Breeds of Buffaloes

The buffalo species originated in India. The present day domesticated buffaloes are the descendants of *Bos arni* found in wild state even today in north-eastern parts of India specially Assam and the surrounding areas. The buffaloes are normally classified into river ad swamp types though both are called *Bubalus bublis*. Most of the animals in India re river type though swamp type are also found in certain parts of the country specially in eastern parts of India.

India is considered as the home tract of some of the best buffalo breeds. Because of preference of buffaloes for milk, many she buffaloes from the breeding tract are moved to the thickly populated urban and industrial centre for meeting the milk requirements of this population. Here generally they are slaughtered after completion of one or two lactation. Their progenies allowed to die due to neglect and thus no replacement of superior germplasm is possible.

Indian buffaloes are in important source of milk supply today and yield nearly three times as much milk as cows. More than half of the total milk produced (55%) in the country was contributed by the 47.22 million milch buffaloes, where as the 57.0 million cows contribute only 45% of the total milk yield. Indian Buffaloes are water buffaloes. There are about 10 indigenous standard breeds of buffaloes, which are well known for their milking qualities.

MURRAH

- It is the most important breed of buffaloes whose home is Rohtak, Hisar and Jind of Haryana and Nabha and Patiala districts of Punjab.
- **Synonyms** : Delhi, Kundi, Kali
- The colour is usually jet black with white markings on tail and face and extremities sometimes found.
- The tightly curved horn is an important character of this breed.
- The body size is massive, neck and head are comparatively long.
- Head of females is short, fine and clear cut.
- Hips are broad and fore and hind quarters are drooping.
- The buffalo cows of this breed are one of the most efficient milk and butter fat producers in India.
- Butter fat content is 7% Average lactation yield is vary from 1500-2500 kg the average milk yield is 6.8 kg/day.
- While a few individual animals yield much as 19.1 kg/day.
- Age at first calving is 45-50 months and inter calving period is 450-500 days.

TOP

NILI RAVI

- This breed is found in Sutlej valley in Ferozpur district of Punjab and in the Sahiwal district of Pakistan. (bred around Ravi river)
- Usually the colour is black with white marking on forehead, face, muzzle, legs and tail.
- The most desired character of the female is the possession of white markings.
- The head is elongate, bulging at top and depressed between eyes. The muzzle is fine.
- The frame is medium sized.
- The peculiarity of the breed is the wall eyes.
- The horns are small and coiled tightly. The neck is long, thin and fine.
- The milk yield is 1500-1850 kg per lactation and the inter calving period is 500-550 days.
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BHADAWARI

- Agra and Etawah district of Uttar Pradesh and Gwalior district of Madhya Pradesh.
- The body is medium size and wedge shaped. The head is comparatively small, the legs are short and stout, and the hooves are black. The hind quarters are uniform and higher than the forequarter.
- The body is usually light or copper coloured is a peculiarity of this breed. Eye lids are generally copper or light brown colour.
- Two white lines 'Chevron' are present at the lower side of the neck similar to that of surti buffaloes.
- Horns are black, curling slightly outward, downward before running backward parallel and close to neck, and finally turning upward.
- The average milk yield is 800 to 100 kg.
- The bullocks are good draught animal with high heat tolerance.
- The fat content varies from 6 to 12.5 per cent. This breed is an efficient converter of coarse feed into butterfat and is known for it high butter fat content.

JAFFARABADI

- These are massive animals found in their pure form in Gir forests. The breeding tract of this breed is Kutch, and Jamnagar districts of Gujarat.
- The head and neck are massive. The forehead is very prominent, wide with a slight depression in the middle.
- The horns are heavy, inclined to droop at each side of the neck and then turning up at point, but les tightly curved than in Murrah (drooping horns).
- The colour is usually black.
- The average milk yield is 100 to 1200 kg. These animals are mostly maintined by traditional breeders called Maldharis, who are nomads.
- The bullocks are heavy and used for ploughing and carting.

TOP

SURTI

- The breeding tract of this breed is Kaira and Baroda district of Gujarat.
- Coat colour varies from rusty brown to silver-grey. Skin is black or brown.
- The body is well shaped and medium sized; the barrel is wedge shaped.
- The head is long with prominent eyes.
- The horns are sickle shaped, moderately long and flat.
- The colour is black or brown
- The peculiarity of the breed is two white collars, one round the jaw and the other at the brisket.
- The milk yield ranges from 900 to 1300 kg.
- The age at first calving is 40-50 months with a intercalving period of 400-500 days.
- The peculiarity of this breed is very high fat percentage in milk (8-12per cent).

MEHSANA

- Mehsana is a dairy breed of buffalo found in Mehsana town in Gujarat and adjoining Maharastra state.
- Body is mostly black; a few animals are black-brown in colour.
- The breed is supposed to have been evolved out of crossbreeding between the Surti and the Murrah.
- The body is longer than in Murrah and the limbs lighter.
- The head is longer and heavier.
- The horns usually are less curved at the end compared to Murrah breed but are longer and could be of irregular shape.
- The milk yield is 1200-1500 kg.
- The breed is supposed to have good persistency.
- The intercalving period ranges between 450-550 days.

NAGPURI (OR) ELLICHPURI

- The breeding tract of this breed is Nagpur, Akola and Amrawati districts of Maharashtra.
- These are black coloured animal with white patches on face, legs and tail.
- This is also called as Elitchpuri or Barari.
- The horns are long, flat and curved, bending backward on each side of the back almost to shoulder (sward shaped horns).
- Horns of this type have a distinct advantage that they help the animals to protect themselves from wild animals and also easy to move in the forest.
- The face is long and thin. The neck is somewhat long.
- The average milk yield is 700-1200 kg per lactation.
- The age at first calving is 45-50 months with an inter-calving period of 450-550 days.

GODAVARI

- Godavari is a result of crossing of native buffaloes with Murrah bulls. The home tract is Godavari and Krishna deltaic area
- The animals are of medium stature with compact body. The colour is predominantly black with a sparse coat of coarse brown hair.
- Godavari buffaloes are reputed for high fat with daily average milk yield of 5-8 litres and lactation yield of 1200-1500 litres.
- The animals breed regularly and have a short calving interval compared to Murrah.

TODA

- Toda breed of buffaloes is named after an ancient tribe, Toda of Nilgiris of south India.
- Coat colour of the calf is generally fawn at birth.
- In adult the predominate coat colours are fawn and ash-grey.
- These buffaloes are quite distinct from other breeds and are indigenous to Nilgiri hills.
- The animals have long body, deep and broad chest, and short and strong legs.
- The head is heavy with horns set well apart, curving inward outward and forward.
- Thick hair coat is found all over the body. They are gregarious in nature.

PANDHARPURI

- Native of Kolhapur, Solapur districts in south Maharashtra.
- Body colour varies from light black to deep black.
- It is medium sized animal having long narrow face, very prominent and straight nasal bone, comparatively narrow frontal bone and long compact body.
- Typical characteristic of this breed is its horns which are very long, curved backward, upward and usually twisted outwards. The horns are very long extending beyond shoulder blade, sometimes up to pin bones

Floor space requirements

Type of animal	Floor space requirement (m2)		Maximum no of animals / pen	Height of the shed (cm)
	Covered area	Open area		
Bulls	12.0	24.0	1	175 cm. in medium and heavy rain fall and 220 cm. in dry areas.
Cows	3.5	7.0	50	
Buffaloes	4.0	8.0	50	
Down – calver	12.0	12.0	1	
Young – calves	1.0	2.0	30	
Old – calves	2.0	4.0	30	

Feeding and watering space requirements

Type of animal	Space per animal (cm)	Total manger length in a pen for 100 animals(cm)	Total water tank length in a pen for 100 animals (cm)
Adult cattle & buffaloes	60 – 75	6000 – 7500	600 – 750
Calves	40 – 50	4000 – 5000	400 – 500

Roof

Roof patterns

Lean to type roof

- These are simple roof with single slope adopted for shed type of buildings.
- Roof ventilation cannot be provided in this pattern.
- In this type of roof one wall is higher than another one to give necessary slope for roof.

Gothic arch

- This is an arched roof providing greater roof space used for store houses.
- Used for storage of feed.

Monitor roof

- The roof has two slopes, but one overlaps other at the ridge of the roof with a ventilation gap of one feet.
- In this roof ventilation can be provided in between two slopes.
- This is also suitable for tropical buildings and it serves the purposes of ventilating and lighting the building.
- **Semi monitor roof** : Roof has 2 slopes but one overlap the other at the ridge of roof with ventilating gap of 1 feet.

Gable roof

- These are coupled roof with two slopes.
- Roof ventilation can be provided in this pattern.

Roofing materials

Pan tiles or Mangalore tiles

- They are cheap and easily available in most of the places.
- It conducts heat rapidly.
- It is suitable for hot climate.
- Wind or accident easily damages them.
- It has to be renewed periodically.
- These are rectangular tiles with grooves on outer surface and two nibs on the inner surface.
- They are lied one at the side of the other to cover the roof.

Country tiles

- They are cheap and easily available in most of the places.
- They conduct less heat.
- These are semi-circular tiles of different shape and dimensions.
- They are used by keeping one over other in layers forming numerous air pockets acting as insulators.

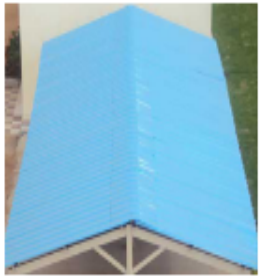
Asbestos sheet

- These are commonly used in animal buildings.
- Asbestos sheets are prepared by mixing cement mixture with varying quantities of vegetable fibers.
- They are available as sheets of different dimensions with corrugated surfaces.
- Sheets are easily fixed to roof trusses and more durable than tiles.
- But the houses under this roof will be hotter during summer.

Aluminum Sheets

- Corrugated aluminum sheets of different thickness and dimensions are available in the market as roof coverings.They are 2 ½ feet width and varying length from 8 to 12 feet. They are very light and can be easily fixed.
- The bright and polished surface of new sheets provides a reflective insulation and keeps the animal houses cool during summer.They are expensive but have a greater resale value.
- They are rust proof and therefore they are more durable.They shall be painted black inside and white outside to facilitate better microenvironment inside the animal building.

Galvanized iron sheets



- These are iron sheets, which are galvanized on the surface and provided with corrugation.
- They are available in standard dimension of 6 feet x 3 feet.
- Galvanized sheets are commonly used in animal houses but this sheet keeps the house very hot during summer.
- It is suggested that sheet should be painted white on outer side to avoid absorption of heat.
- They are strong and may be rusted after long use.

Thatched Roof

- This roof is made of either coconut or Palmyra leaves.
- Sometimes hay and straw are used as roof coverings.
- They are cheap and poor conductors of heat.
- They keep the house cool in summer.
- They are non-durable and has to be removed yearly or once in two year.
- They are very prone for fire accident.

Reinforced Cement Concrete

- This roofing material made up of mixture of cement, sand, small cresor stones with iron rods to make solid concrete.
- This is very strong and more durable.
- This material reduces heat inside the animal shed.
- It costs more expensive than other materials.

Floor

Floor types

Solid floor

- It is a common floor with solid surface made out of different materials such as cement concrete, vitrified paving brick, building brick, stones and gravel.
- Such solid floors should be laid properly for good drainage.
- A slope of 1/40 is desirable in animal standing and a slope of 1/60 is desirable towards the dung channel.
- Even in surface with impervious quality is necessary to prevent water stagnation.
- In this type proper cleaning and disinfection are essential to control diseases.

Deep litter floor

- It is made of bedding material as dried layers.
- Straw, paddy husk, saw dust groundnut hulls, dried leaves are spread on the floor used as litter materials.
- It can be spread as layer of 4-6 inches thickness and can be allowed to accumulate over a period of a month to 1 year.
- The litter get mixed with excreta and decomposed.
- The dried litter materials absorb the moisture. Hence bacterial activity is controlled.
- Excessive bacterial action in the deep litter is kept controlled by addition of lime.

Floor materials

Cement concrete floor

- This is a common material used in animal house.
- It is cheap and durable floor if properly constructed.
- In tropical condition, it provides the required cool condition for the animals.
- Groove and rough surface are to be provided for making it nonslippery and to prevent accident.

Stones

- Granite stones are used in place where they are easily available.
- They are made into a block.
- The floor surface is roughened and laid over a cushion of sand.
- It is durable and strong.

Gravel

- Fine quality of gravel can be used as cheap quality flooring materials.
- It absorbs water and worn out quickly.
- Periodical repair and maintenance is required.
- During disease outbreak disinfection is not possible with this type of flooring.
- Lime dressing and smearing of cow dung mixture will help in proper maintenance of floor.

Vitrified paving bricks

- These are hard impervious bricks with grooves on the surface.
- It is an ideal flooring for animals because of durability and damp proof condition.
- The bricks are set over the bottom and a cushion of sand.
- The joints are coated with cement mortar.

Building bricks

- They are sometimes used as a flooring material.
- They are not good floor materials.
- They absorb water and are easily worn out.
- They are set on edges closely and packed with good quality of cement.

Building Units

Main building units

Single row system : In single row system, 12-16 numbers of animals can be kept.

Double row system

- If it is greater than 16, then double row system is preferable.
- In double row system up to 50 animals can be maintained in a single shed.
- The distance between two sheds should be greater than 30 feet or it should be twice the height of the building.
- **Tail to tail system**
  Advantages
  - Cleaning and milking of animals easy.
  - Supervision of milking also easy.
  - Less chance for transmission of diseases from animal to animal.
  - Animals can get more fresh air from outside.
  - This system is more labour friendly system.
- **Head to head system**
  Advantages
  - Getting animals into the shed is easy.
  - Feeding of animals also easy.
  - Disinfection of gutter will be more due to the direct fall of sunrays over the gutter.
  - Animals are better exhibited to visitors

  Disadvantages

  - Milking supervision is difficult.
  - Possibilities of transmission of disease are more.
  - Not labour friendly.

Tail to tail system

Head to head system

Milking Barn / milk parlour

- This is a barn where milch animals are milked and is fully covered.
- It should be located at the centre of the farm with all other farm buildings arranged around it.
- There shall be an individual standing in the milking barns and the number of standings required should be 25% of total number of milch animals in the herd.
- The milking operation should be carried out in batches.

Dimensions of milking barn

- Length of standing space : 1.5 – 1.7 m
- Width of standing space : 1.05 – 1.2m (80% of length, of standing space)
- Width of central passage : 1.5 – 1.8 m
- Width of feed alley : 0.75 m
- Width of gutter : 0.30 m
- Overhang : 0.75 m

Down calver shed/ calving pen

- Pregnant animals are transferred to a calving pen 2 to 3 weeks before the expected date of calving.
- Calving pen of 3m x 4m (12 m2) is essential to keep the animals in advanced stage of pregnancy.
- It should be located nearer to the farmer's quarters for better supervision.
- The number of calving pens required is 10% of the number of total breedable female stock in the farm.

Calf pen

- This is meant for housing young calves separately.
- It can be located either at the end or on the side of the milking barn.
- This facilitates taking calves to their dams quickly.
- If there are large numbers of calves, the separate unit of calf shed should be arranged and located nearer to the milking barn.

Young stock/ heifer shed

- It is meant for housing young heifers separately.
- Older heifers calves from about six months of age to breeding age are to be housed separately from the suckling calves.
- When a large number of young stocks are there, they should be divided into different age groups and each group housed separately to facilitate scientific feeding.

Dry animal shed

- In large farms, milch and dry cows are housed separately.
- The floor in the covered area should preferably be made of cement concrete.
- Under Indian conditions, in smaller farms, milch and dry animals can be housed together.
- Normally, one third of the animals in a farm will be in dry or in dry cum pregnant stage.

Bull shed

- It is meant for housing bulls separately in a farm.
- It should be constructed towards one end of the farm.
- There shall be one shed for each bull.
- The number of bulls required being one for every 50 breedable females on the farm, if natural breeding is practiced.
- When artificial insemination service facilities are available, no necessary to keep the bulls on the farm.
- The bull shed shall have covered 3x4 metre dimensions, leading into a paddock of 120 square metres.
- The bull sheds shall be located in such a way that the bulls are able to see the cows and hear their sounds.

Isolation shed

- It is the separation of sick animals from apparently healthy animals to avoid transmission of diseases to healthy stock.
- It should be located at the corner of the shed so that these sheds are inaccessible to other animals.

Quarantine shed

- It should be located at the entrance of the farm.
- The newly purchased animals entering into the farm should be kept in quarantine shed for a minimum period of 30 to 40 days to watch out for any disease occurrence.

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Accessory buildings

Store room

- All the four walls should be closed and it should be rat proof.
- There should be one concrete store room with feed mixing unit at a distant place and a smaller feed store room behind the milking parlour.
- The floor and walls of store room should be impervious and damp proof.

Milk room

- It is essential to keep the milk and also to chill the milk in larger dairies having 400 to 700 litres production capacity that requires 3.7 m x 5m size of room and an additional 0.37 m2 for every 40 litres of milk production.
- For a smaller dairy unit below 100 litres a small room with a dimension of 3.75m x 3m can be sufficient for storing milk and concentrate feed.

Hay or straw shed

- An adult animal consume about 5 to 10 Kg of hay or straw per day, while young stock consume about 2 to 5 kg of hay or straw per day.
- The annual requirement can be calculated and the space requirement can be arrived.

Housing Methods

Loose Housing

- It is a system of housing in which animals are kept loose in an open paddock throughout the day and night except at the time of milking and treatment.
- In this system, shelter is provided along one side of open paddock under which animals can retire when it is very hot or cold or during rains.
- Common feed manger and water tank is provided and concentrates are fed at the milking time which is done in a separate milking barn or parlour in which cows are secured at milking time and are milked.
- The open paddock is enclosed by means of half walls or plain wire fences of convenient height.

Advantages

- Cost of construction is cheaper.
- Future expansion is possible.
- The animals will move freely so that it will get sufficient exercise.
- The animal can be kept clean.
- Common feeding and watering arrangement is possible.
- Clean milk production is possible because the animals are milked in a separate milking barn.
- Oestrus detection is easy.
- At least 10-15 percent more stock than standard can be accommodated for shorter period.

Disadvantages

- It is not suitable for temperate Himalayan region and heavy rainfall areas.
- It requires more floor space.
- There is competition for feed.
- Attention of individual animal is not possible.
- A separate milking barn is needed for milking of animals.

Conventional Barns or Stanchion Barns

- In this system of housing, the animals are confined together on a platform and secured at neck by stanchions or neck chain.
- The animals are fed as wells as milked in the same barn.
- These barns are completely covered with roofs and the sidewalls are closed with windows or ventilator located at suitable places to get more ventilation and lighting.
- It is applicable for temperate and heavy rainfall region.
- The same type of housing can be utilized for tropical region with slight modification.

Advantages

- The animals and men caring for animals are less exposed to harsh environment.
- The animals can be kept clean.
- Diseases are better controlled.
- Individual care can be given.
- Separate milking barn is not required.

Disadvantages

- Cost of construction is more.
- Future expansion is difficult.
- Not suitable for hot and humid climatic conditions.

FEEDING

Buffaloes are, like cattle, ruminants. This means that they utilize micro-organisms in the rumen to digest the feed. The feed eaten by ruminants are mainly of vegetable origin. The ruminant is an expert in converting cellulose and other fibrous materials into high quality milk and meat. Their digestive capacity is greater than the non-ruminant. Ruminants" chew the cud" e.g. regurgitate the food to the mouth and chew it several times, thus helping the breakdown.

The feed will enter the rumen compartment when swallowed by the animal. The rumen is an anaerobe environment, e.g. no oxygen is present. The feed is exposed to microbes such as bacteria, protozoa and fungi. These microbes attack the feed particles and by enzymatic action the components are broken down and used for their own metabolism, growth and propagation. The feed is masticated, regurgitated and exposed to microbes in the rumen. Large particles will become smaller and eventually be transported to the reticulum and further on. How long time a specific feed particle will stay in the rumen depends on size, palatability and fiber content of the feed. The buffalo has slower rumen movement than cattle, which leads to a slower rate of ingest outflow. The pH of the rumen content is similar to that of cattle, and it is affected in the same manner. Normal pH is between 6 and 7 depending on feed and time of feeding.

The components of the feed can be divided into protein, energy (carbohydrates), fat, minerals and water. The breakdown and utilization of the different feed components are reviewed below.The waste end products of the microbial attack are methane and carbon dioxide which are eructated. Volatile fatty acids (VFA) of which acetic, prop ionic and butyric acids are the predominant ones, are together with ammonia absorbed by the animal through the rumen wall, and transported via the blood to, e.g. the liver and udder where they serve as building material for chemical compounds such as glucose, protein and fat (see Figure 10). Ammonia can be utilized directly by the rumen microbes to synthesize proteins. To be correct, one is actually not feeding the buffalo, but its' microbes. Ruminants are entirely dependent on the function of the rumen microbes. Therefore, it is important to keep the rumen environment healthy. The easiest and best way is to feed a high amount of good quality roughage and a smaller amount of good quality concentrate.

Protein

Almost all protein is attacked by the microbes and utilized in their metabolism and incorporated in the microbial mass. Microbial protein is of high quality and is absorbed as amino acids after being digested by gastric enzymes in the abomasums.

Ammonia which is absorbed by the rumen wall and transported by the blood to the liver, is converted to urea. In case of protein deficiency, urea can be utilized by the rumen microbes as a non-protein nitrogen source to build protein. In this way nitrogen is circulated and efficiently used by the animal.

Protein can be protected to withstand microbial attack. It is then called"by-pass protein". By-pass protein is only degraded in the abomasums and small intestine where it undergoes enzymatic attack similar to that of mono-gastric animals. By-pass-protein is commercially available in some ready made concentrates and is usually given to high producers.

Carbohydrate

Carbohydrates are the predominant sources of energy for ruminants. Carbohydrates, or sugars, are the components of starch and fibers. Fiber is a common name for cell-wall components such as cellulose, hemi-cellulose and lignin. Starch can be degraded by animal gastric enzymes, whereas fibers cannot. Ruminants can utilize fibers to a larger extent than mono-gastric animals because of the ruminal microbes. However, lignin (wood-fiber) is not utilized. It is generally believed that buffaloes utilize fiber more efficiently than cattle do. The coefficient of digestion is 5-8% higher in buffaloes than in cattle.

Fat

Fat is not as such required in other than very small amounts for the ruminant. However, what ever fat is present in the feed undergoes microbial attack and degradation. Unsaturated fatty acids are hydrolyzed and thus saturated. This is one of the reasons for the milk and body fat of the ruminant to be of equal composition, largely independent of the type of feed given. If the fat can in some form be protected from ruminal degradation, and instead be utilized in the lower intestinal tract, it may be used as an additional energy source. However, it may then alter the milk fat composition unfavorably. Too much unprotected fat in the diet depresses the ability of the microbes to ferment fibers, thus influencing the energy utilization negatively.

Top

Nutrient requirements

In order to utilize the animal, feed and economical resources as efficiently as possible, one must know the nutrient requirements of the animals. If an animal is wrongly fed this may lead to diseases, loss of production and thereby economical losses. By knowing what a specific animal needs, proper advice concerning purchase, cultivation and feeding systems can be given. Requirements for buffaloes are more or less the same as for cattle, therefore, nutrient requirement tables for dairy cattle may be used as a guidance, the farmer must observe the animals and change feeding system with the guidance of an extension officer if it seems

Energy

Sources of energy are predominantly carbohydrates like fiber and starch and fat to a lesser extent. For buffaloes, fiber in the form of roughage is the most important and cheapest energy source. When calculating feed ratios for buffaloes the term Metabolizable Energy (ME) is used. This means the amount of energy that can be used by the animal for maintenance, growth, lactation etc. The gross energy (GE) of the feed is the amount present in the feed, when entering the animal, much of the energy is converted into heat which is lost through the thermal regulation. Energy is also lost in the feces and urine as well as in the methane and carbon dioxide gases.

Energy is measured in calories (cal) and joules (J) (1 cal equals 4.18 J). The most common is to use the term Mega calories (M cal) or Mega joules (MJ) which means a million cal or J. Another measurement is Total Digestible Nutrients (TDN) which is the sum of carbohydrates and fat in the diet. The unit for TDN is kg or gram.The energy ratio in the feed may be increased by adding fat in protected form, thus transferring the digestion from rumen to the intestinal tract. Feeding of protected fat (1 kg safflower oil) has proven to increase nutrient utilization. Feeding of unprotected fat in similar amounts has shown to adversely affect nutrient utilization.

Protein

Protein is required for growth, tissue repair and milk production among other things. Good sources of protein are leguminous forage, grain and oil-seed-cakes.

The protein requirements are measured in Crude protein (CP) in kg or gram.

Minerals and vitamins

- Minerals are essential for many body functions. The macro-minerals calcium and phosphorus are especially important in milk production. They are also vital for the skeleton and the function of nerve-impulses. Phosphorus is the mineral included in the body's energy metabolism, ATP. When considering the Ca and P requirements for the animal it is equally important to consider the ratio in which it is given. The Ca ration should be 2:1 since there exists and antagonist relationship between the two minerals concerning uptake from the small intestine.
- Salt, e.g. sodium and potassium together with chloride are the more important micro-minerals. Minerals are present in various amounts in feed and water.
- Vitamins are essential for total body function. Most vitamins are synthesized by the animal or it's rumen microbes. Such vitamins, B, C and K (and to some extent D) does not need to be fed. Vitamin B is synthesized by ruminal microbes, vitamin K by intestinal microbes and vitamin C in the tissues. Vitamin D is formed when the precursor, found on the skin on animals and on grass, is exposed to UV-rays, in tropical countries deficiency of vitamin D is rare. Vitamins A and E are not synthesized in the animal but must be supplied. Vitamin A is found in silage, fresh grass, dark green leaves, peas and carrots. Cereals are a source of vitamin E.
- Mineral and/or vitamin mixture should always be supplied in order to fully meet the requirements. Animals which do not receive a ready made concentrate mixture with mineral and vitamin supplement, must be fed supplement in the form of "lick stones" of which the animals have free access to or as "powder" fed once or twice a day individually. Vitamins may be included in the mineral feed, but vitamins are more sensitive and may be destroyed if kept in sunlight. Care must therefore be taken to store vitamin supplements correctly.

Water

Water is essential for most body functions, such as body temperature control, milk production and maintaining blood plasma volume. Thermal regulation of the animal is the most water consuming process. The animal receives water in three different ways

- Drinking water
- Water in feed
- Metabolic water = water made from feed degradation

Drinking water is the most important water source and should be of good hygienic quality. The water available in feed is highly dependent on the dry matter in feed. Straw, hay and cereals include little water, whereas silage and fresh grass may contain as much as 70 percent.
The water requirements of the buffalo depend on;

- The diet (dry matter)
- The environment (humidity, temperature)
- Physiological function (growth, pregnancy, lactation etc.)

Generally, buffaloes require more water than cattle under the same circumstances and should have access to clean cool water and libitum. A restricted water intake leads to a decrease in dry matter intake and thus affects milk production and growth negatively.

Salinity of water is seldom a problem in dairy buffalo feeding. A salt content of up to 5 g/liter of water can be used for buffaloes. However, temporary diarrhea may be caused by water approaching the higher levels.

Feedstuff

The main diet for the buffalo is roughage such as grass, legumes and straw. The roughage can be fed either fresh as pasture or in a cut-and-carry-system or conserved as hay or silage. The roughage is often complemented with grains, concentrate and agro-industrial by-products such as oil-seed cakes, sugar cane tops etc.

The roughage should form the base of the feed ration and contribute to meet (at least) the total maintenance requirements. Grains and concentrate should be fed only to meet additional requirements such as growth, pregnancy and milk production. Too much non-fibrous feed will alter the rumen environment. In the long run this could lead to serious problems in feed digestion causing loss of appetite, weight loss and a drop in milk yield. This is especially important for animals under stress, such as high growth rate and high milk yield. The roughage should be of good quality, both nutritional and hygienic quality, this cannot be emphasized enough.

Types of roughage

The most common roughage is grass of a number of species. Lucerne, berseem and clover are herbaceous legumes and have an advantage over grass as they are nitrogen fixing. This means that the plants will (with the help of bacteria) fix air-nitrogen and thus they are less dependent on the nitrogen content of the soil. These plants contain more protein than grass under the same circumstances. Lucerne (or Alfalfa) has several advantages. It contains an elevated amount of calcium, vitamin E and carotene which are of major importance for milk production.

There are also tree legumes which can be used as high quality feed, e.g. Leucaena leucocephala, Gliricida spp., Sesbania and others. As many of the tree legumes contain anti-nutritional compounds which may depress digestibility as well as decrease feed intake, they should not be fed as the sole source of roughage. A maximum ratio of 50% tree legumes in the total diet can be considered as a safe level. Since buffaloes are strict grazers, the trees should be pruned and the branches or leaves given to the buffaloes. Pruning with regular interval of 6 to 10 weeks increases re-growth of the leaves.

Roughage of lesser quality are straws. Straw from rice, barley, wheat, sorghum etc. are widely used in feeding ruminants. Their protein content is zero and their energy content low because of their largely lignified cell-walls. Rice or paddy straw has a high silica content in the cell walls which makes it difficult to digest.

Harvesting roughage

In the beginning of the growth season, the protein and sugar (energy) content of the grass is high and the lignin content low. Thus, the grass is of high quality. With maturity the protein and sugar content decreases and the cell walls become lignified. The growth pattern is the same for legumes although it is a little slower. It is therefore important to harvest the roughage in the optimal period and to conserve it for use under dry seasons.

Pastures should not be over or under grazed. Over grazing leads to insufficient forage in the later season and the soil will be more vulnerable to erosion and permanent damage. In the case of under grazing, the pasture is not utilized efficiently. The grass will grow quicker than the animals can eat. Thus the nutrient composition will change unfavorably to high lignin and low protein content.
In many areas, grass is not harvested even if not grazed and is left as "standing hay". However, the standing hay has a very low nutritive quality, close to that of straw.

Treatment of roughage

Chaffing, grinding and pelleting are ways to improve nutritive quality of straws to some extent by making the nutrients available to the rumen microbes. Chemical treatment with alkali or ammonia is effective ways of improving quality. Ammonia treated, chaffed straw may even substitute green forage for low milk producing buffaloes to some extent. Ensiling Lucerne reduces vitamin E and carotene content.

Concentrate

The term concentrate means that a high amount of nutrients are concentrated in a small amount of dry feed. The most typical concentrates for tropical countries are oilseed cakes of different types. Oilseed cakes are the common name for products that are derived of the oil for human use and the remainder is pressed together to form a cake. The cakes have relatively high energy content but are mostly used because of their very high protein content.

Other types of feed which can be classified as concentrate are molasses and urea. Urea can be used by the microbes as a source of nitrogen. The use of urea also requires an easily fermented energy source for the micro-organisms e.g. molasses. The micro-organisms must always have a good balance between protein and energy in the rumen to be able to do their qualified job. There are a number of ready made concentrates on the market manufactured by various companies. Care should be taken to ensure that the quality of the concentrate is up to standard.

Grain

Barley, wheat, oat, rye, maize and sorghum grains are excellent feed for ruminants, given in balanced amounts. However, since they are used for human consumption their use as animal feed is limited.

Voluntary intake

The definition of voluntary intake is the amount of feed an animal can eat per day. It is commonly expressed in kg of dry matter or in percent of live weight. After having considered the nutrient requirements of the animal and the feed stuff to be used the proper feeding regime can be calculated. However, one must take into consideration how much the animal can eat.

A high producing lactating cow can eat more than a low producing. Similarly a growing heifer may eat more than a dry cow. As pointed out before, feed intake decreases with high environmental temperature and humidity. Individual feeding usually results in higher feed intake due to less competition for feed and a more relaxed atmosphere.

A rough estimation of voluntary intake for a buffalo heifer is 2.2 to 2.5% of its' live weight per day, if provided with a small portion of straw, a large portion of green feed and some concentrate. A milk producing buffalo should be able to consume good quality feed up to 3% of its' live weight. A too high ratio of straw in the diet reduces voluntary intake. A protein content of less than 6% also reduces intake of that feed.

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Formulating feed ratios for the milk producing buffalo

Formulating feed ratios for milk producing buffaloes starts with theoretical calculating of the requirements. As there are no standardized international tables for dairy buffaloes' requirements, the calculations here are based on NCR's tables for dairy cattle (see Table 3). It is important to know the buffaloes live weight, this is most accurately done by weighing the animals three times in a week and calculating the average. However, this requires an animal scale and is further very time consuming. Weighing the animals once is good as guidance. Once the weight is known, the requirements for maintenance are extracted from Table 1. The milk yield should be known as well as the fat percentage. Recommendations are at least 3 days of milk recording to calculate the average yield and fat percentage. For simplicity, the yield is then calculated to 4% fat corrected milk (shown in Table 1). The total requirement is gained by summing requirements for maintenance and for milk production.

Table 1. Nutrient requirements for milk producing buffaloes

Requirements for Live weight	Energy (ME in MCAL)	TDN (kg)	Total Crude Protein (g)	Calcium	Phosphorus (g)
450 kg	13.0	3.4	341	18	13
500 kg	14.2	3.7	364	20	14
550 kg	15.3	4.0	386	22	16
600 kg	16.3	4.2	406	24	17
Requirements for Milk yield per kg 4% fat corrected milk	1.24	0.32	90	2.73	1.68

If the animal seems to be too fat at the time of weighing, the maintenance requirements may be reduced by 10 %. Similarly, if the animal is too skinny, 10% may be added to the maintenance requirements.

The feeding regime of the buffaloes can then be decided. Primarily, crops grown on the farm should be included in the diet. For the optimal economic feeding regimes the feed should be analyzed at a laboratory for dry matter content, energy and crude protein and for calcium and phosphorus.

Table 2. Optimal economic feeding

Feed name	Energy (ME in Mcal)	TDN (kg)	Total Crude Protein (g))	Calcium (g)	Phosphorus (g)
Alfalfa hay	2.36	0.63	200	15.4	2.2
Napier grass	2	0.55	87	6	4.1
Rape fresh	3.16	0.81	164	-	-
Oats	2.73	0.6	140	2	2
Sorghum fresh	2.36	0.63	88	4.3	3.6
Sorghum silage	2.14	0.58	62	3.4	1.7
Maize silage	2.67	0.7	81	2.3	2.2
Wheat straw	1.51	0.44	0	1.8	1.2
Rape seed	2.93	0.76	390	7.2	11.4
Cotton seed cake	2.71	0.71	448	1.9	1.2
Wheat bran	2.67	0.7	171	11.8	3.2
Molasses	2.67	0.7	103	11	1.5
Urea	0	0	281	0	0

Practical feeding of the calf

Calf mortality is very high, in India it is often 30-40% before 3 months of age, and in Italy the figures may be higher. This is caused by malpractice such as negligence, limited milk feeding, injuries and diseases. By increasing the amount of feed to the calf's requirements and by practicing the following instructions the mortality can be decreased.

Colostrum is the most important and most suitable feed for the newborn calf. It contains all the nutrients needed (see Table 3) along with the vital antibodies. It is crucial for the survival of the calf that it receives colostrums during the first 12 hours of its life, the earlier the better. The calves should be given colostrums as long as the mother provides it e.g. 3 to 4 days. Any surplus colostrum can be frozen and then thawed and carefully heated to 390C. If no freezing facilities are available colostrums can stay fresh for a couple of days if it is cooled in a hygienic container. Colostrum can be fermented with living lactic acid culture. Fermented colostrums can be kept for at least a week and up to two weeks if cooling facilities are available.

If the calf is not allowed to suckle its mother it should be provided with colostrums as soon as possible after birth. If it is not possible to feed the calf directly after milking the buffalo, colostrums should be cooled in order to maintain hygienic quality. When it is time to feed the calf, the milk should be carefully heated to no more than 390C. Colostrums must never be boiled. By boiling the milk the antibodies are destroyed and hence, cannot be utilized as such by the calf.

The natural eating behavior of the calf is to suckle its mother often and to consume a small amount of milk at each suckling period. It is best for the calves reared under artificial conditions if their eating behavior is as"natural" as possible. Colostrum should be fed to the calf at least twice daily with equal intervals.

The calf should be trained to drink from a bucket. The easiest way to do this is to dip clean fingers into the milk and then allow the calf to lick and suck the fingers. The hand is then gradually drawn into the milk in the bucket while the calf is still suckling. Once the calf has learnt to drink it is easy to feed. The calf may need assistance for 5 days. There are special nipples which can be put in the bucket. The calf will suckle these, hence it will need less assistance from the trainer.

Table 3: Feeding of the calf

Age (days)	Daily gain (kg)	DCP (g)	TDN (g)	ME (M cal)	Ca (g)	p (g)	Vit A (1000IU))	Vit D (IU)
0-15	0.20	80	400	1.5	2.5	1.5	1.5	200
16-30	0.30	90	500	1.7	3.0	2.0	1.5	250
31-60	0.30	125	800	2.4	3.5	2.5	1.7	250
61-90	0.35	150	100	3.6	4.0	3.0	2.0	260

After the colostrums period, whole milk should be provided to the calf until 15 days of age @ a level of 1/8th to 1/10th of the calf's body weight. (see Table 3). Milk replacer can be fed along with the whole milk provided that it has a certain composition of nutrients. It is not advisable to completely substitute whole milk with milk replacer. Milk and/or replacer should be offered to the calf on at least two occasions per day. The milk and/or replacer should be served at body temperature (38-39OC).

At two weeks of age, the calf should be introduced to good quality green feed and concentrates, as a calf starter (Table 3). This stimulates the rumen to grow and function properly. By following the feeding schedule in Table 8 a daily gain of 0.35 kg can be expected in Murrah calves.

Feeding schedules for calves

Age (days)	Whole milk (l)	Skimmilk (l) / milk replacer	Calf starter (g)	Hay (g)
0-14	4*	-	-	-
15-21	3.5	-	50	300
22-28**	3.0	-	300	500
29-35	1.5	1.0	400	550
36-42	-	2.5	600	600
43-49	-	2.0	700	700
50-56	-	1.5	800	800
57-63	-	1.0	1000	1000
64-70	-	-	1200	1100
70-77	-	-	1300	1200
78-84	-	-	1400	1400
85-91	-	-	1700	1900

*first 3 to 4 days, feed colostrum.

**ensure a smooth and gradual change to milk replacer

An alternative method is to rear calves with foster mothers. In Italy, 40% of the buffalo calves are reared by suckling an old and less productive buffalo or even a cow. This has several advantages, e.g. little labor is required concerning feeding of the calf and the calf will secure it's nutrient intake itself.

Calf starter mixture

Feed source	Amount
Crushed barley	50 %
Groundnut cake	30 %
Wheat bran	8 %
Fish meal / skim milk powder / meat meal	10 %
Mineral mixture	2 %
To increase acceptability, add, per 100 kg of starter	
Molasses	5-10 kg
Salt	500 g

Buffalo calves fed with Stover's of maize, bajra and oat cannot meet their nutrient requirements and are often in negative energy and protein balance. However, feeding the calves with treated Stover's with a urea-molasses-salt complex both enhances the palatability of the Stover's as well as the digestibility and nutrient value. Buffalo male calves weighing 150-200 kg has proven to increase the intake of treated Stover's verses untreated ones and thereby increasing weight gain, nitrogen balance and health.

Feeding Schedule

Feeding Schedule for different breeds of Buffaloes (Kg)

Type of animal	Feeding during	Green Fodder	Dry Fodder	Concentrate
Murrah (7 to 8 liter milk per day)	Lactation days Dry days	25 to 30 20 to 25	4 to 5 5 to 6	3.5 to 4.0 0.5 to 1.0
Mehasana (6 to 7 liter milk per day)	Lactation days Dry days	15 to 20 10 to 15	4 to 5 5 to 6	3.0 to 3.5 0.5 to 1.0
Surti (5 to 6 liter milk per day)	Lactation days Dry days	10 to 15 5 to 10	4 to 5 5 to 6	2.5 to 3.0 0.5 to 1.0

Nutrient Requirement

Nutrient requirement of working bullocks

Body weight of the bullock	Digestible Crude Protein (kg)		Total Digestible Nutrients (kg)	
	Normal work (4 hours)	Heavy work (8 hours)	Normal work (4 hours)	Heavy work (8 hours)
300 kg	0.227	0.241	3.06	3.89
350 kg	0.254	0.277	3.56	4.50
400 kg	0.283	0.287	4.00	5.03
450 kg	0.307	0.335	4.40	5.60

MILK PRODUCTION

Lactation and milk yield

The onset of lactation is with the birth of the calf. The initial yield is a reliable indicator of the animal's genetic potential. The highest yield is reached after five to six weeks of lactation and maintained for some weeks. Thereafter the yield decreases until the end of lactation. The lactation ends as the dry period starts.

In buffaloes, the highest milk yield is seen in the fourth lactation where after it declines. The shape of the lactation curve depends on factors such as feed, management, milking frequency, diseases among others. The length of lactation and yield for various breeds is shown in Table 10. The optimum lactation length in the Murrah has been reported to be 262 to 295 days. Factors affecting lactation and milk yield

Lactation and milk yield depend on both genetic and non-genetic factors. The genetic influence is due to species, breed, and individual. Further, it is affected by ability to reproduce, e.g. fertility and thereby calving interval. Improvement on these may be the result of breeding and selection.The non-genetic factors are management, amount and quality of feed and skill of the farmer to detect heat and illnesses. Factors which are outside the farmer's control such as climate, temperature, humidity etc. also influence lactation and milk yield.

Feeding is the most important factor for increasing and sustaining the milk yield. Sufficient amount of energy, protein, minerals and water must be provided in order to achieve maximum yield. See section on Practical feeding of the lactating buffalo.Calving interval is closely related to lactation length and milk yield. The longer the calving interval, the longer the lactation and the higher the lactation yield. However, total life time yield will be substantially less comparing with a buffalo with short calving intervals.Milking frequency affects both total milk and fat yield. A study using Murrah buffaloes showed that 31% more milk and 26% more butter fat resulted from milking three times per day as compared to twice a day.

Weight of the heifer seems to affect milk yield. Studies on Murrah indicates that the heifers should weigh at least 500 kg at the time of calving in order to reach a maximum milk yield.

Dry period

The buffalo should be dried off approximately 2 to 3 months before expected calving. The dry period is valuable to the buffalo, she may rest and the udder tissue is repaired.In a high yielding herd (above 10 kg per day) the buffalo should be dried off when the daily yield falls below 2.5 kg, even if it is still more than 3 months to expected calving. This goes especially for machine milked herds. An alternative to drying off is to use the buffalo as a foster mother to newly born calves. One buffalo may serve one newborn calf or two older calves which receive additional feed. Care should be taken to dry her off completely no later than 2 months before calving.

In herds which are hand milked and where the yield is low, it is difficult to set a lower limit in kg. Instead, the 2 months limit is recommended.

Table 1: Macro and micro elements (ppm) in buffalo milk

Macro and micro elements		
Sodium	750	317
Potassium	1390	908
Calcium	2030	1880
Magnesium	200	91.9
Iron	-	0.325
Phosphorus	1290	-
Zinc	-	6.26
Copper	-	0.303

Composition of colostrums

During approximately the first three days of lactation the buffalo secretes colostrums. Colostrums is vital for the newborn calf and its composition reflects the calf's need (see Table 2). Colostrums contains the important proteins; the immuno globulins, which are the newborn calf's source of antibodies. The content of iron and copper is markedly higher in the colostrums as compared to normal milk.

Table 2: Composition of colostrums

Water (%)	Fat (%)	Total Protein (%)	Lactose (%)	Vitamin A (µg/kg)
68	15	13.6	3.1	-
73	9.55	9.59	7.54	1.8

Alterations of milk composition

Milk composition can be altered both before and after the milking. If the change occurs inside the udder it is mostly due to a disease or treatment of the disease by antibiotics or other type of medication. Feeding can alter the normal composition, however, these changes are seldom extreme, but within normal intervals. Season can effect the normal milk composition, although these changes are mostly due to differences in feeding during different seasons.

Feedstuff

Rule of thumb is that roughage increases fat content in milk, whereas concentrate depresses it. This depends on the differences in VFA production in the rumen from the different carbohydrate sources. Digestion of fiber results in a higher proportion of acetic acid and thereby more milk fat. Digestion of concentrate on the other hand, results in a higher proportion of propionic acid which is unfavorable for milk fat synthesis. If too much concentrate is given, fat depression might occur. Higher energy diets seem to give better coagulation properties of the milk. Long-chain fatty acids increase when the energy concentration in feed is low.

Glucosinolates in Brassica spp. are hydrolyzed by the ruminal microbes into thiocyanates, iso- thiocyanates and some other products. Thiocyanate is then excreted in the milk. High feeding levels with Brassica spp. may therefore lead to unsatisfactory levels of thiocyanate in the milk. Thiocyanate may cause thyroid enlargement in animals as well as humans ingesting it. A common feed stuff of Brassica spp. is mustard fodder and mustard oil cake. Even 15 days after withdrawal of mustard feed, circulatory high levels of thiocyanate exists and is secreted in milk.

Disease and medication

Mastitis changes the milk composition dramatically. The alterations can sometimes be used as detection of the disease. If antibiotics are used in order to cure for example mastitis, these will be excreted in the milk. Controlling of external parasites with e.g. diazinon affects milk yield as well as composition. The chemical is detected in the milk upto 48 hours after dermal application.

Milking the buffalo

Buffaloes have been used for milk production for centuries. They have not been subjected to the same upgrading and breeding like cattle of the western world. However, the buffalo is an excellent milk producer, given the correct circumstances. Milking the buffalo is not a difficult task. One should, however, take care not to implement cattle milking techniques directly on the buffalo cow. As described below, the anatomy and physiology of the buffalo udder differs slightly from the bovine one. This has further implications on the milking technique as mentioned later.

Machines for milking buffaloes

Since the udder and teats in buffaloes are different compared to cattle, milking machines for cattle have to be modified in order to fit buffaloes. In general, a heavier cluster, a higher operation vacuum and a faster pulsation rate is required. Results from recent studies in India indicate that it might be possible to reduce the cluster weight and the frequency of liner slip by applying an appropriate combination of liner design and cluster weight.

It is not only the total weight of the cluster that is important, but also the distribution of its weight on the udder. Unequal weight distribution can cause uneven milk output. The long milk and vacuum tubes should be aligned and stretched to ensure equal weight distribution of the cluster on the udder.

Milking characteristics depend upon vacuum levels and pulsation rates among others. Studies on Egyptian buffaloes revealed that a vacuum of 51 kPa and a pulsation rate of 55 cycles/min led to much longer milking times than a vacuum of 60 kPa and a pulsation rate of 65 cycles/min (6.21 min. compared to 3.18 min.). The higher vacuum level, however, caused a significant increase in the somatic cell counts. Highest milk yield within an acceptable time were found when using 56 kPa and 65 cycles /min. In all trials a pulsation ratio of 50:50 was used. Studies in Pakistan indicated that the pulsation rate and ration should be 70 cycles/min and 65:35 respectively for Nili-Ravi buffaloes.

In Italy, the majority of farms use the same machines for both buffaloes and cattle. It is a simple "cattle machine" with one vacuum level operating at approximately 40 cm Hg. In India, recent trials have been made with milking with Duovac TM from Alfa Laval Agri. Successful milking was done with a vacuum level of 55 kPa, 70 cycles/min pulsation rate and pulsation ratio of 65:35 for milk flows above 0.2 kg/min. For milk flows under 0.2 kg/min the respective data where 38 kPa, 48 cycles/min and the same pulsation ratio. The Duovac TM is physiologically correct for the animal since it helps in gently stimulating let-down and is also gentler to the teats after the peak flow.

Milking with machines

In order to obtain all the advantages with machine milking the correct technique must be used. The milkers and buffaloes must be familiar with the machines. If the buffaloes are scared or feel uncomfortable they will withhold the milk and thereby yield less. This in turn will lead to economic loss for the farmer and eventually he will loose his faith in machine milking.

DISEASE MANAGEMENT

BUFFALO-POX

The disease occurs in India in both generalized and localized forms, udder, inner thigh, lips and nostrils. The disease is of zoonotic importance manifesting lesions on the hands and fingers of milkers. The methods of treatment and prevention are similar to those recommended for cow-pox. Since buffaloes wallow in marshy places care should be taken to see that the wounds are cleaned well and kept free form files. Attempts to develop a vaccine against buffalo-pox have not given encouraging results.

Symptoms

After an incubation period of 2 to 5 days there is some rise in body temperature; the animal develops pin-point red spots and papules of the size of mustard or sago which cab be felt by hand. Later, these papules coalesce into vesicles, Papules occurring on the udder are generally circular, but those on the teats are elongated. The lesions heal in the course of 15 to 20 days; the udder and the teats regain their normal appearance. In males, the disease is very often unnoticed, because the, being on the scrotum and inside of the things are often covered with dirt and consequently hidden from view.

Treatment, Prevention and Control

The lessons heal by themselves in the normal course and the adoption of special measures is not called for; only the usual rules of hygiene need to be observed. The lesions should be cleaned with a 1:1,000 solution of potassium permanganate followed by the application of an antiseptic ointment such as 1:110 boric acids. The affected animals should be isolated and milked by separate milkers. Milk from affected animals should be boiled before use. If the disease assumes serious proportions, vaccination may be undertaken by scarification in the perineum with calf lymph or with material collected from lesions from the anima.

BLACK QUARTER

Black quarter is an acute infection but a non-contagious disease characterized by inflammation of muscles, severe toxaemia and high mortality in cattle and sheep.

Transmission

In cattle the disease is confined to young stock between the age of 6 months and 2 years. Buffaloes usually suffer a mild disease. The outbreaks occur with a onset of rainy season. The cattle acquire infection from ingestion of organism and the ingested bacteria remain as dormant spores in tissues until predisposing factors stimulate the development of negative forms and rapid multiplication and formation of toxins.

Symptom

Sometimes animal may be die without showing symptoms. The most obvious sign in a crepitate swelling in hind- or forequarters crackles when rubbed due to gas in the muscle. The symptoms are fever, lameness and switching of the muscles of the affected region. Death usually occurs within 24 hours of the symptoms first observed. The affected region is hot and painful but soon becomes cold and painless, and there is crepitation due to gas. The skin over the affected area becomes dry, hard and dark. Sometimes the muscle of neck and back is affected in sheep; there is high fever and anorexia.

Treatment

Penicillin and tetracycline's if given promptly and inoculated into the site of lesion are of value and should be given in normal therapeutic dose. Sulphathiozole and antitoxicsera also effective.

Control

Hygiene and prophylaxis are the methods of control. Proper hygiene requires the destruction of carcases by burning, and cleaning and treatment of all wounds.

Active immunization of animals has proved to be effective. The vaccine used is formalized alum precipitated whole culture vaccine. It is a common practice to vaccinate animals before the onset of rainy season. In sheep vaccination prior to lambing or castration and docking is a useful precaution.

JOHNE`S DISEASE

Johne`s disease is a specific chronic contagious enteritis of cattle, sheep, goat, buffaloes and occasionally of pigs. The disease is characterized by progressive emaciation and in cattle and buffaloes by chronic diarrhea and thickening of the intestine.

Transmission

Under natural conditions the disease spread by ingestion of feed and water contaminated by the faeces of infected animals. The infection occurs mostly in the early month of life. The incubation period extends from 12 months to several years. The animal aged 3 to 6 years mostly suffer from the disease. Affected animals may not show clinical symptoms continue to discharge organisms in faeces. The organisms persist in pastures for about 1 year. The organisms are susceptible to sunlight, drying and high PH of soil; continuous contact of urine with faeces reduces the life of bacteria.

In cattle clinical signs appear mainly during 2-6 years of age. The infected animals which are apparently healthy often show clinical signs after parturition.

Treatment

The organisms are more resistant to chemotherapeutic agent's invitro than Mycotuberculosis. Because of this the practical utility of treatment in clinical cases is poor.

Control

The affected animal should be segregated and their faeces properly disposed off. Alive vaccines have been developed. It reduces the incidence of clinical disease. It consists of a non-pathogenic strain of Jhone`s bacillus with an adjuvant. The calves soon after birth are inoculated with vaccine subcontaneously. The vaccinated animals become reactors of Jhonin. Vaccination is generally done in heavily infected herds.