriculture, universities and vocational institutions.

i) Urban Dairies

Urban dairies are dairies that are established near the city to supply milk and milk products. They consist of the farm and the processing centre. High yielding cows, like the foreign breeds of Holstein, Brown Swiss, Jersey and their crosses (exotic x indigenous crosses) are kept. An urban dairy is usually equipped with pasteurizing, refrigeration and packaging equipment. Milking is usually by machine while in modern farms, equipments are employed for farm operations. Urban dairies in the country Include:

- **Agege Dairy:** The oldest dairy farm in Nigeria, established in 1942. It was formally a beef station to serve the army during the 2nd world war. On this farm began the pioneer work which provided information for the policy and execution of most dairy projects in the country.

- **Ikorodu Dairy:** It started in 1965 with the aim of investigating how dairying can be profitably integrated into the general farm programme thereby practicing mixed farming. By 1972, this objective changed because the farm institute in which the dairy was situated became a School of Agriculture.
- **Ikenne Dairy:** This was originally Dairy Herd Multiplication Centre for the purpose of breeding and selecting the breeds of exotic cattle for distribution to government stations. In 1967, about 100 animals of various exotic breeds (Holstein, Brown Swiss and Jersey) were imported from U.S.A. The project was not well financed and it had to close down.
- Other urban dairies under plan were Sokoto, Benin, Port-Harcourt, Calabar, Shika, Samaru, Nsukka etc. Universities and Schools of Agriculture Dairies were for Teaching and Research e.g. Universities of Ibadan and Ife (now Obafemi Awolowo University).
- Many urban dairies were under construction in almost every state for most part of 1970s. However, a decision could not be arrived at as to which particular breed would be best suited to the environmental conditions of this country. In spite of all the commitments, urban dairies could not make much impact on the milk consuming market in Nigeria because of the following:
 1. There has been continuous population increase
 2. The milk supplied from industries was inadequate
 3. Inability of the imported cattle to produce milk due to diseases and environmental problems
 4. The indigenous breeds were low producing
 5. No organized collection and processing of milk from indigenous cattle to ensure uniform distribution
 6. Indiscriminate importation of foreign animal
 7. Poor feeding
 8. Seasonal fluctuations in production and consumption.

b) Dairy schemes whose herds are unsettled:

These are schemes which do not maintain a farm for rearing cows. Under these schemes, a dairy is built with milk collection centre in central areas to the kraal. Milk is purchased from the herds men who are predominantly Fulanis and Shuwa Arab tribesmen. The milk is subjected to physical and chemical tests for acceptability. The milk is then transported

to the dairy processing centre some kilometers away where it is pasteurised and sold as liquid milk, cheese, butter and yoghurt. Schemes that follow this pattern include the **Ilorin milk pilot project**. The Dairy is built in Ilorin and the milk is collected from a distance of 10km radius. Ilorin milk pilot project was equipped with modern equipment donated by the UNICEF. Pasteurised milk, butter and yoghurt are made from the milk so purchased. Others are Kaduna Dairy, Kano Dairy, Maiduguri Dairy and Birnin kebbi dairy.

e) Dairies without herds:

This is the scheme without herds called the 'Plants'. These are dairies which depend upon importation for their raw materials. They include:

- **SAMCO** (Swedish African Milk Company). It is based in Mushin, Lagos State. Founded in 1959. It imports materials like dried whole milk or skim milk powder, butterfat, flavouring, colouring and sweetening agents for recombined milk and milk products.
- **FAN MILK** at Eleyele, Ibadan, Oyo State founded in 1960. It was founded by a Danish merchant.
- **WAMCO** (West African Milk Company), founded in 1974. It has a recombining plant. It is different from SAMCO and FAN in that its milk is packed in tins, whereas SAMCO and FAN MILK pack their products in cartoons. Friesland found WAMCO. He combines local production with imports from the Netherlands.

d) Rural dairy schemes:

The most important and the least developed is milk production from local semi-nomadic herds scattered throughout the country. The development of local production of milk among these semi-nomadic herdsmen constitutes the rural dairy scheme. A milk production survey revealed that the main breeds used are Keteku, Bunaji (WF) and Ndama breeds. The Fulanis (the main cattle rearers) who by nature are superstitious and secretive would not release accurate figures of the breed as well as accurate milk production figures. Bush grazing rather than established pastures is the rule. Early in the morning, the cows are tethered down to suckle the calves for a few minutes before the cows are milked. The animals are later driven to graze in the bush. A distance of 8 km daily may be covered in search of water and good grass. In the dry season, the distance may be longer. After gazing, they returned to kraal in the evening where they are tethered

down to suckle after which they are hand milked by the housewife. The milk is collected in a calabash and handed over to the housewife. Half of the milk is consumed and half is manufactured into local cheese called 'gashi' using bomubomu leaves until 'junket'(curd) is formed. Bomubomu leaves possess a proteolytic enzyme like resin which curdles milk. Junket is added into small basket moulds to drain off. It is then sold to the middlemen. Calf mortality is about 50%. There is no preserved food for the animals in the dry season, However, some browse plants are fed to the animals. These are supplemented with the dry fibrous bush available for the cattle in the dry season. The bark of Agano tree plus common salt is used as a kind of local mineral supplement to improve the health of the animals. Inbreeding is a regular feature among the herd. The generation interval of the cow is 4 years. Conception rate is low and lactation period is 6 months. The cow dries up when she losses her calf usually at 3 months. The Fulani is reluctant to cull sick animals except when he needs money, and then he sells off the sick and the old ones in the herd.

Milk production is higher in the rains than in the dry season. Milking is done twice daily. In the rains, the average yield of a cow per day is 3 star beer bottlefuls (1.5 litres) while in the dry season, half is the yield. Thus, the average yield per cow per day under Fulani management is 1 litre while the same breed can produce 4 litres under improved management.

Advantages of rural dairy scheme

(1) Low capital cost:

The acquisition of land, compensation for acquired land, land clearing and preparation, buildings for stock, fencing, water supply, purchase of expensive farm machines like tractors and implements, purchase of stock and their maintenance etc are dispensed with. Thus, the high cost expended on opening a livestock station is saved.

(2) Promotion of dairying to private farmers:

The Rural Dairy Scheme is a short course towards passing milk production enterprise to the private sector. The government livestock stations have been doing the job for decades yet very few farmers are in the livestock business. With the Rural Dairy Scheme, the dairy farmers that are already in the business only needed to be educated, advised and given the right incentives.

(3) A change system to nomadic Fulanis:

The nomadic nature of the herdsmen will change as the regular purchase will make them settle as farmers. This type of settlement has tremendous advantage. Each animal can be located. Statistics for planning for development will be easily available if the farmers are settled. Tax for the country's development will be easily collected.

(4) Easy market for milk and its products

The economic status of the milk farmers will be raised because he can enjoy the benefit of a steady market and standard price for his milk and milk products.

(5) Higher productivity by the milk farmers:

In order to make the herdsmen more productive and become settled farmers, apart from the regular buying of their milk, water dams will be constructed at strategic places, to offset the long trek in search of drinking water. Spraying of their animals to check endo-parasites will be carried out. Free veterinary services will be rendered. Artificial insemination will be carried out on their cows using the semen from proven bulls.

DAIRY PRODUCTION SYSTEMS

(1) Extensive or Traditional system

Under the extensive system, the producers are generally scattered among rural communities at some considerable distance from the urban centres. The stock used consists of a collection of cows sometimes goats and sheep. The cows are not selected for high milk production or any of the other characters derivable in a good dairy animal. Milking is not carried out at regular intervals and very often there is no record for milk produced by each cow. There are no cultivated pastures on which to feed the animals. The animals rely on grazing on the open range grounds with the change of seasons. In most cases, this development results in a very low level of production. The milk produced is not usually processed and the system requires thousands of milking cows to satisfy the requirement of the market.

(2) Intensive (modern) system

This system involves the use of dairy animals specialized for milk production. This involves the investment of considerable capital. The size of the dairy herd could vary from 50-100 cows for small scale operations and up to 500-1000 cows for medium size operator. The large scale operation has more than 1000 cows. The animal used for this

operation are high yielding European type of breeds e.g. Friesian. In some of urban dairies in Nigeria, crosses of European breeds with indigenous cattle, selected indigenous cow are used in urban dairies in Nigeria. Breeding records are kept and selection for high milk yield is intensively carried out. The milk is regularly tested for quality and AI is used to improve the milk producing ability of the animal. The animals are fed regularly on cultivated pastures usually green soiled or zero-grazed. They are also supplemented with concentrates usually rationed according to production. The animals are housed and milking is usually done in a dairy parlour under hygienic conditions. There is a considerable degree of mechanization in most of the operations. The animals are subjected to regular veterinary inspection to prevent and cure diseases. Under this system of production, the farmer is concerned with making as much profit as possible. The example of intensive system in Nigeria can be seen in the Urban Dairy Scheme at Agege, Iwo dairy, Kano, Maiduguri, Vom and Maizube Farms in Minna.



Plate 1: Maizube Farms, Minna



Plate 2: Dairy Cows at the Maizube farms (Minna, Nigeria)

BREEDS OF CATTLE USED IN MILK PRODUCTION

In most temperate countries, milk comes mainly from domesticated cattle which have over several generations become specialized for milk production. In most tropical countries, on the other hand, milk comes from domesticated cattle as well as buffalos, sheep, goats and sometimes camel. Buffaloes are used largely for milk production in India, Zaire, Sudan and Egypt. The contribution of buffalos, sheep, goats and camels is just 20% of total milk production in the tropics. 80% milk comes from domesticated cattle.

Specialised Dairy Breeds

These include Friesian, Brown Swiss, Jersey, Ayrshire and Guernsey (All of temperate origin). Friesian, Brown Swiss and Jersey were imported to Nigeria for crossbreeding with indigenous cattle in order to raise the level of production.

Holstein-Friesian

It originated from Netherlands but it has spread to other parts of the world especially where emphasis has been on milk production. The colour is black and white or red and white. World's highest producing dairy animal. Holstein-Friesian is a cross between the black cattle of the Batavians (Holstein) and white cows of Friesian bred to produce the most efficient milk with limited feed resources. Calf weighs 41 kg or more at birth. Holstein cow weigh 650kg and 147cm tall. Heifers are bred at 13 months and weigh 363kg. Holstein-Friesian

calves for the first time between 23 and 26 months of age. Gestation period is approximately 9 months. Average milk production is 10,443kg, 381kg butterfat and 321kg. Top producing Holstein milked twice a day produce 30,806kg milk.



Plate 3: Holstein-Friesian Cow

Brown Swiss

This is the oldest of all dairy breed. It is brown in colour. It produces the second largest quantity of milk per annum, 9,000kg. MEkg is 9991kg, 397kg fat, 329kg protein. They have good milk, protein and fat production and have correct feet and legs that allow them to stay in the milking herd. They have one of the lowest somatic cell count averages of all dairy breeds with best fat-to-protein ratio coveted by cheese makers. Brown Swiss producers receive more for 45kg of their milk than milk producers from other breeds. They are noted for their dairy strength, longevity and reproduce longer than cattle of other breeds.



Plate 4: Brown Swiss Cow

Jersey

Jersey cattle are a small breed of dairy cattle . Originally bred in the Channel Island of Jersey. Jerseys come in all shades of brown, from light tan to almost black frequently fawn in colour. All purebred Jerseys have a lighter band around their muzzle, a dark switch (long hair on the end of the tail), and black hooves. Cow weight ranges from only 360 to 540 kg. Bulls are also small, ranging from 540 to 820 kg. They are notoriously aggressive. High butterfat conditions, 6% butterfat and 4% protein, and the ability to thrive on locally produced food. A lower maintenance costs is incurred by its lower bodyweight, and superior grazing ability as well as its genial disposition. The cattle has a calving ease and a relatively lower rate of dystocia, leading to their popularity in crossbreeding with other dairy and even beef breeds to reduce calving related injuries. High fertility. Jerseys are adaptable to hot climates and are bred in the hottest parts of Brazil.



Plate 5: Jersey Cow

Indigenous Dairy Breeds

Most of the indigenous breeds particularly, the Southern breeds offered no prospect for milk production due to poor performances in experimental stations. Nevertheless, some of the Northern breeds offer some prospect for milk production because of the available figures on yield as well as the large number of the breed e.g Kuri, Shuwa Arab, White Fulani.

Kuri

The gigantic bulbous horns are an unmistakable trait of the Kuri. It is also called Lake Chad Cattle or Buduma Cattle. These cattle are native to the shores of Lake Chad where Cameroon, Chad, Niger and Nigeria join. The Kuri are believed to be descended from the Hamitic Longhorn cattle and have been herded by the Buduma and Kuri peoples for centuries. The tribesmen were strict in their selection of animals for their horns, many of which grow in a lyre or crescent shape. The horns sometimes reach 130 cm in length and 55 cm in diameter. Most remarkable is the unique pear shape of the horns.

These animals are kept as dairy cattle in herds of approximately 30 females with one bull. The animals spend several hours each day in the water swimming in search of water plants for food. It is thought that the horns act as floats. The cattle are acclimated to water to such a

degree that they survive with difficulty away from their indigenous area. They are easily affected by the sun if unable to bath. The Kuri are tall for an African breed, with a long back, shallow body and a large, bony rump. The legs are strong, long and bony with large, widely cleft hooves. Kuri are usually white in color. The females are 135 to 145 cm in height and average 400 kg in weight. The bulls range from 152 to 180 cm and average 475 kg of weight. Some males will reach 600 kg.

The breed has been known to produce reasonable amount of milk and records from Maiduguri show the average of 6 lactations was 1,259kg in 280 days. Highest individual yield is 2,440kg in 314 days. The cows yield 4 litres of milk a day after nursing their calves. The Kuri as at present is confined to Lake Chad environment.



Plate 6: Kuri Cattle

Shuwa Arab (Wadara Cattle)

This is found in North East part of Nigeria. Wadara cattle are medium-sized, lightly built cattle, and are usually dark red, black, pied or brown. They are short-horned and have a small erect hump, representing some 6.6% of the national herd. Wadara cattle are the 'indigenous' cattle of Borno and are referred to by the Koyam and related pastoralists as 'our' cattle. They are frequently called 'Shuwa' in the literature, after the Shuwa Arabs who also herd them. A related breed with a white coat, the Ambala, is often traded into Nigeria from Chad. In its natural environment, it is used as dual purpose breed i.e. for milk and meat. Average age at first calving is 45 months. Average breeding life is 7 years. Average milk yield of 23 lactations was 1,305kg. Highest performance was 3,421kg in 305 days. The Shuwa Arab offers some prospect for selection for milk production because of available figures on its performance as well as large numbers of breed.



Plate 7: Shuwa Arab Cattle

White Fulani (Bunaji) Cattle

This is the most widely distributed of all Nigerian cattle breed. It is found in Nigeria particularly Kano, Bauchi and Katsina province. It constitutes 50% of total cattle production. The coat colour is white with black points on the ears, muzzle and feet and tip of tail. It is used for milk production throughout the ecological zones in the country. The breed has been involved in crossbreeding programmes with imported cattle. The breed has given 1,000-3,600 kg milk per lactation. The udder is well developed with medium size teat. It is a triple purpose breed - milk, meat and work. About 26 coat colour combinations have been reported. Mature size for male is 530-600kg. Female is 340-360kg. Average age at first calving is 43 months. It has a breeding life of 9-10 years. The bulk of White Fulani are in the hands of the nomadic pastoralists. Under this condition, milk production is low ranging from 200-450kg/cow per annum. However, the milk production potential of the breed has been recognized as a result of the performance of cow's kept under improved conditions on government stations such as Shika, Vom, Agege and University of Ibadan. Birth weight is 21.6-25.1kg. Percent fat is 5.63-6.40%. It offers the best prospects for dairy production among indigenous breed. It is easily adapted to all ecological zones in the country and can be selected easily.



Plate 8: White Fulani Cattle

FEEDING AND MANAGEMENT

The major emphasis on the management of dairy cattle should be to treat each female so that it can produce calf each year. Fortunately, most breeds in Nigeria have genetic capability to calf annually if a well balanced dietary and management programme is developed to meet the nutritional need of the animal. This means providing good grazing pastures and minerals with calcium, phosphorus, salt lick and clean water during the wet and dry season. In the dry season, browsing plus additional dry grass, groundnut hay, cowpea hay, rice bran, guinea corn hay or stalks, various kinds of concentrates such as cottonseed, groundnut cake, guinea corn and millet should be provided.

Disease prevention and vaccination should be carried out. A herd of 5-30 cows will need one bull for servicing. The non-producing female and castrated male should be herded in a separate group and dispose of to save grass and feed for the producing animals. For feeding purposes, cattle should be divided into the following herds: 0-3months, 4-6 months, young heifers/breeders, pregnant and lactating herds.

0-3 Months Calves

After calving, the calves are left with their dam to receive colostrums. The colostrums contain antibodies which protect calf from disease. However, if calves are removed by birth, they are transferred to calves pen. It is essential to bucket feed the calves with 2-3 litres of milk/day at

the temperature of 37.5-38°C. If the dam dies at calving or for other reasons fails to produce colostrums, then an effort should be made to obtain either surplus colostrums from another dam or feed colostrums substitute. A well known recipe is to whip up a fresh raw egg in 1 litre of milk and add half boiled water, 1 teaspoonful of castor oil. This will be sufficient for one feed and should be fed at body temperature 3 times a day for the first 3 days or *ad libitum*. Once the black jelly-like foetal dung passes along the faeces, the castor oil can be omitted. The milk should be supplemented with a mixture of soyabean cake and maize. They should be confined in another pen and allowed to graze during the wet season.

4-6 Months Calves

These are calves that have been weaned. In dry season, apart from grazing, they should be supplied with a mixture of cottonseed cake (75%) and guinea corn (25%). This should be reduced as from 15-24 months. By 24 months, the animals should be ready for slaughter, while the females are kept in the young heifers herd for breeding. Like the calf, the heifer can be reared indoors or out-doors but indoor rearing is very expensive. Shortly after weaning, calves are usually placed in a group of 8-10. They should be carefully watched to ensure that they do not suck each other. The quarters should be clean and a calf starter ration containing 16% or more crude protein should be fed up to 4 months. The amount of starter diet fed depends on the rate of weight gain and body condition desired of the calf. Quality hay should be fed and medium moisture silage and corn silage can also be used. Water should be available at all times. At 4 months of age, the calves should be introduced to concentrate feeds of the cows. When calves are 10 months old, grain can be discontinued if good quality roughage is fed. They should receive salt as well as Ca and P supplements. Rotational grazing should be adopted and heifers should not be grazed on any one paddock for more than 5 days at a stretch, to minimize disease infestation and destruction of vegetation.

Heifers and Breeding Cows

Depending on the breed, first service is usually between 15-24 months of age. Between 3-6 months of age all replacement heifers should be vaccinated against brucellosis or contagious abortion. Most heifers in the tropic are too small to be bred at 15-24 months and the size or the degree of body maturity is a better guide of fitness for bulling than actual age. Undersized heifers should not be mated until growth is up to average unless their ration is to be generously supplemented with concentrate. Even when supplementation occurs it is to be realized that those that have reached sexual but not physical maturity are less likely to

withstand the stresses and strains of pregnancy and the subsequent lactation and maintenance of reasonable level of milk production. After the first conception, the heifer not only have to continue to grow but also to bear a viable calf and produce milk, so she needs to be well fed particularly during the pre-calving period. Very heavy feeding results in fat deposition and subsequent milk production is less than that of normally fed heifers. Underfed animals also produce less milk and make calving difficulties but achieve rapid growth during the first lactation and catch up with normally fed animals during 2nd and 3rd lactation. Underfeeding delays the onset of puberty but does not significantly affect conception rate. Housing of heifers need not be elaborate and varies with climate. Protection should, however, be given from rain and wind. Open sheds that allow 40-50sqft per heifers are considered adequate.

Gestation period varies between 275 and 287 days with an average of 281 days. Heat period occur on the average at 21 days interval with a normal variation between 16 and 26 days. If calving is at 12 months intervals, the cow should be bred between 75 and 110 days after calving and cow should be milked for 10 months (305 days) and rested for 2 months. The dry period allows the mammary glands to rest and the cow to build up body reserve ready for the next lactation. Heifers and cows in poor condition should be allowed longer dry period i.e they should not be milked. The dry cow can be fed on pasture alone until just prior to the next lactation. After calving, the cow should be fed a little more concentrate than her milk production justifies during the first part of lactation. A lactation period is the period between parturition and final drying off or cessation of milking.

Pregnant and Lactating Herd

During pregnancy, the cows will need to be monitored until they calved. They should be allowed to graze at least 6 hours during wet season and 9 - 10 hours during the dry season. The cow will need to graze, rest and graze the second time. Water will need to be given during the resting period. Each cow will need 28g of combined mineral containing calcium and phosphorus and trace elements plus 28g of saltlick/day. Cows should be served by bulls so that calf can be born in early wet season where there is adequate amount of grass at the time it is producing milk for the calf. If a cow or heifer is to be fit for heavy and sustained milk production, adequate nutrition (in quantity and quality) before calving is essential. This feeding will provide for the building up of the unborn calf and body reserves of the dam.

The growth and development of the udder tissue is also dependent on the adequate pre-calving feeding. To meet the objectives, a feeding practice known as “steaming up” is

generally employed especially where high yield is the aim. Steaming up should begin 6-8 weeks before calving. The heifer should be given a steaming up ration meant to further supplement her normal ration. The amount of such ration to be fed is determined by the condition of the cow or heifer and her probable milk producing capacity. Attempt to steam up cows or heifers on roughages or succulent feed (good quality hay, silage or dried grass) are much less effective than the use of concentrate. This is because the animal has not the appetite to consume enough of these feeds apart from the facts that the feeds themselves do not have the same body building power as concentrate. Steaming up, apart from building up the body condition of the cow or heifer, so that she is fit but not fat, also has the effect of stimulating the secretory activities of the udder.

Milking before Calving

This practice is recommended in most cases because of the distension and congestion of the udder tissues just prior to calving. When the udder is fully distended and does not yield easily to pressure from the hand, pre-calving milking is practiced for 3 reasons.

- a. To prevent udder inflammation which increases the size but not the secretory capacity of the animal, thus, overloading and strain may lead to pendulous and badly shaped udders.
- b. To prevent development of the high internal udder pressure which if it leads to re-absorption of milk constituents into blood stream will tend to start 'drying off' process. This will limit the animal yield after calving.
- c. To relief udder congestion and the accompanying painful condition which often makes the milking of a newly calved heifer, a most difficult task. With careless handling, it may also lead to the development of bad milking habit in heifers and failure to let down their milk readily to the machine.

GENERAL MANAGEMENT PRACTICES OF DAIRY ANIMALS

(1) Sanitation and General Cleanliness

Sanitation and General Cleanliness are important to prevent digestive upsets and diarrhoea. The pens and stores as well as management equipments must be thoroughly clean and disinfect pen after one calf is removed and before another calf enters. Calves should be housed in warm environment to prevent pneumonia. Stalls usually 1.5x2m with solid

partitions between them are suitable to prevent calves from sucking each other after milk feeding and minimise spread of disease. Group housing saves labour but provisions must be made for individual milk feeding and tying up of the calf for a short period after milking to prevent them from sucking one another. Diseases of one calf are easily spread to other calves.

(2) Dehorning

Horns are objectionable on animals in the commercial herd because of possibility of inflicting injuries of one another. The presence of horns also necessitates the provision of extra shed and feeding space and makes the animal more difficult to handle. It is therefore desirable that calves should be dehorned at 2-4 weeks old. Several methods are in use:

- **Use of chemicals eg KOH or NaOH**

They come in the form of sticks, pastes or liquids. The hair around the horn buds clipped closely. A ring of heavy grease or petroleum jelly is smeared on surrounding skin to prevent skin burn and keeps the liquid caustic from running into the calf's eyes. If a stick is used, then slightly moisten one end of the stick with water and rub it firmly over the horn buds with a rotator motion until blood appears. The effect is to deaden the horn root, in a few days a scab appears over each horn bud which soon drops off leaving a smooth spot of skin devoid of hair. Calves treated should be protected from rain for a day following the application since the chemical may wash down and injure the side face and the eyes of the calf. It is also best not to turn calves back to their dam for a few hours after the application of the caustic.

- **Use of saws, shears and clippers**

Saws of various forms, shears and clippers are used for dehorning. This is, however, less desirable method which applies only to older calves. Whatever the instrument used, it is necessary to remove the horn 0.50 to 1.00cm of the skin around its base to be certain that horn forming cells are destroyed

- **The electric dehorner or hot iron dehorner**

This method consists of the application of a specially designed electrically heated hot iron to the horn buds of young calves. The cup-like end of the hot iron is firmly pressed on the horn bud for a few seconds to destroy horn forming cells. While the method is bloodless, it is much painful than the use of chemicals. It can only be used for calves under 5 months of age.

- **The elastrator**

It is an instrument used in stretching a specially made rubber over the horn well down into the hair-line. This is aimed at cutting off the blood circulation to the bud. This system may be used on cattle with horns from 6-15cm long. Small horns drop off in 3-6weeks. Large horns stay up to 2 months.

Treatment after dehorning

It is essential that a good fly repellent be applied to the wound to remove the danger of flies. The danger of infection is generally reduced if there is extreme care and cleanliness. Instruments should always be disinfected

(3) Castration of bull calves

This results in a more symmetrical development and balancing of body between the fore and hind quarters. It makes animal more quiet and easier to handle. The bull is not prone to excitation, i.e. decreased libido. Bull calves can be castrated from few weeks to 8 months but best done at 4 months old. The older the animal, the greater the shock and risk

Methods of castration

(i) The bloodless castrator (Burdizzo Pincers)

It is used in animals with pendulous testis. The spermatic cords and associated blood vessels are crushed or severed so completely that the testicles waste away from lack of blood circulation. Young calves can be castrated while standing but those over 3 months are best castrated while lying down. The operator's assistant should sit on the calf's head and keep the upper most hind leg of the calf pulled well forward. Two independent closures about 1/4 inch apart should be made for each cord. If done properly, it is a satisfactory means of castration as there is no external bleeding and the chances of infection are reduced.

(ii) Open incision

An incision is made on the scrotal sac. The testes are removed by pulling them away from the spermatic cord. It is not advisable to cut spermatic cord since excessive bleeding may result. The cord is gradually scrapped with a sharp knife until it snaps off.

(iii) The rubber ring elastrator

This involves stretching a specially made rubber ring over the scrotum. It is a useful method for castrating young calves under 2 months old. The ring cuts off the scrotal and testicular blood circulation so that they finally drop off. As a rule the hands of the operator and instrument should be kept clean and as nearly sterile as possible by dipping in disinfectant solution between operations. The wounds should also be disinfected

(4) Branding and Marking

It is highly desirable that all animals in the herd bear some mark or tag whereby each can be positively identified. This is necessary for the establishment of pedigree or ancestry as in case of purebred herd. The method of marking employed will depend primarily on the objective. When the objective is to establish ownership as in the case on open range and in poorly fenced pastures, branding with a hot iron is probably the best method. Although, much has been said against branding because of the pain inflicted and the damage to the hide, the hot iron is still the common method. In advanced countries, before cattle can be legally branded, the brand being used must be properly registered with the Livestock Identification Office to avoid duplication especially at state boundaries. Other methods include Ear marking, Ear tags, Neck chains or strap and tattoo.

PHYSIOLOGY OF MILK PRODUCTION

Milk is synthesized in the mammary gland. Within the mammary gland is the milk producing unit, the alveolus. It contains a single layer of epithelial secretory cells surrounding a central storage area called the lumen, which is connected to a duct system. The secretory cells are, in turn, surrounded by a layer of myoepithelial cells and blood capillaries.

The raw materials for milk production are transported via the bloodstream to the secretory cells. It takes 400-800 L of blood to deliver components for 1 L of milk.

- **Proteins:** building blocks are amino acids in the blood. Casein micelles, or small aggregates thereof, may begin aggregation in Golgi vesicles within the secretory cell.
- **Lipids:** C4-C14 fatty acids are synthesized in the cells. C16 and greater fatty acids are preformed as a result of rumen hydrogenation and are transported directly in the blood.
- **Lactose:** milk is in osmotic equilibrium with the blood and is controlled by lactose, K, Na, Cl; lactose synthesis regulates the volume of milk secreted.

The milk components are synthesized within the cells, mainly by the endoplasmic reticulum (ER) and its attached ribosomes. The energy for the ER is supplied by the mitochondria. The components are then passed along to the Golgi apparatus, which is responsible for their eventual movement out of the cell in the form of vesicles. Both vesicles containing aqueous non-fat components, as well as liquid droplets (synthesized by the ER) must pass through the cytoplasm and the apical plasma membrane to be deposited in the lumen. It is thought that the milk fat globule membrane is comprised of the apical plasma membrane of the secretory cell.

Milking stimuli, such as a sucking calf, a warm wash cloth, the regime of parlour etc., causes the release of a hormone called oxytocin. Oxytocin is released from the pituitary gland, below the brain, to begin the process of milk let-down. As a result of this hormone stimulation, the muscles begin to compress the alveoli, causing a pressure in the udder known as letdown reflex, and the milk components stored in the lumen are released into the duct system. The milk is forced down into the teat cistern from which it is milked. The let-down reflex fades as the oxytocin is degraded, within 4-7 minutes. It is very difficult to milk after this time.

DAIRY CHEMISTRY

The role of milk in nature is to nourish and provide immunological protection for the mammalian young. There are many factors that can affect milk composition such as breed variations (cow to cow variations, herd to herd variations - including management and feed considerations, seasonal variations, and geographic variations. With all this in mind, only an approximate composition of milk can be given:

- 87.3% water (range of 85.5% - 88.7%)
- 3.9 % milkfat (range of 2.4% - 5.5%)
- 8.8% solids-not-fat (range of 7.9 - 10.0%):
 - protein 3.25% (3/4 casein)
 - lactose 4.6%
 - minerals 0.65% - Ca, P, citrate, Mg, K, Na, Zn, Cl, Fe, Cu, sulfate, bicarbonate, many others
 - acids 0.18% - citrate, formate, acetate, lactate, oxalate
 - enzymes - peroxidase, catalase, phosphatase, lipase
 - gases - oxygen, nitrogen
 - vitamins - A, C, D, thiamine, riboflavin, others

The following terms are used to describe milk fractions:

- Plasma = milk - fat (skim milk)
- Serum = plasma - casein micelles (whey)
- solids-not-fat (SNF) = proteins, lactose, minerals, acids, enzymes, vitamins
- Total Milk Solids = fat + SNF

Looking at milk under a microscope, at low magnification (5X) a uniform but turbid liquid is observed. At 500X magnification, spherical droplets of fat, known as fat globules, can be seen. At even higher magnification (50,000X), the casein micelles can be observed.

Milk Lipids

The fat content of milk is of economic importance because milk is sold on the basis of fat. Milk fatty acids originate either from microbial activity in the rumen, and transported to the secretory cells via the blood and lymph, or from synthesis in the secretory cells. The main milk lipids are a class called triglycerides which are comprised of a glycerol backbone binding up to three different fatty acids. The fatty acids are composed of a hydrocarbon chain and a carboxyl group. The major fatty acids found in milk are: Long chain (C14 - myristic 11%, C16 - palmitic 26%, C18 - stearic 10% and C18:1 - oleic 20%) and short chain (C4 – butyric, C6 – caproic, C8 - caprylic and C10 – capric)

Butyric fatty acid is specific for milk fat of ruminant animals and is responsible for the rancid flavour when it is cleaved from glycerol by lipase action. Saturated fatty acids (no double bonds), such as myristic, palmitic, and stearic make up two thirds of milk fatty acids. Oleic acid is the most abundant unsaturated fatty acid in milk with one double bond. Triglycerides account for 98.3% of milk fat. The small amounts of mono- , diglycerides, and free fatty acids in fresh milk may be a product of early lipolysis or simply incomplete synthesis. Other classes of lipids include phospholipids (0.8%) which are mainly associated with the fat globule membrane, and cholesterol (0.3%) which is mostly located in the fat globule core.

Fat Destabilization

While homogenization is the principal method for achieving stabilization of the fat emulsion in milk, fat destabilization is necessary for structure formation in butter, whipping cream and ice cream. Fat destabilization or agglomeration refers to the process of clustering

and clumping of the fat globules which leads to the development of a continuous internal fat network or matrix structure in the product.

Coalescence: an irreversible increase in the size of fat globules and a loss of identity of the coalescing globules;

Flocculation: a reversible (with minor energy input) agglomeration/clustering of fat globules with no loss of identity of the globules

Functional Properties

Like all fats, milk fat provides lubrication. They impart a creamy mouth feel as opposed to a dry texture. Butter flavour is unique and is derived from low levels of short chain fatty acids. If too many short chain fatty acids are hydrolyzed (separated) from the triglycerides, however, the product will taste rancid. Butter fat also acts as a reservoir for other flavours, especially in aged cheese. Fat globules produce a 'shortening' effect in cheese by keeping the protein matrix extended to give a soft texture. Fat substitutes are designed to mimic the globular property of milk fat. The spreadable range of butter fat is 16-24° C. Unfortunately butter is not spreadable at refrigeration temperatures. Milk fat provides energy (1g = 9 cal.), and nutrients (essential fatty acids, fat soluble vitamins).

Milk Proteins

The nitrogen content of milk is distributed among caseins (76%), whey proteins (18%), and non-protein nitrogen (NPN) (6%). This does not include the minor proteins that are associated with the fat globule membrane (FGM). The concentration of proteins in milk is as follows:

	grams/ litre	% of total protein
Total Protein	33	100
Total Caseins	26	79.5
alpha s1	10	30.6
alpha s2	2.6	8.0
beta	9.3	28.4
kappa	3.3	10.1

Total Whey Proteins	6.3	19.3
alpha lactalbumin	1.2	3.7
beta lactoglobulin	3.2	9.8
BSA	0.4	1.2
Immunoglobulins	0.7	2.1
Proteose peptone	0.8	2.4

Caseins

The casein content of milk represents about 80% of milk proteins. The principal casein fractions are alpha(s1)- and alpha(s2)-caseins, β -casein, and kappa-casein. The distinguishing property of all caseins is their low solubility at pH 4.6. The common compositional factor is that caseins are conjugated proteins, most with phosphate group(s) esterified to serine residues. Within the group of caseins, there are several distinguishing features based on their charge distribution and sensitivity to calcium precipitation:

alpha(s1)-casein: It can be precipitated at very low levels of calcium.

alpha(s2)-casein: It can also be precipitated at very low levels of calcium.

β -casein: Less sensitive to calcium precipitation.

kappa-casein: Very resistant to calcium precipitation and stabilizes other caseins.

Caseins are able to aggregate and there are four major ways in which aggregation can be induced:

1. chymosin - rennet or other proteolytic enzymes as in Cheese manufacturing
2. acid
3. heat
4. age gelation

Whey Proteins

The proteins appearing in the supernatant of milk after precipitation at pH 4.6 are collectively called whey proteins. These globular proteins are more water soluble than caseins and are subject to heat denaturation. The principle fractions are β -lactoglobulin, alpha-lactalbumin, bovine serum albumin (BSA), and immunoglobulins (Ig).

Enzymes

Enzymes are a group of proteins that have the ability to catalyze chemical reactions and the speed of such reactions. The action of enzymes is very specific. Milk contains both indigenous and exogenous enzymes. Exogenous enzymes mainly consist of heat-stable enzymes produced by psychrotrophic bacteria: lipases, and proteinases. There are many indigenous enzymes that have been isolated from milk. The most significant group are the hydrolases:

Lipoprotein lipase (LPL): A lipase enzyme splits fats into glycerol and free fatty acids. This enzyme is found mainly in the plasma in association with casein micelles. The milkfat is protected from its action by the FGM. If the FGM has been damaged, or if certain cofactors (blood serum lipoproteins) are present, the LPL is able to attack the lipoproteins of the FGM.

Plasmin: Plasmin is a proteolytic enzyme; it splits proteins. Plasmin attacks both β -casein and alpha(s2)-casein. It is very heat stable and responsible for the development of bitterness in pasteurized milk and UHT processed milk. It may also play a role in the ripening and flavour of cheese.

Alkaline phosphatase: Phosphatase enzymes are able to split specific phosphoric acid esters into phosphoric acid and the related alcohols. The enzyme is destroyed by minimum pasteurization temperatures, therefore, a phosphatase test can be done to ensure proper pasteurization.

Lactose

Lactose is a disaccharide (2 sugars) made up of glucose and galactose (which are both monosaccharides). It comprises 4.8 to 5.2% of milk, 52% of milk SNF, and 70% of whey solids. It is not as sweet as sucrose. When lactose is hydrolyzed by β -D-galactosidase (lactase), an enzyme that splits these monosaccharides, the result is increased sweetness, and depressed freezing point. One of its most important functions is its utilization as a

fermentation substrate. Lactic acid bacteria produce lactic acid from lactose, which is the beginning of many fermented dairy products. Lactose is relatively insoluble which is a problem in many dairy products, ice cream, sweetened condensed milk. In addition to lactose, fresh milk contains other carbohydrates in small amounts, including glucose, galactose, and oligosaccharides.

Vitamins

Vitamins are organic substances essential for many life processes. Milk includes fat soluble vitamins A, D, E, and K. Vitamin A is derived from retinol and β -carotene. Because milk is an important source of dietary vitamin A, fat reduced products which have lost vitamin A with the fat, are required to supplement the product with vitamin A. Milk is also an important source of dietary water soluble vitamins: B1 – thiamine, B2 – riboflavin, B6 – pyridoxine, B12 – cyanocobalamin, niacin and pantothenic acid. There is also a small amount of vitamin C (ascorbic acid) present in raw milk but it is an insignificant amount relative to human needs and is quite heat-labile: about 20% is destroyed by pasteurization. The vitamin content of fresh milk is given below:

Vitamin	Contents per litre
A (ug RE)	400
D (IU)	40
E (ug)	1000
K (ug)	50
B1 (ug)	450
B2 (ug)	1750
Niacin (ug)	900
B6 (ug)	500
Pantothenic acid (ug)	3500
Biotin (ug)	35
Folic acid (ug)	55
B12 (ug)	4.5
C (mg)	20

Minerals

All 22 minerals considered to be essential to the human diet are present in milk. These include three families of salts:

1. Sodium (Na), Potassium (K) and Chloride (Cl): These *free* ions are negatively correlated to lactose to maintain osmotic equilibrium of milk with blood.
2. Calcium (Ca), Magnesium (Mg), Inorganic Phosphorous (P(i)), and Citrate: This group consists of 2/3 of the Ca, 1/3 of the Mg, 1/2 of the P(i), and less than 1/10 of the citrate in *colloidal* (nondiffusible) form and present in the casein micelle.
3. *Diffusible* salts of Ca, Mg, citrate, and phosphate: These salts are very pH dependent and contribute to the overall acid-base equilibrium of milk. The mineral content of fresh milk is given below.

<i>Mineral</i>	<i>Content per litre</i>
Sodium (mg)	250-640
Potassium (mg)	1100-1500
Chloride (mg)	800-1200
Calcium (mg)	1100-1300
Magnesium (mg)	70-140
Phosphorus (mg)	800-1000
Iron (ug)	100-700
Zinc (ug)	2500-7000
Copper (ug)	100-350
Manganese (ug)	10-50
Iodine (ug)	50-600
Fluoride (ug)	20-80
Selenium (ug)	20-40
Cobalt (ug)	0.5-1.3
Chromium (ug)	0.5-20
Molybdenum (ug)	20-100
Nickel (ug)	0-50
Arsenic (ug)	20-60
Aluminum (ug)	50-1600
Lead (ug)	tr-20

CHEMICAL TESTS ON DAIRY PRODUCTS

ALKALINE PHOSPHATASE (ALP) TEST

Alkaline phosphatase (ALP) is an enzyme normally present in raw milk and it is inactivated when thermal treatment conditions are slightly higher than those required for the destruction of the pathogenic bacteria. Hence, the chemical test carried out to determine alkaline phosphatase (ALP) concentration in pasteurized milk is used to verify if thermal treatment has been done correctly.

Test principle

The alkaline phosphatase causes the hydrolysis of the Nitrophenylphosphate in a half alkaline and forms a yellow complex whose intensity, measured at 405 nm, is directly proportional to the concentration of ALP in the sample.

LACTIC ACID TEST

Lactic acid is produced by the fermentation of lactose due principally to the microbial activity. Its concentration is correlated to the total bacterial count; hence, a chemical test aimed to determine the concentration of lactic acid is a useful index of the good state of preservation of food. In addition, thermal treatment for example in UHT milk destroys the bacterial charge but does not modify lactic acid concentration and therefore lactic acid value can be used to investigate the "history" of the product. The test can be done even in powdered food as powdered milk, whey and additives after reconstitution with water. This chemical test is used to determine lactic acid concentration in cheese, ricotta, mozzarella, yogurt since its value has to be kept under fixed law limits.

Test principle

Lactic acid, in presence of the lactate oxidase and the peroxidase, reacts with a phenolic derivative and forms a violet complex whose intensity, measured at 505 nm, or at 545 nm, is directly proportional to the concentration of lactic acid in the sample.

AMMONIA CONCENTRATION TEST

Ammonia concentration value is an important index of the good quality of milk and it is applicable to all production phases. In fact, ammonia is a metabolite of the microbial activity and grows as bacteria content in milk increases. In addition, ammonia value that is the last

product of the amino acid degradation of soft cheese can be considered an index for the freshness of the product during its commercial life and may be an essential instrument to evaluate its shelf life.

Test principle

The test principle is based on a colorimetric reaction in which the ammonia reacts with a phenolic derivative forming a blue/green complex whose intensity, measured at 700 nm, is directly proportional to its concentration in the sample.

CHLORIDE TEST

Chloride test is used to measure the quantity of salt present in different dairy products as cheese, mozzarella, preservation liquid or in liquids used while processing food (for example: pickle).

Test principle

The chloride ions react with mercury thiocyanate and release thiocyanate ions. The thiocyanate ions react with the Fe(III) giving an orange coloured complex whose intensity, measured at 505 nm, is directly proportional to the concentration of the chlorides in the sample.

MILK UREA NITROGEN (MUN) TEST

Milk Urea Nitrogen (MUN) content is related to the protein content of animal nourishment and is used to define an adequate diet. The chemical test of urea concentration in raw milk may help to detect fraudulent additions done to increase the protein content of milk.

Test principle

The urea is transformed into ammonia from the urease. The ammonium ions react with a phenolic derivative and form a blue-green coloured complex whose intensity, measured at 700 nm, is directly proportional to the concentration of urea in the sample.

HYDROGEN PEROXIDE TEST

Hydrogen peroxide is used as a sanitizer of the machinery used for milk treatment. The presence of hydrogen peroxide inside the machinery may contaminate the milk: the scope of the test is the determination of its presence since it would determine milk contamination. The test is also used to determine an addition of hydrogen peroxide in raw milk, before undertaking pasteurization, to increase its duration.

Test principle

Hydrogen peroxide, in presence of the peroxidase, reacts with a phenolic derivative and forms a pink complex whose intensity, measured at 505 nm, is directly proportional to the concentration of hydrogen peroxide in the sample.

PEROXIDASE TEST

Lactoperoxidase (POD) is one of the most abundant enzymes present in milk. Peroxidase is associated to whey proteins of milk. It is inactivated by thermal treatments with high temperatures (70° C for 15 minutes or 80° for 30 seconds) or by any treatment that overcomes the standard conditions required for a normal pasteurization process. Hence, the persistency of lactoperoxidase in pasteurized milk can be used as a good index of product quality; in fact it is possible to apply a mild pasteurization treatment that will not deactivate the enzyme only to raw milk of good microbiologic quality; in this case chemical-physical and nutritional characteristics of milk will be only partially deactivated.

Test principle

The peroxidase contained in milk, in presence of an indicator and/or hydrogen peroxide, catalyzes the formation of a red colour whose intensity, measured at 505 nm, is directly proportional to the concentration of the peroxidase in the sample.

ESTABLISHMENT AND MAINTENANCE OF A DAIRY ENTERPRISE

Cows are the core of most dairy farm business. They are the animals that provide the milk that you will be selling off for money, and they are also responsible for reproducing other cows that can grow your business. Obviously, the majority of cows that you will rear in your farm should be females. However, if you also wish to make off money selling cows to slaughterhouses, you might want to retain a male and a few females for breeding. The following are needed in the establishment and proper maintenance of a dairy enterprise:

Capital

Starting your own dairy farm can be a matter of full-time employment, hobby farming or anything in between. Whatever your interest, calculating the cost of getting started in dairy farming is crucial. How much money you need to get started may be a big factor in whether you can jump right into the business in full. However the following should be put in consideration when thinking of cost.

- Take account of what you already have. If you already have pasture land, a barn and adequate fencing, you're off to a good start.
- Decide if you want to purchase a farm or simply lease some land. This is a large portion of the start-up costs for dairy farming.
- Get an estimate on fencing. In case you don't have enough natural barriers to keep the dairy animals contained, so determine how much it will cost you to add sufficient fencing.
- Determine whether you want any buildings or other structures, such as a barn for storing hay or for milking the animals. You may need a large barn, or you may just need a small covered area to protect you and the animal when milking.
- Add to the expected costs the price of purchasing dairy animals, veterinary services, equipment and other supplies. What you need largely depends on how large or small an operation you want to run. For instance, if you're planning to sell milk commercially, you probably need to purchase pasteurization equipment, which can be very expensive.
- Consult with a loan agent, if you're seeking a loan to cover start-up costs, to find out about down payments and loan fees. These administrative costs can quickly add up to significant amounts.
- Calculate the sum of all the associated costs. If the amount is too much for you to afford, start smaller. Go through the steps once more to see if you can find a more affordable solution.

Capital requirements are a common obstacle for dairy startup candidates. Unlike beef cattle operations, dairy cattle operations have substantial equipment requirements as well as barn and acreage demands. You can reduce the upfront capital investment by purchasing silage, hay and corn from other operations, but there is no getting around an initial investment in milking parlors (or pipelines), milk tanks, barn cleaners and other physical assets.

The size and scope of your herd is another critical consideration. If possible, you'll want a mix of milk cows and heifers to ensure seamless operations. Each year, a percentage of the cows in your herd will need to be culled for productivity and replaced by heifers that have recently delivered calves -- the herd's next generation of producers.

Unless you have abundant financial backing, the best entry strategy is to start small and build your way into a full-time operation. Many aspiring dairy farmers hone their skills and build a herd while working for another farmer, with the understanding that the goal is for the worker to lease a working dairy facility and launch his own operation in a specified period of time.

Equipment

Dairy farms are one of the more expensive businesses to operate and start. You need to have some elaborate equipment in order to pull the business off properly. Some of the more important dairy farm equipment includes:

- **Tractor** This is important equipment for pulling machinery around. Most of the other equipment cannot be operated without this.
- **Hay baler** Responsible for producing bale that is then fed to the cows. Each round bale produced by this machine is enough to feed 25 cows a day.
- **Combine** The machine used to harvest crops for feeding to the cows, or for selling off. If you plan to grow your own cow feeds, you would need this definitely.
- **Storage buildings** These buildings are useful for storing the feeds and the plants that you grow in your farm. There are also specialized buildings that are designed to store cow's manure, as they are good fertilizers for the crops.
- **Milking equipment** This will help make your life easier. Having automated milking equipment in your dairy farm will help cut the time required for you to produce milk from your cows, rather than doing it by hand.

Cattle Fences

Farmers have considerable investments of time and money invested in their farm operation. Many small farmers work all the hours that they can and generally involve their partner/spouse and children in the operation of their farming venture.

But a failure to put up the best fencing for their farm can have disastrous consequences insofar as they run the risk of losing livestock or hens to predators and having to constantly repair, mend and maintain their existing fences.

Types of Fences

Here are 4 types of fences that are commonly used and which have specific purposes that you should consider to safeguard your investment and livelihood.

1. Post and Rail Fencing

Post and rail fencing is very common and a popular choice and will generally comprise a timber post and rail fence with 3 horizontal rails. Generally the timber will be pressure treated and if you are near a busy road you may consider concrete post and rails fencing to ensure

that cattle or horses do not break out and cause accidents with motorists with disastrous insurance consequences for you.



Plate 9: Fencing of cattle paddocks

2. Barbed Wire Fencing

This type of fence is illegal in some districts but is incredibly effective but not ideal for all situations as it can be difficult to work with and cause injury to animals, particularly new born foals or calves.

3. Electric Net Fence

Electric net fencing is very useful to smart pasture management and can be moved around easily as the occasion warrants it; very useful for fencing cattle, goats, poultry and sheep. Electric net fencing has the advantages of being easy enough to set up and will keep out raccoons, deer and other predators. It is also very versatile and portable. However it needs maintenance as it tends to sag and falling tree branches can cause it to fail and you will need to monitor the energizer and ground rods.

4. Woven Wire Fencing

Woven wire fencing is a popular choice among small farmers; it is easy to set up and unlike electric fencing does not require a power source.

Cattle Barn

There are many different designs of cattle barns available .Some plans are designed to work for dairy farm operations. Others are useful for the calving process of a beef cattle operation. In some cases, the barns are built for only seasonal housing of livestock; others are built for year-round use.

Planning a Cattle Barn

1. Determine the design and layout of the cattle barn. Dairy barns are often built as housing for the cattle year-round and also contain a milking parlor and other equipment associated with a dairy operation.
2. Beef cattle are usually allowed to graze on pastureland much of the year. A barn may be built for use as shelter during the calving season or as a loafing shed used to when calves are fed to slaughter weight.
3. Determine the size of the barn. Make sure the building offers enough space to house the cattle as needed for whatever time necessary. The barns may be open on the interior or divided into stalls or pens as needed.
4. Determine the construction method. Pole construction methods are commonly used for barns. Poles, set in the ground, serve as the framework of the barn. Other building methods for barns include concrete blocks and wood frame construction.

Building a Cattle Barn

1. Prepare the building site by leveling the ground and removing all obstructions. Any water lines to the barn should be dug in before construction starts.
2. Set the posts for a pole barn or pour a foundation for a cement block or wood frame barn. This serves as the base for the barn. Use pressure-treated lumber for any components of the barn that will come in contact with the livestock manure.
3. Complete the exterior of the barn by adding wall components and the roof. Use construction techniques consistent with the type of construction being used on the barn. Add insulation to the roof and walls of the barn. Even if the barn is not heated, insulation will help moderate temperatures during adverse weather.

4. Add any interior walls or pens to the barn. These components complete the design of the plan for the barn. Install electric lights and outlets as desired. Keep outlets high enough to be out of the reach of the livestock housed in the barn. Add other items such as feeders or water tanks as needed to the barn. Add any doors or ventilation systems necessary to complete the barn.

Training

For new comers in dairy farming, training is essential component, it is very essential to go for training prior to starting this enterprise. As it is practical aspect and you have to manage all living animals with maintaining their productivity. Nowadays, very few personal are running their dairy farm, in scientific way to enhance the productivity of animals. It is however better to undergo training.

Cow Feeds

One of the primary keys to a successful dairy operation is a good nutrition program. Not only is nutrition one of the highest input costs (about 50% of the total costs), but it also controls the results of milk production, reproduction and health.

When you rear animals, you should also feed them. Cows feed on a number of plants: grass, corn or grain, among others. You can buy these feeds or, better yet, you can choose to grow them right next to your dairy farm. You can save up that way, and you can also make another business: selling off the feeds that you have extra from feeding your cows. You can also grow corn for your own consumption.

It is also possible to influence the milk composition through the feeding. As the cow normally experiences a shortage of nutrients in early lactation, it is of importance to feed the cow a well balanced diet in order to maximise the dry matter intake. An unbalanced diet increases the risk for metabolic disturbances and weight loss, which have a negative effect on the milk yield. Healthy cows will also make the transition from dry to peak easier.

Dairy farms

Dairy farms are farms where cows are raised to make milk and milk products like cheese, ice cream and butter. When establishing a dairy farm, constructions should be made in such a way to allow the following:

1. Cleaning and sanitizing to get rid of germs of the hoses, connections, and pipes that the milk flows through.
2. Feeding the cows.
3. Milking the cows. Once the machines are turned on, the milk goes through tubes until it reaches a big milk jar. It is checked to be sure the milk is good and then it goes into the bulk tank where it waits for the milk truck to come and haul it away. The milk truck will take the milk to a dairy, where it will be pasteurized and homogenized for health safety.
4. The big bottle is checked all the time to make sure that the milk doesn't have anything bad in it. It goes into a big tank where a tube of milk is taken out by the milk hauler so that they can test it when they get to the dairy.

The farmer's may also included:

1. Taking the cows out to the exercise yard in warmer weather and then cleaning their stalls. In colder months, the cows stay in and they have to clean the stalls around the cows.
2. Taking care of the animals: checking bruises, wounds, hooves--just seeing that the cow is healthy.

3. Feeding and taking care of the young calves. [Bottle feeding for the new ones, a bucket of milk for the older ones.]
4. Taking care of the crops when the weather is warmer. [Sowing, growing, harvesting].
Checking out the feed that is stored in silos and grain bins; doing maintenance on equipment.
To lower food costs, the dairy farmer grows part of the food for the cows.
5. Sanitizing the hoses, connections, and pipes again.
6. Milking the cows again around 4:00 p.m.
7. Checking milk to be sure that the butterfat content is right and that there isn't anything wrong with the milk so that the hauler can come to get it.
8. Feeding cows.

Common Management Practices Recommended for Dairying

Farmers should use modern and well established scientific principles, practices and skills should be used to obtain maximum economic benefits from dairy farming. Some of the major norms and recommended practices in when establishing dairy housing is as follows:

1. Construct shed on dry, properly raised ground.
2. Avoid water-logging, marshy and heavy rainfall areas.
3. The walls of the sheds should be 1.5 to 2 meters high.
4. The walls should be plastered to make them damp proof.
5. The roof should be 3 - 4 metres high.
6. The cattle shed should be well ventilated.
7. The floor should be hard, even non-slippery and drained to keep dry and clean.
8. A standing space of 2 x 1.05 metre for each animal is needed.
9. The manger space should be 1.05m high, 0.5m and depth of 0.25 m.
10. Corners in mangers, troughs, drains and walls should be rounded for easy cleaning.
11. Provide 5-10 sq. metre loaf space for each animal.
12. Provide proper shade and cool drinking water in the dry season

13. In cold weathers, keep animals indoor during night and rain.
14. Provide individual bedding daily.
15. Maintain sanitary condition around shed.
16. Control external parasites (ticks, flies etc.) by spraying the pens and sheds
17. Drain urine into collection pits and then to the field through irrigation channels.
18. Dispose of dung and urine properly.
19. Give adequate space for the animals.

Moreover, Dairy industries in European, American, and Asian nations evolved over time, focusing on improving indigenous potentials. Dairy industries improved hand in hand with industrialization. Industrialization improved nutritional and health conditions of animals: well-fed animals increasingly expressed their genetic potentials and responded well to breeding objectives. This produced high quality animals and high milk output, and thus overall milk processing achieved high standards in Europe, America, and Asia.

The example of these countries shows that as feeding of animals was improved, milk yield increased. Abundant grain production brought about by industrialization and mechanization made the feeding of grains to animals economical. With good feeding and healthcare, animal breeding produced cattle breeds with higher milk yield. All these are a result of the use of knowledge in production.

The Nigerian experience has been characterized by indiscriminate importation of foreign animals, poor feeding, high incidence of diseases, loss of animals, and failure of programs. Apparently, Nigeria is disregarding the lessons of history, the necessary and scientific sequence in the development of the dairy industry, and adopting passive technology transfer as a strategy for developing the dairy industry. This explains the failure of Nigeria's industrialization endeavour. This also explains the failure of dairy development programs in South-western Nigeria.