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Indigenous Goat Breeds

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Characteristics of Registered Indigenous Goat Breeds of India: An Overview

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Our traditional goat farmers have extensively practiced the art of selection and inbreeding for evolving definite breeds with specific or multiple functions. The country as a whole represents an important genetic reservoir of goat breeds for meat, milk, fibre and skin production. Some of these are well-known but more than half of the population is on non-descript type. The true productive potential of individual breeds has not been adequately documented. This has, in turn, affected a detailed description of the breeds, also their genetic potential and their more extensive use in development programmes. There are about 24 breeds of goats with specific characteristics. However, the majority of breeds are diverse and it is often difficult to classify them into breed groups for lack of descriptive data. Black and brown colours are common and dominant over white. There is very little differentiation between meat and milk breeds. As a general rule, breeding is uncontrolled. This is reflected in a large population of crossbred goats, a range of colours, ear and horn shapes etc. This is evident throughout the country, especially in extensive grazing situations. It is very essential that the great genetic reservoir that we possess is properly identified for individual breeds consistent with controlled breeding and definite production objectives. Increased contribution from goat is possible only with breeding better quality animals and improved management practices. Based on the region, Indian breeds of goats are classified into the following:-

(I) NORTHERN TEMPERATE REGION GOATS

The region comprises Jammu and Kashmir, Himachal Pradesh and Hilly tracts of Uttar Pradesh. The region has only 2.8% of the total goat population of the country including the pashmina production goats, Changthangi, Chegu and Gaddi. The characteristics of breeds are discussed below.

1. Changra or Changthangi

The Changra or Changthangi is found in the northern temperate Changthang region of Leh district in Jammu and Kashmir, which is one of the highest plateaus in the world. These goats are largely reared by a nomadic tribe called the 'Changpa'. Predominantly white and the rest are brown, grey and black. Undercoat white/grey; yields warm delicate fibre pashmina (cashmere, pashm). The Changra are also useful as pack animals. Body and legs are small, have strong body and powerful legs. Ears are small, pricked and pointed outwards. Horns are large turning outward, upward and inward forming a semicircular ring. Average live weight of buck is 20 and doe is 20 kg; average birth weight is 2.1 kg. Kidding is once a year, normally single; Average age at first kidding is 20 months.

2. Chegu

The Chegu breed is fairly widespread in

Himachal Pradesh. A few thousands are also found in Sikkim. Chegu goats are recognised for their multifarious utility as providers of quality meat (chevon), pashmina the valuable textile fibre, coarse fibre, manure, hide and skin, and milk to a limited extent. Coat colour is predominantly white but greyish red and mixed colours are also seen. Chegu goats are medium sized with small ears and horns which are bent upward, backward and outward. Average buck live weight of buck is 39 kg and doe is26 kg. Average birth weight is 2.0 kg. Kidding is once a year and mostly single. Average lactation yield is 69 kg and lactation length is 187 days. Used for draught to carry salt and small loads. Have long hair with under coat of delicate fibre below (cashmere or pashm). Legs are medium sized. Face and muzzle is tapering. Ears are Small. Horns are bent upward, backward and outward with one or more twists. Used for draught (pack) to carry salt and small loads.

3. Gaddi

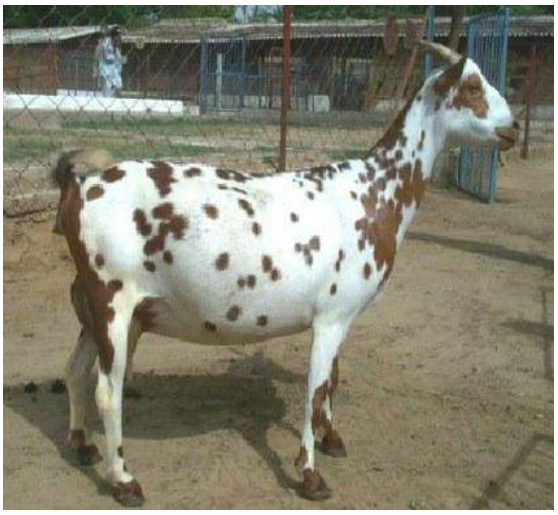
The Gaddi breed, also known as the White Himalayan, is distributed throughout Chamba, Kangra, Kullu, Bilaspur, Simla, Kinnaur and Lahaul and Spiti in Himachal Pradesh and Dehradun, Nainital, Tehri Garhwal and the Chamoli districts of Uttarakhand. They are well built and sturdy animals and have drooping and pointed ears with long pointed horns bending upwards and backwards. Kidding takes place once a year with single births. The hair is about 17-19 cm long and lustrous; one shearing yields ½ to 1 kg of wool. The meat is coarse and devoid of fat, and milk yield averages about 1.5 kg/day.

(II) NORTH WESTERN ARID & SEMI ARID REGION GOATS

The region comprises the states of Punjab, Haryana, Rajasthan and Gujarat including plains of U.P. and M.P. The region has the largest number of goats comprising 43% of the total goat population of the country. The characteristics of breeds are discussed below.

1. Barbari

The breed is a promising dairy type goat which has probably originated in the city of Barbera in British Somali land in East Africa. In India the breed is distributed at Etawah, Agra, Mathura and Aligarh districts of U.P. and Bharatpur district of



Rajasthan. In addition to being a good milkier it is highly prolific and generally give birth to twin and triplets. It is dwarf breed highly suited for stall-feeding conditions and hence generally found in the cities. Small animals with compact body. An adult female goat weighs between 25kgs to 35kgs, whereas an adult male goat ranges between 35kgs to 45kgs. The color of this breed is white

with light brown patches. Ears are short, tubular and erect. Both sexes have twisted horns, medium in length and directed upward and backward. Daily milk yield average about 750 ml to 1000 ml. Average lactation may be 130-200 kgs of milk in a lactation length of 150 days with a fat percentage of about 5. This breed have better reproductive capabilities. They will give, 2 to 3 kids in parturition. It may kid twice in a period of 12-15 months. Litter size' single 25%, twins 65%, and triplets 10%.

2. Beetal:

The Beetal is native to the districts of Gurdaspur, Amritsar and Ferozepur in Punjab. It is also known as Amritsari goat. Amongst native breeds, the Beetal is one of the heaviest dairy type goat breeds, well known for milk production and has largely been used in cross-breeding and other goat improvement programmes. The skin of these goats is considered to be of high quality because of larger size and yield finest leather such as Velour, Suede and Chamois for manufacturing clothes, shoes and gloves. Generally smaller than the breed of Jamunapari. Coat Colour is predominantly black or brown with white spots of distering size. The ears are long and flat, curled and drooping. Males usually possess beard. They are not so heavy in weight. Average birth weight 3 kg. An adult female goat ranges between 40kgs to 50kgs, whereas an adult male ranges between 50kgs to 70kgs. Age at first kidding 20-22 months. Average lactation yield 150 kg. They are having the ability to give, one kg to two kgs of milk per day. Maximum yield being 591.5 kg in a lactation period of 177 days. These goats are also adapted to stall feeding and thus preferred for intensive goat farming.

3. Gohilwadi

The Gohilwadi breed is concentrated in the north-west arid and semi arid regions in the Bhavnagar, Amreli and Junagadh districts of Gujarat.It derives its name

from Gohilwad which was a part of the Kathiawar region and was also the old name for district Bhavnagar. Gohilwadi goats are multipurpose animals and are reared for milk, meat and fibre production. The traditional keepers of this breed are the Rabari and Bharwar communities (also known as Maldharis). These are relatively large animals with a black coat covered with coarse long hair. The nose line is slightly convex. Ears are tubular and drooping; both bucks and does have slightly twisted horns, turned backward. Age at first kidding is around 20 months, with a twinning percentage of 40 to 50%. Milk yield is about 1.7 kgs per day and the average lactation period is 227 days.

4. Jakhrana

The Jakhrana breed is found in the north-west arid and semi-arid regions mainly in eastern Rajasthan. The breed derives its name from the Jakhrana and few surrounding village near Behror, of Alwar district of Rajasthan where it is found in its purest form. Animals are large and predominantly black with white spots on ears and muzzle. The breed is very similar to Beetal, the main contrast is that Jhakrana is comparatively longer. These goats are used mainly for milk production. Average daily milk yield varies from 2.0-3.0 kg for a lactation length of about 180-200 days. These are prolific. Kidding is mostly single but in 40% cases twins are given birth. The goats are also useful meat producers, and their skins are popular with the tanning industry.

5. Jamunapari:

The home tract and natural habitat is the Chakarnagar area of the Etawah district in the State of Uttar Pradesh, along the delta of the Jamuna and Chambal Rivers, and the Bhind district of the State of Madhya Pradesh along the Kwari River, east of New Dehli and not far from the

famous Taj Mahal at Agra. The Jamunapari is known as the best dairy goat in India. It is also the tallest breed and commonly known as the "Pari" in its area of origin-the "home tract"-because of its majestic appearance. Its coat colour is white with tan or black markings at neck and ears. They are beard in both sexes; have tuft of long hairs in the buttocks. It is largest and most elegant of the long-legged goats of India. It has pronounced Roman nose having a tuft of hair which results in parrot mouth appearance. Their horns are short and flat and horizontally twisting backward. Their ears are large and drooped downwards. An adult female weighs between 45kgs to 60kgs, whereas an adult male ranges between 65kgs to 80kgs. Average birth weight is up to 4 kg. Average age at first kidding is 20-25 months. They have large udder and big teats and average yield is 280 kg / 274 days. Average daily yield varies from 1.5 to 2.0 kg per day with a total lactation yield of about 200 kg. The fat content of the milk ranges between 3 to 3.5%.They thrive best under range conditions with plenty of shrubs for browsing. Usually doe kids once a year, giving birth to single in 57% while twins in 43% cases, They kid once a year.

6. Kutchi or Kathiawari

The Kutchi or Kathiawari, is an important dual-purpose (meat and milk) goat breed, native to the Kutch district of Gujarat. They are medium-sized animals. Average milk yield is around 2 kg/day under stall fed conditions and 0.5 to 1 kg on grazing resources. The lactation length is about 6 to 7 months. Generally there is one kidding annually with a twinning percentage of 11, which increases with supplementary feeding under stall fed conditions. The coat is predominantly black, but a few white spotted animals are also found. Ears are medium in size, floppy and drooping with typical white markings. The coat is shaggy and dull in appearance with medium to long coarse hair. The annual yield of hair is about 200 gms when shorn twice a year. Both sexes have short, thick horns pointed upward.

7. Marwari

The native tract of the Marwari goat breed is western Rajasthan the districts of Barmer, Jaisalmer, Bikaner, Jodhpur, Jalore, Pali and Nagaur. This is a dual purpose breed, reared for both mutton and milk, and is well adapted to the harsh environment of the Thar desert. The Marwari goat is a medium sized animal, predominantly black in colour. The hair covering is lustrous and The tail is small and thin. The udders are fairly well developed but small and round with small teats placed laterally. The milk yield varies from 0.5 to 1 kg when reared on grazing and from 2 to 3 kg under stall fed conditions. Kidding is primarily single births, with a twinning percentage of around 10%, which increases when the goats are kept under stall fed conditions and given supplementary feed. The thick hair protects the animal from the extremes of temperature found in this region. The hair is used to weave traditional harnesses for camels, and also carpets and bags, the latter used by potters. The male has a thick beard. The ears are small and flat, carried on a small head. Both sexes have short pointed horns, directed upward and backward.

8. Mehsana

The Mehsana is a dual purpose breed and is mainly found in the Mehsana,

Banaskantha, Gandhinagar and Ahmedabad districts of Gujarat. The Mehsana is a large sized breed. The colour of the coat is black with white spots at the base of the ear. The Milk yield averages one kg/day. The litter size is mostly single. Average yield of hair per goat per year is 200 grams. Hair coat is long and coarse. Ears are always white. Both sexes have twisted horns curved upward and backward. The udder is moderately developed having large and conical teats.

9. Sirohi

The Sirohi breed is native to the Sirohi district of Rajasthan where its purest form is found. It is now fairly widespread in the neighbouring district of Udaipur and also in the districts of Nagaur and Ajmer. The breed is also known by other names such as Devgarhi, Parbatsari, and Ajmeri. Sirohi goat are dual-purpose animals, which are reared for both milk and meat. Coat colour is brown, white, and admixture of colours in typical patches; hair coarse and short. Compact and medium sized body. Ears are flat and leaf like, medium sized and drooping. Both sexes have small horns, curved upward and backward. Tail twisted and carries coarse pointed hair. Horns are small and pointed, curved upward and backward. Average body weight of buck is 50 and doe is 23 kg. Average birth weight is 2.0 kg. Kidding is once a year, twins are common. Average age at first kidding is 19-20 months. Average lactation yield 71 kg. Average lactation length 175 days. The animals are popular for their weight gain and better lactation even under poor quality rearing conditions. The animals are resistant to major diseases and are easily adaptable to different climatic conditions. Though the main breeding tracts of Sirohi goat are situated in the Aravalli hills of Rajasthan, they are also widely distributed in several other Indian states. The kidding is 90% single and 10% twins. The lactation can last for 90 days and average to 0.75–1 kg/day for a good does.

10. Surti

The Surti breed is traditionally found in the Surat and Vadodara districts of South Gujarat. The white goat is distributed in Surat and Baroda.

The breed is know to be a good dairy breed and is good for maintenance under complete confinement and stall feeding conditions. Medium sized breed, white in color with highly developed udder. Ears are medium in size. Both sexes have small horns directed backward. The breed is unable to walk long distances and is stall feed. They are most economic to rear as they can live on leaves or on food waste thus brings higher feed efficiency ratio. The breed is a good milk

producer, yields on an average of 2.0 kg per day. by crossing with Sannen it has resulted high potentiality of milk yield.

11. Zalawadi

Zalawadi goats are native to Gujarat. They are large animals. The coat is black and comprises long coarse hair. Ears are long, wide, leaf-like and drooping. Both sexes have long twisted horns, pointed upward. The kidding percentage is 78% and the litter size is mainly single (82%) and sometimes twins (18%). The average daily milk yield is 2 kg and the lactation period is about 200 days. The average annual yield of hair is 245 gms.

12. Pantja

Pantja goat is reared for meat and milk in Udham Singh and Nainital districts of Uttarakhand and adjacent Tarai area of Uttar Pradesh. These goats are well adapted to humid condition of Tarai region. Twining is common in Pantja goat.

(III) Southern peninsular region

The region comprises the states of Maharashtra, Karnataka, Andha Pradesh, Tamil Nadu, Kerla and some territories in the central area. It has about 30% of the total goat population of the country comprising Attappady Black, Berari, Kanni-Adu, Konkan Kanyal, Malabari, Osmanabadi, Sangamneri . The characteristics of breeds are discussed below.

1. Attappady Black

The Attappady Black breed is native to the Palakkad district of Kerala. The economy of this region, home to the Irula,

Muduka and Kurumba tribal communities, is primarily dependent on goat rearing and some agricultural activities. This local goat breed evolved and developed by tribal communities in the region, is medium sized, lean and slender bodied and black in colour. They have bronze coloured eyes and black horns with curved backward oriented tips. The ears are black and pendulous and the tail is curved and bunchy. Attappady goats are poor milk producers and are reared mainly for meat. The birth weight of males and females is around 1.73 kg and 1.60 kg respectively.

2. Berari

Berari goats, also known as Lakhi and Gaorani.

They are found in the Vidarbha region of Maharashtra and in the Nimar region of Madhya Pradesh. Berari goats derive their name from the erstwhile 'Berar' region. As a unique feature, animals have light to dark strips on lateral sides from horn base to nostrils of face. The breed is primarily raised for meat by local farmers. The coat colour is light to dark tan. Thigh hair, eye brows and nostrils are tan to black in colour. The horns and ears are flat, leafy and drooping. The head is convex shaped with a slightly roman nose and with light or dark stripes on the lateral sides extending from the base of the horn to the nostril. Berari goats have a black hair line along the vertebral column extending up to the tail. These goats show good prolificacy, with the litter size ranging from single kids to four kids. Twinning is common. Milk yield for farm reared goats is about 43 kg in a lactation period of 123 days.

3. Kanni-Adu

The Kanni-Adu breed is found in Tamil Nadu in south India. They are also known locally as Pullaiadu and Karapuadu. These are the tallest goat breeds found in Thirunelveli and Ramanadhapuram districts of Tamilnadu. Black or white spots in the black background are the characteristics colors of this breed.

The ears are medium long, males are horned and females are polled. The tail is medium-sized and thin; the udder is small and round, with small teats placed

laterally The Kanni-Adu is maintained primarily for meat and is not milked. The adult females of this breed ranges from 25kgs to 30kgs and the adult males ranges from 35kgs to 40kgs in body weight. They are having ability to give birth to 2 to 3 kids. They grow well in the draught regions.

4. Konkan Kanyal

Konkan Kanyal goats are native to the Konkan region of Maharashtra, and are reared mostly by the Dhangar and Maratha communities for meat. Konkan Kanyal goat is meat type breed adapted to high rainfall and hot and humid climate of Konkan region of Maharasthra. These goats are mainly black with a white marking in a specific pattern the ventral surface of the body is white and the legs have white 'stockings'.

Konkan Kanyal goats have bilateral white strips from nostrils to ears; a flat and broad forehead; flat, long drooping ears; backward, straight, pointed, cylindrical horns; white muzzle and long legs, laterally black, medially white from knee to the fetlock joint. The body weight of adult bucks and does averages 35 and 30 kg respectively. Konkan Kanyal goats are regular breeders and breed round the year, with a twinning percentage of about 66%.

5. Malabari

Malabari also known as Tellicherry or Cutch are native to Kerala. Malabari goats are reared for milk and meat and their skin is popular in the tanning industry. The animals are medium in size. They have no uniform colour and the coat varies from completely white to black. All males and a small number of females are bearded. They have a medium sized head with a flat and occasionally a Roman nose with medium sized ears directed outward and downward. Malabari goats are reared under a semi-intensive management system, with 4 to 6 hours of grazing supplemented with stall feeding in the evening. The breed is quite prolific

and has a 50% twinning, 25% triplets and 5% quadruplets kidding percentage. The milk yield ranges from 0.5 to 1.5 litres a day with an average of 90 kg in a lactation period of 178 days.

6. Osmanabadi

Osmanabadi goats are native to the Latur, Tuljapur and Udgir taluks of Osmanabad district of Maharashtra, from where they derive their name. They are also fairly widespread in Karnataka, and the Nizamabad district of Andhra Pradesh. The goats are large in size. Coat colour is predominantly black; white, brown and spotted occur. Long and short-haired type, based on presence or absence of long hair on the thighs and hind quarters.

Tall and large size body and legs. Average birth weight 2.4 kg. Kidding is once a year. Average age at first Kidding19-20 months. It has good quality meat. Average daily milk yield varies from 0.5 to 1.5 kg for a lactation length of about 4 months. Average milk yield 170-180 kg per lactation. In favourable conditions they breed regularly twice a year and twinning is common.

7. Sangamneri

The semi arid region of Maharashtra comprising of Nasik, Ahmednagar and Pune districts forms the native habitat of the Sangamneri goat breed. The breed derives its name from the Sangamner Tehsil of Ahmednagar District. They are medium-sized animals. The coat is completely white with mixtures of black and brown. Ears are long and drooping. Both sexes have horns directed backward and upward.

The litter size is mainly single however 15 – 20% goats show twinning whereas triplets are rare. The average daily milk yield varies between 0.5 to 1.0 kg with an average lactation length of about 160

days. Although this breed is reared mainly for meat, some animals show a good milch potential. Dressing percentage[1] is about 41% at 6 months, 45% at 9 months and 46% at 12 months of age.

(IV) EASTERN REGION

The region comprises the states of Bihar, West Bengal, Orissa, Assam, Meghalaya, Arunachal Pradesh, Mizoram, Manipur, Tripura, Nagaland and Sikkim. The region represents only 25% of the goat population of the country. Major breeds are Black Bengal and Ganjam.

1. Black Bengal

The Black Bengal is found in the eastern region of India, in the states of West Bengal and adjoining areas in Jharkhand, Bihar and Orissa, Assam, Mizoram and

Tripura, with a few numbers found in Jammu and Kashmir, Himachal Pradesh and Punjab. Coat colour is predominantly black, brown/grey and white with soft, glossy and short hairs. Dwarf in body size, legs short, straight back; both sexes are bearded. Average live weight of buck is 15 kg and doe is 12 kg. Most prolific among the Indian breeds. Multiple births are common - two, three or four kids are born at a time. Kidding is twice a year. Average litter size is 2.1. Average age at first kidding 9-10 months. Average lactation yield is 53 kg. Lactation length is 90 to 120 days. Its skin is in great demand for high quality shoe-making. The meat is excellent and palatable. Milk yield is low and is barely sufficient to feed the kids. Skin of the Black Bengal goat is used for making chamois leather a highly valued specialty leather.

2. Ganjam

The Ganjam breed, also known as Dalua, is found in eastern India, primarily in the Gajapati, Rayagada and Koraput districts of Odisha. A small number are also found in Sikkim. They are tall, leggy animals.

The coat may be black, white, brown or spotted, but black predominates. The hair is short and lustrous. Ears are medium sized and both bucks and does have long, straight horns, directed upward with a medium-length tail. The kidding percentage is 82 and the litter size is primarily single (98.4%). Kidding takes place once a year. Milk yield is about 3 kgs a day and the average lactation period is 150 days.

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In Vitro Production of Bovine Embryo: An Overview

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Abstract

In vitro production of bovine embryo has considerable potential value in disseminating genetic improvement and shorting the generaion interval as compared to programme based on progeny testing. Embryos of high genetic quality can be obtained from oocytes collected from slaughtered house ovaries or from donors of high genetic quality by ultrasound guided follicular aspiration. In vitro maturation (IVM), in vitro fertilization (IVF) and in vitro culture (IVC) of bovine oocytes are valuable tools that can be easily applied for both research and agricultural purposes. Because of low efficiency of superovulation and high cost of FSH, in vitro embryo production (IVEP) technology has been researched in the last decade as an efficient alternate to in vivo system. It also offers new dimension in research and development for further application in the genetic improvement of farm animals. The efficiency of IVF in buffalo is much lower than that in cattle. Despite technological progress in the last two decades, the practical application of in vitro fertilization technology (IVF) is still less than anticipated because of low efficiency and high cost.

INTRODUCTION

In vitro embryo production (IVEP) is a reproductive biotechnology that has great potential for speeding up genetic improvement in cattle. The *in vitro* production and storage of gametes and embryos with high competence to development is the key of success for several technologies including transgenesis and assisted reproduction. The IVEP is preferred over *in-vivo* generation due to availability of large number of embryos & conveniency (Madan *et al*., 1991). Due to limitation of repeated induction of superovulation, the OPU (Ovum pick up) at frequent intervals in combination with IVF-IVC is providing as a more efficient method of producing embryos from selected donors (Devaraj, 2006). Some commercial applications of *in vitro* fertilization technology have included efforts to: (1) upgrade the productive and genetic performance of animals; (2) to overcome infertility of valuable high yielding animals; (3) to produce transgenic and cloned animals; (4) provide a source of sexed embryos; (5) for twin production in beef cattle; and (6) at the molecular level, the technique is used to elucidate events

related to maturation, fertilization of oocytes and development of embryos.

***In vitro* production of Bovine Embryo:**

Major steps involved in *In vitro p*roduction of bovine embryo are oocyte recovery, *In vitro* maturation of oocyte, *In vitro* capacitation of spermatozoa, *In vitro* fertilization and *In vitro* embyo culture.

1. Oocyte Recovery:

Various methods of retrival of oocytes from slaughter house specimens like aspiration of oocyte from surface of follicle, collection of oocyte after isolation of individual follicle and slicing of ovary have been developed (Chauangsoongneon and Kamonpatana, 1991). Higher numbers of oocytes were recovered per ovary by slicing method (Dutta and Goswami, 1998). Laproscopy, endoscopy and transvaginal ultrasound guided follicle aspiration (TUGA) technique can also be used to recover oocytes from live animals (Pieterse *et al.,*1988). TUGA is less dependants on the reproductive status of the donor, with use of TUGA oocytes can be harvested from juvenile animals and pregnant animals in the first 3 months of pregnancy, but the success in term of available follicles and quality of oocytes was low (Munjunatha and Devaraj, 2006).

2. ***In vitro* maturation of oocyte:**

Oocytes with compact multilayered cumulus cells and evenly granulated cytoplasm are selected for *in vitro* maturation (Albertini *et al*., 2001). Prolonging bovine sperm-Oocyte incubation in modified medium-199 improves embryo development rate & the viability of vitrified blastocyst (Nedambale *et al.*, 2006). Most widely used complex media for *In vitro* maturation is Tissue Culture Medium- 199 (TCM-199) with Earle's salt, L-glutamine and 25 mM HEPES supplemented with 10-20% heat inactivated serum. Ham's F-10, Ham's F-12, CR1aa, MEM- Minimal Essential Medium, Synthetic Bovine Oviductal Fluid medium are also used as complex media for IVM. Medias are also supplemented with fetal calf serum (FCS), estrus cow serum (ECS), new born calf serum (NBCS) (Gandhi *et al.,* 2000), superovulated cow serum (SCS), anoestrus cow serum (ACS) or bovine serum albumin (BSA) like ingredients as well as hormones like pituitary FSH and/or LH (gonadotrophins) with estrdial-17â either alone or in combination or with extra gonadotropin hormones like human chorionic gonadotrophins (hCG) or equine chorionic gonadotropin (eCG) are also used. Some laboratories also prefer to add growth factors like epidermal growth factor (EGF) (Nedambale *et al*., 2006), EGF plus fibroblast growth factor (FGF), insulin like growth factor (IGF), insulin, transferrin sodium selenite (ITS) (Galli *et al*., 2001) etc. for improvement of maturation *in vitro*. An *In vitro* maturation rate of 85% has been reported in TCM-199 with steer serum 10% and PMSG-40 IU/ml (Ravindranath *et al*., 2003).

3. *In vitro* capacitation of spermatozoa:

Sperms used for fertilization should pass through process of capacitation. Capacitation leads to an acrosomal reaction which causes a release of acrosomal enzymes needed for penetration of different layers of ovum during

fertilization. For capacitation frozen semen is used and Percoll based separation system is the most common method for isolating the motile sperm fraction after thawing (Galli *et al.,* 2003). Although other systems can also be used like swim-up, simple centrifugation but separation through a Percoll gradient offers the consistency, flexibility and reliability as well as it reduces the polyspermy – major cause of IVF failure (Mermillod *et al*., 1990). Sperm can be artificially capicited by High ionic strength media (Brackett *et al*., 1982), High pH, Glycosamine glycan such as Heparin (Numbe *et al.,* 2001), Bovine follicular fluid, Calcium ionopore, Caffeine and pentoxyphylline (Numbe *et al.,* 2001), Caffeine and Theophylline (Chauhan *et al.,* 1998), Mixture of penicillamine, hypotaurine and epinephrine (PHE) as well as by Bovine Serum Albumin.

4. *In vitro* fertilization:

Buffalo oocytes matured *in vitro* are generally fertilized with frozen-thawed *in vitro* capacitated spermatozoa in Tyrode's Albumin Lactate Pyruvate (TALP) medium or a SOF (Synthetic bovine Oviductal Fluid) based medium both without glucose and with varying concentration of heparin (Galli *et al*., 2003). Fert-CDM medium with non-essential amino acids (Lu and Seidel, 2002) is also used for incubation medium. An *in-vitro* fertilization rate of 60-80% has been reported in both BO medium and HEPES- TALP medium (Misra, 2005). Suthar (2008) used m-TALP and m-SOF medium for *in vitro* fertilization and found 64% fertilization rate in eight HF x Sahiwal crossbred cows.

5. *In vitro* embyo culture:

Several protocols have been developed and applied for embryo culture. They include various co culture and cell-free systems and also the *in vivo* culture procedure in the surrogate sheep and rabbit oviduct. In IVC the TCM-199 is supplemented with serum and oviductal cells of Ovine or Bovine origin is used. The evaluation and selection of embryos for transfer or freezing is conducted on Day 7. By this time normally developing embryos should have reached at least the early blastocyst stage (Galli *et al*., 2003). Much research is still needed in domestic animal on mechanisms controlling embryo development and on development of totally *in vitro* system for embryo culture.

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Biosensor:

An Active Molecule Used In Day To Day Life

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The term biosensor is used in the literature in many ways, some definitions are:

- A device used to measure biologically derived signals.
- A device that "senses" using "bio-mimetic" strategies (imitative of life), e.g. artificial nose
- A device that detects the presence of biomolecules.

According to IUPAC (1996), "A self-contained integrated device which is capable of providing specific quantitative or semi-quantitative analytical information using a biological recognition element which is in direct spatial contact with a transducer element". Many diagnostic kits are available for rapid and sensitive tests like pregnancy test (detects the hCG protein in urine), glucose monitoring device, infectious disease diagnosis, oestrous detection and therapeutic drugs in livestocks. Professor Leland C Clark (1918–2005) is known as father of biosensor.

TYPES OF BIOSENSORS

Biosensors can be grouped according to their biological element or their transduction element. Biological elements include enzymes, antibodies, micro-organisms, biological tissue, and organelles. The method of transduction depends on the type of physicochemical change resulting from the sensing event. Often, an important ancillary part of a biosensor is a membrane that covers the biological sensing element and has the main functions of selective permeation and diffusion control of analyte, protection against mechanical stresses and support for the biological element. There are five types of biosensors as given below:

1. Calorimetric Biosensor
2. Potentiometric Biosensor
3. Electrochemical Biosensor
4. Optical Biosensor
5. Piezo-electric Biosensor

1. CALORIMETRIC BIOSENSOR

Calorimetric transducers measure the heat of a biochemical reaction at the sensing element. Isothermal calorimeters maintain the reaction cell at constant temperature using Joule heating or Peltier cooling and the amount of energy required is measured. Heat conduction calorimeters measure the temperature difference between the reaction vessel and an isothermal heat sink surrounding it. Using highly conducting materials ensure quick heat

transferred between the reaction cell and the heat sink. Finally, the most commonly used is the isoperibol calorimeter that also measures the temperature difference between the reaction cell and an isothermal jacket surrounding it. This calorimeter has the advantage of being easily coupled to flow injection analysis systems.

2. Potentiometric biosensor

The change in distribution of charge is detected using ion-selective electrodes, e.g. pH-meter.

3. Electrochemical biosensor

Amperometric and potentiometric transducers are the most commonly used electrochemical transducers. In amperometric transducers, the potential between the two electrodes is set and the current produced by the oxidation or reduction of electroactive species is measured and correlated to the concentration of the analyte of interest. Most electrodes are made of metals like platinum, gold, silver, and stainless steel, or carbon-based materials that are inert at the potentials at which the electrochemical reaction takes place. However, because some species react at potentials where other species are present, either a selective membrane is used or an electron mediator that reacts at lower potential is incorporated into the immobilization matrix or to the sample containing the analyte. Electrochemical DNA Biosensor involved three steps:

- Formation of the DNA recognition layer
- Actual hybridization event
- Transformation of the hybridization event into an electrical signal

4. Optical biosensor

Fiber optic probes on the tip of which enzymes and dyes (often fluorescent) have been co-immobilized are used. These probes consist of at least two fibers. One is connected to a light source of a given wave length range that produces the excitation wave. The other one is connected to a photodiode, detects the change in optical density at the appropriate wavelength. Surface plasmon resonance transducers, which measure minute changes in refractive index at and near the surface of the sensing element, have been proposed. Other optical biosensor like colorimetric for color, which measures change in light adsorption. Photometric for light intensity, which measures photon output for a luminescent or fluorescent process can be detected with photomultiplier tubes or photodiode systems.

5. Piezo-Electric Biosensors

Piezo-electric devices use gold to detect the specific angle at which electron waves are emitted when the substance is exposed to laser light or crystals, such as quartz, which vibrate under the influence of an electric field. The change in frequency is proportional to the mass of absorbed material.

BASIC CHARACTERISTICS OF A BIOSENSOR

1. **Linearity:** Linearity of the sensor should be high for the detection of high substrate concentration.
2. **Sensitivity:** Value of the electrode response per substrate concentration.
3. **Selectivity:** Chemicals Interference must be minimized for obtaining the correct result.
4. **Response time:** Time necessary for having 95 per cent of the response.

Application of biosensor in livestock

Biosensors are used in many fields, out of which some areas where it indiscriminately used are given below;

- Food analysis like meat adulteration
- Study of bio-molecules and their interaction
- Drug development and antibiotic resistance of microorganisms
- Crime detection
- Disease diagnosis (both clinical and laboratory use)
- Environmental field monitoring
- Industrial process and quality control
- Detection systems for biological warfare agents
- Manufacturing of pharmaceuticals and replacement organs

Biosensors used in poultry industry

Poultry are frequently infected by bacterial infection like Campylobacter spp. and the pathogen is rapidly spreaded between rearing mates in the broiler chicken shed. Most threatened outbreak in poultry industry is caused due to viral disease like avian influenza. Now-a-days biosensor is commonly used to detect the bacterial infection and multiple strains of avian influenza virus. Biosensor is also used detect and measure harmful levels of antibiotics in food, so the farmers overdose their poultry with antibiotics to keep them healthy.

Biosensors on the nanoscale

- Molecular sheaths around the nanotube are developed that respond to a particular chemical and modulate the nanotube's optical properties.
- A layer of olfactory proteins on a nanoelectrode react with low-concentration odorants (SPOT-NOSED Project). Doctors can use to diagnose diseases at earlier stages.
- Nanosphere lithography (NSL) derived triangular Ag nanoparticles are used to detect streptavidin down to one picomolar concentrations.
- The School of Biomedical Engineering has developed an anti-body based piezoelectric nanobiosensor to be used for anthrax, HIV hepatitis detection.

CONCLUSIONS

The recent trend towards integrated and automated instruments based on bioassays has had an extraordinary impact on the speed and efficiency with which analytical and diagnostic measurements can be made. Bioassays are methods by which one may determine the absolute or relative concentration of a specific biomolecule in a sample; the target molecule is called the analyte. One of the major driving forces for the development of biosensors is biomedical diagnosis. The most popular example is glucose oxidase-based sensor used by individuals suffering from diabetes to monitor glucose levels in blood. Biosensors have also found potential applications in the agricultural and food industries. However, very few biosensors have been commercialized.

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Hydroponics Technology:

An Alternative to Conventional Method of Green Fodder Production

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The term hydroponics originates from the ancient Greek "hydros," meaning water, and "ponos," meaning work. It can sometimes be mistakenly referred to as aquaculture, or aquiculture, but these terms are really more appropriately used for other branches of science that have nothing to do with gardening. The major constraints in production of green fodder are decreasing land size for fodder cultivation, scarcity of water, more labor requirement, and non-availability of same quality green fodder round the year, requirement of manure/fertilizer and natural calamities. Feed alone constitutes 60-70% of milk-production cost. So the need of the hour is to find some fodder alternative so that the ever increasing pressure on land reduces but without compromising with the fodder production.

HISTORY OF HYDROPONICS AND SOIL-LESS GARDENING:

During the 10th and 11th centuries, the Aztecs developed a system of floating gardens based on hydroponics. Driven out of their land, they settled at Lake Tenochtitlan. Unable to grow crops on the lake's marshy shore, they built rafts out of reeds and roots. These rafts were topped with a bit of soil from the bottom of the lake, and then floated out to the center of the water. Crops would grow on top of the rafts, their roots reaching through the rafts and down into the water. Marco Polo's writings indicate he witnessed similar floating gardens while visiting China in the late 13th century. In 1699, another English scientist, John Woodward, performed tests involving spearmint growth in various water solutions. He attempted to grow spearmint plants in rain water, river water and water that had been mixed with soil and then drained. He found that the mint grew faster and produced healthier plants in the water solution that had been mixed with soil. His conclusion was that plants would grow better in less pure water than they would in distilled water. We know today that his results were due to minerals

that remained in the water after it had been mixed with the soil.

WHAT IS HYDROPONICS?

Hydroponics is the science of soilless growing of plants nutrient rich solutions with very little water. It is a technique where the physiological requirements of plants can be met without use of soil or natural sunlight. Hydroponics techniques have proven it to be very useful and efficient for producing food for livestock. The food that is available is free from undesirable materials such as weeds, insects, dust, insecticides, germicides, carcinogens.

Requirements:

- Greenhouse unit (for growth of fodder)
- Control unit (for regulation of light)
- hydroponic system can also be set up on the low cost devices or shade net structure
- Last but not the least seeds are required. Studies have been conducted on use of this technique for production of barley, oat, wheat, maize, sorghum, alfalfa, and cowpea.

Inside the green house there is framework of shelves on which metal or plastic trays are stacked. Shelves contain a number of rows, in which trays containing soaked seeds are accommodated. For barley and maize soaking period is of 4 hours. Farmers can also practice soaking of maize seeds by putting them in gunny bag which is made wet and kept for 1-2 days. To maintain the green house humidity pipes containing micro-foggers are fitted just above the trays for water fogging. Generally watering is required twice a day. A cow, which yields 15 litres of milk, can be given 25 kg of hydropincs fodder, 10 kg of conventional green fodder and 5 kg of straw per day. It can result in saving 20-25% of feeding and working cost. Milk production increases by 1 to 3 liters per cow; in terms of quality also there is an increase of 0.3 percent in fat and 0.5 per cent in SNF, fetching better prices for the farmers (a study by Kerala Veterinary and Animal Sciences University).

Hydroponics and Its Types

Plants' roots are hold in the substrate that does not have any impact on the plants nourishment.

Sometimes there is no substrate at all. In hydroponics there are a few dozens of hydroponic systems that can be categorized in six main types:

1. Wick system
2. Deep water culture
3. N.F.T system
4. EBB & Flow system
5. Drip System
6. Aeroponics

1. Wick system:

This type is the most simple hydroponics system. It belongs to the so called passive systems and is based on the capillary force that does not require any mechanism. Nourishment is delivered to the roots with the help of wicks going from the tank to the substrate (Picture 1). Thus, different materials can form the substrate. Among them there are coconut fiber, pearlite layer, vermiculite etc. This system is used for the ornamental gardening with normal soil (one end of the wick is placed into the

water or special solution and the other one is in the pot with soil). This system has one and rather important drawback: it works only for relatively small plants. Big and hygrophilous plants need more nutrient solution than they can get from filters. I In such cases the plants are grown with the help of another system. Due to this disadvantage wick systems are not very wide spread.

2. Deep Water Culture:

This is the most simple hydroponics system. The plants are fixed on the platform that is often made of foam plastic (Picture 2). This platform drifts in the tank filled with nutrient solution. Plants roots are constantly placed in water to obtain enough oxygen. The aeration of the nutrient solution is done with the help of a special pump. The solution is changed on a regular basis.

This system is ideal to cultivate small fast-growing plants that need a lot of liquid (for example salad). But it is not suitable for big longstanding ones. To grow a big plant, a modified version of this system was invented. It is called the J-Racks system (or the fixed-platform system). In his case the platform is attached to the tank with nutrient solution and special racks are fixed to support the plants (for example tomatoes). This type of hydroponics systems is suitable to acquire first experience and skills in hydroponics.

3. N.F.T. System:

The nutrient solution is transferred from the tank to the container where the plants are fixed in small plastic cups with holes for roots to grow. The nutrient solution is delivered with the help of a pump. The solution gets to the roots and then drops back into the tank. The flow is either maintained constantly or switched on automatically within small time periods. The roots are in touch with a thin layer of the nutrient solution that is constantly on the tank bottom. Roots receive enough oxygen due to humid air above the nutrient solution. In such type of hydroponics solution you will not need the timer for the pump. There is no substrate used except for air what helps to keep it cheap. The main disadvantage of this system is the sensibility for power shortage or pump breakdown. In case of the lack of electricity roots start drying almost immediately.

As a solution autonomous energy sources are used (batteries) as well substrates to prevent roots from drying.

4. EBB & Flow System:

Nutrient solution is delivered to the roots in the substrate (haydite, pearl-stone, gravel, coir etc) and then it flows over into the tank. The process is automatic as the pump is connected to the timer. When the timer is on the pump starts delivering nutrient solution to the roots. When it is off the solution gets into the tank by itself (Picture 4). After all the solution is gone into the tank the roost are aired. The flooding is done a few times a day that depends on the culture and the substrate type. The disadvantage is hidden in the energy shortage and the pump breakdown. In case of breakage plants can die if haydite or likewise substrates are used (the ones that do not hold liquid properly). That is why it is advisable to use substrates that hold moisture well (coir, vermiculite etc).

5. Drip System:

This is the most popular hydroponics system. The timer operated pump delivers nutrient solution that goes through pipes and drips at the root of each plant. Plants roots are placed in the substrate (Picture 5). It is possible to use separate pots to make it easier to remove, to change or to withdraw plants. There are two types of the Drip system:

a) Recovery Drip System

The overage flows back to the tank and is reused. You will not need an accurate water management plan so you can resort to a simple timer. Nevertheless you should keep an eye on acidity level and the solution composure.

b) Non-Recovery Drip System

The solution is not used twice. That is why the timer is to be set thoroughly. It should be more accurate to avoid any overage to prevent roots from rotting. This system requires less time for maintenance since the pH level and the nutrient balance remain the same thus making it unnecessary to check it. As all other active systems this method is vulnerable to energy shortage as well as pump and timer breakdown. Besides pipes can get clogged.

6. Aeroponics:

Aeroponics is the most state-of-art hydroponics system. The plants are fixed on the top of the container. They are hung and their roots are in the air. Inside the container there are sprays that are activated by the timers and the pump. Sprays regularly shower the roots with nutrient solution (the time interval is calculated on the basis of the time required for absorbing). Thus roots are constantly in a mist of oxygen and nutrient solution. High aeration encourages shorter periods for growing. In hydroponics it is very important to set up the timer correctly. It will maintain a short cycle and switch on

the pump for a few seconds every minute. The system disadvantage is the roots drying in case of energy shortage or timer and pump breakdown.

AS A FEED FOR DAIRY ANIMALS

Advantages:

- Through hydroponic gardening; plants can be grown anywhere as long as their growth requirements are met.
- It uses only 1/20th of water compared to traditional (soil based) gardening.
- It provides a sterile environment for plant production. This technique does not require pesticides, fertilizers and other chemicals, as there's no chance of damage due to soil-borne diseases or pests.
- Crops grow two times faster in hydroponic gardening. It provides controlled environment, and yield is doubled leading to more production from same amount of space.
- It needs 20% of less space in comparison to soil based gardens, as plants with small roots can be grown closer to each other.
- Run-off in traditional gardening can lead to environment degradation due to high proportion of calcium, phosphorous and potassium content dissolved in it. But in hydroponic systems; water can be reused multiple times leading to water conservation with less expense incurred on it.
- There's no-doubt in the fact that hydroponics involves less labor. Upkeep is also minimal.
- It's simple to get complete control over nutrient balance by using solutions like Olivia's Growing Solution.
- There are no soil setup and testing hassles.
- Plants grown through this technique are healthy and have better nutritional value. It has been proved that vitamin content is 50% more in hydroponically grown plants as compared to conventional ones.
- It is easy to harvest in this type of gardening.
- There are no worries about the changing seasons, as crops can be grown all year round.
- Hydroponic gardening is amazingly stress-relieving and a relaxing hobby. Moreover it is a great way to spend quality family time.

Disadvantages of Hydroponic Gardening:

- Initial set up cost of hydroponic system is high. It requires constant supervision.
- These gardens can also become susceptible to power outage; in this case plants will dry out. If this ever happens, you have to manually water your garden.
- Water-based microorganism can be easily introduced.
- Technical knowledge is required for growing plants through hydroponics.

There are numerous benefits of hydroponic gardening. Its practice can yield excellent results in short span of time with proper knowledge and techniques. Various environmental concerns, reduction in arable land, and scarcity of water can be easily conquered with the use of hydroponics. It is extremely beneficial for commercial farmers and home gardeners alike.

CONCLUSION

Hydroponics technology can be a real alternative source to overcome the scarcity of the fodder and is able to provide animals

with nutrient rich fodder in highly acceptable form. Burden on land holdings is decreased along with reduced labor input. Farmer is able to meet the fodder requirements without being dependant on climatic factors and enabling him to have fodder 365 days of year. This sustainable fodder has huge ecological and economical advantages to farmer. The technique requires an initial setup which must be built as explained by trained personnel. So availability of a technical trained person is of utmost priority as farmers can consult him/ her for their queries. Farmers interested in this technique must undergo a brief training regarding the maintenance of setup and daily operations to be carried out. This will ensure sound skill development in farmers which in turn will lead to more profitable business. Once the setup is established, hydroponic fodder production is cost effective and economically viable with low running cost. This technique can be beneficial where there is densely populated area with less cultivable land and when the farmer intends to have maximum livestock production using minimal land.

Need For Conservation of Indigenous Germplasm

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The complete set of genetic material of any plant/animal species are defined to its germplasm. These resources may take the form of seed collections stored in seed banks, trees growing in nurseries, animal breeding lines maintained in animal breeding programs or gene banks etc. Germplasm collections can range from collections of wild species to elite, domesticated breeding lines that have undergone extensive human selection.

WHAT IS & WHY?

Plant and animal genetic resources are the most important primary materials needed by breeders and farmers to develop new crop varieties and animal breeds. Development efforts have long neglected animal genetic resources and their long-term conservation for the good of rural populations and the international community. The past two decades have seen an overall decline in development funding for rural areas. But recently, the Millennium Development Goals (which include halving world hunger and malnutrition by 2015) have refocused interest on rural areas. There has been a similar revival of interest in the conservation of livestock breeds. They are dying out be- cause of crossbreeding, the expansion of intensive agriculture and of wild- life reserves, changes in the economy, and other factors. The Interlaken Conference held in Switzerland in 2007 (FAO, 2008) noted that livestock diversity is decreasing at an accelerated pace, with many breeds being lost throughout the world. It concluded that local livestock diversity in developing countries represents a unique resource for productivity and provides a major pathway out of poverty, and adopted the Interlaken Declaration and a Global Plan of Action for animal genetic resources (AnGR). Currently, about one-fifth of the world's 7,616 breeds of domestic livestock are at risk of extinction and most of the endangered breeds are in developing countries (Sere, 2010). Conserving livestock breeds is possible only if (a) the breeds are first identified and adequately documented, and (b) if the communities which keep the animals participate fully in conservation efforts. Crossbreeding of native cattle for increase milk production has been advocated as a breeding policy across the country. As a result, some

In Indian condition following classification will be suggested

Table-1 Criteria for classification of a breed

Status	Population size	No. Of breeding females
Normal	Population is not in danger zone. No visible changes are seen in population size	More than 25,000
Insecure	Population numbers are decreasing rapidly.	15000-25,000
Vulnerable	Some disadvantageous effects on the existence of the population. Prevent further decline in number.	5000-15000
Endangered	The population size is high in breeding and is reduced. Need to initiate conservation action.	2000-5000
Critical	Close to extinction. Genetic variability is reduced. Action to increase the population size is essential.	Less than 2000

indigenous breeds are getting threatened, while others are in the process of replacement by certain high producing strains. If this trend continues for few years, the valuable native breeds germplasm would grossly be depleted or even lost forever. Thus conservation of indigenous breeds of cattle is essential due to their potentiality for production of milk or draught capability or high resistance to diseases and heat tolerance ability.

VULNERABILITY OF A BREED

The FAO expert panel on preservation of Animal Genetic Resources proposed that whenever the population size of a breed reduces to 5000 breeding females, appropriate action should be initiated for its preservation. The panel observed that in case of developing countries, a breed with an effective population size of less than 2000 is to be taken as rare, with less than 500 as vulnerable and less than 100 as endangered. It also suggested that whenever the total number of animals falls below 10,000, one should start preserving semen and embryos.

Causes of genetic erosion in indigenous breeds of cattle:

There are following causes responsible for genetic losses in indigenous livestock: -

1.Inappropriate Aid: Lack of appreciation

of the value of indigenous breeds and their importance. More stress given to introduce exotic and cross breeds by A.I.

2.Changes in agriculture: Changes in agriculture mixed farming systems, introduction of modern techniques and limited knowledge about traditional livestock husbandry practices

3.Change in Technology: Replacement of animal draught and transport by machinery, artificial
insemination programme for cross breeding rapid replacement of indigenous breeds

4.Change in Economy: Decline in economic viability of traditional livestock production systems and dual local breeds of cattle replaced by higher milk yielder,

5.Disaster: Natural disasters such as, drought or famine, floods can result in loss of valuable local breed, breeding tracts and mixing of genetic characters of various local breeds in each other's.

How to conserve:

Prior to plan any process of livestock conservation first we determine the vulnerability of a breed on the basis of
Size of a population.
Recent trends of breeding in the population.
Number of herds of a population.
Availability of breeding bulls in a population,and extent of crossbreeding in the breeding tract should be considered. Once genetic resources have been identified and characterized, two basic conservation activities can be followed, i.e., in situ and ex situ.

***In situ* conservation:**

In situ conservation requires establishment of live cattle breeding farms and their maintenance. *In situ* conservation strategies emphasizes wise use of indigenous cattle genetic resources by establishing and implementing breeding goals and strategies for animal sustainable production systems. In any such program, the success depends upon the participation of the farmer for which he needs support and incentive.

Advantages

Major advantages of in-situ conservation are- live animals can be evaluated and improved over the years, genetic defects can be detected and eliminate. They are always available for immediate use; act as a gene bank for future use.

Disadvantages

In situ conservation involves a large infrastructure of land, buildings, feed and fodder resources, water supply, technical and supervisory manpower, etc. Therefore, new establishments for in-situ conservation of farm cattle genetic resources are quite costly and even the maintenance of existing ones is cumbersome. The costs need to be estimated for each ecosystem.

***Ex-situ* conservation:**

Ex-situ conservation includes cryogenic preservation. Cryogenic preservation includes -Preservation of frozen semen, preservation of oocytes, preservation of embryos, preservation of ovaries, use of embryonic stem cells or blastomeres, production of embryos in vitro, Embryo

splitting etc. It is the storage of genetic resources, which the farmers are currently not interested in using. Ex situ conservation is based on the use of live animals populations wherever practicable, supported by cryopreservation where technology exists or can be developed, combining within-country gene banks with global repositories. Interested governments, non-governmental organizations, research institutions and private enterprises should be encouraged to maintain in vivo samples of breeds at risk, with national inventories being established and kept up to date so that the genetic resources are readily available for use and study.

Advantages

Advantages of cryogenic preservation are- to maintain populations without genetic change, it can be best done by cryogenic storage as it is difficult to breed many generations of animals without any environment interactions in the genetic structure. Ex situ conservation is comparatively more convenient, economical and easy with the application of modern reproductive technologies.

CONSERVATION PROGRAMME OF INDIGENOUS BREEDS OF CATTLE

Survey of breeding tract:

Before taking up any meaningful breeding improvement and conservation programme in a breed it is necessary to know the present status of breed, need and requirements of the farmers, their habit, habitant and management practices, availability of local feed and fodder, availability of grazing land etc.

Identification of cattle:

First of all, the breeding objectives must be identified for each indigenous breeds separately, before starting conservation programmes. The breeding objectives should be relevant to the prevailing production system of an area and needs of people. The selection of the best indigenous cattle should be made according to their well performance in adverse climatic condition, heat tolerance capacity, sustainability on locally available fodder, high disease resistance and need of people.For improvement and upgrading the genetic code of non-descript cattle, selective breeding programme must be adopted in place of crossbreeding programme with exotic breeds. The bull to be used for this purpose should be produced from superior dams, which have more than 2000 kg. as lactation yield for Tharparker and Rathi breeds of cattle. This will improve the milk yield by 500 to 800 kg. in first generation.

General genetic characterization:

Genetic characterization of the breed and its similarities and dissimilarities with other breeds using molecular genetic techniques like micro satellites, Amplified Fragment Length polymorphism etc.,

should be taken up for Tharparkar, Rathi and Nagori breeds of cattle

Milk yield capacity:

Indigenous breeds of cattle e.g.: Tharparkar, Rathi, have potential to produce about 2500 liters milk per lactation period. The milk yield in Nagori breed is very poor. The genetic variation in the milk yield should be utilized for the improvement of dairy characteristics using appropriate breeding strategies. The incentives should be given in the form of regular health care and technical advice on managemental practices at the doorsteps by concerning govt.departmants like- animal husbandry, agriculture etc. Molecular markers with productive and reproduction performance identifying breeding bulls at an early stage and cryopreservation, Embryo Transfer Technologies useful in producing large number of elite males & females.

Draught power:

Our indigenous breeds are mainly known for their high draft ability e.g.: Nagori, Tharparkar, Rathi, but very little objective assessment has been made about their work efficiency. There is need to evaluate the draft efficiency in a systematic manner. There is also a need to evolve packages of feeding and management practices for obtaining better draft power from these draft breeds. Identification of simple morphological or biochemical attributes closely associated with work efficiency could help in genetic improvement of draft power of the breed. Marker Assisted Selection using molecular markers associated with work efficiency will also yield quick results.

Govansh savardhan sangh:

The movement of improvement, up grading and conservation of cattle can't be

success without involvement and participation of farmer's, because they are play major role in this movement.

There is an urgent need to start "Govansh savardhan sangh" at district level for individual cattle breeds of state like- Tharparkar breeders sangh, Nagori breeder's sangh, Rathi breeders sangh. The members of district breeders associations are farmers/villagers have concern pure breed of cattle, district veterinary officer, district agriculture officer, etc. At the state level "Central Govansh savardhan sangh "should be made.

The Central Govansh savardhan sangh should act as the nodal agency for monitoring all activities relating to a particular breed including genetic improvement, conducting cattle shows, identifying the areas of research and to act as a liaison between Government, gosewaayog, Agriculture Universities, research institutions, organized farms and the farmers.

Breeding policy:

Animal husbandry programmes have been run through the State schemes. Each State has to evolve its own breeding policy deciding on choice of breed, cross breeding strategy, optional mixture of animals of different breeds required, breeding goals in terms of expected genetic progress to be achieved, specific breeding programmes and the control measures that should be adopted to achieve the desired genetic gains in the population.

General parameters in the breeding policy formulated by various States are:

Indigenous milch breeds such as Shaiwal, Red Sindhi and Gir, should be selectively developed for dairy traits in their native tracts. Indigenous dual purpose breeds such as Hariana, Tharparkar, Rathi, Kankrej, Gaolao, Ongole Deoni etc. should be developed selectively in their native tracts for dairy and draft traits. Indigenous draft breeds like Kangayam, Hallikar, Khillari, Amrit Mahal etc. should be developed selectively for draft traits in their native tract. Non-descript cattle will be bred with exotic semen to produce cross breed with Holstein Friesian or jersey and maintaing 50% exotic impenitence. In some States Red Sindhi, Tharparkar and Hariana have also been used upgrading non-descript cattle.

Development of indigenous breeds:

To develop indigenous breeds Government of India has initiated three schemes namely National Project for Cattle and Buffalo Breeding, Central Herd registration scheme, Central Cattle Breeding Farms.

National Project for Cattle and Buffalo Breeding:

Genetic improvement is a long term activity and Government of India has initiated a major programme from October 2000 "National Project for Cattle and Buffalo Breeding"(NPCBB) over a period of ten years, in two phases each of five years, with an allocation of Rs 402 crore for the 1st phase. National Project for Cattle and Buffalo Breeding envisages genetic up gradation on priority basis and also had focus on the development of indigenous breeds. The National Project for Cattle and Buffalo Breeding envisages 100 per cent grant in aid to implementing agencies and has the major objectives of (a) to arrange delivery of vastly improved artificial insemination service at the farmers doorstep; (b) to progressively bring under organized breeding through artificial insemination or natural service by high quality bulls, all breedable females among cattle and buffalo within a period of 10 years; (c) to undertake breed improvement programme for indigenous cattle and buffalo breeds so as to improve their genetic qualities as well as their availability and (d) to provide quality breeding inputs in breeding tracts of important indigenous breeds so as to prevent the breeds from deterioration and extinction. At the Central Government level a Central Project Management Unit (CPMU) with a core group of professional staff implements the Project. There is broad based Steering Committee for the

project to provide guidance to the CPMU. At present following 15 States are participating under the project and following funds has been released to these States for implementation of the project:

Central Herd Registration Scheme:

For identification and location of superior germplasms of cattle and buffaloes, propagation of superior genetic stock, regulating sale and purchase, help in formation of breeders societies and to meet requirement of indigenous bulls in the different parts of the country. Government of India has initiated Central Herd Registration Scheme. Four CHRS units were established in different breeding tracts of the country. For milk recording 103 milk recording centers were set up. Indigenous cattle breeds covered under the scheme are Gir, Kankrej, Hariana and Ongole. During 2001-2002 final registration for 1795 animals were completed. The criteria laid down for registration is given in Table-2

Table 2: Criteria for registration under CHRS

Breed	Milk yield in Kg's	
	Category-I	Category-II
Gir	3500 & above	3000 to 3499
Hariana	2700 & above	2500 to 2999
Kankrej	3000 & above	2700 to 2999
Ongole	2500 & above	2250 to 2499

Information center:

An information center should be established on indigenous breeds of cattle and it should have all the information about their distribution, farming practices, physical and molecular characteristics of the breeds, information of breed's herds and availability of elite breeding male and female cattle etc. The information also needs to be updated periodically and easily available to all.

Role of voluntary organization

Breeder association without involvement and participation of farmer's it is not possible to conserve the breed. Improvement of Indigenous breeds can be taken up in collaboration with Breeders' association through selection of outstanding animals true to their breed types. These Breeders' association can be encouraged to form a Federation at the State/District level to take up issues relating to conservation and development of respective indigenous breeds. States may consider having State level awards for Breeders' associations and for progressive farmers who have contributed to conservation and development of recognized indigenous breeds.

Use of Science and Technology

Since the introduction of cross breeding programme, most of the techniques and methodologies for breed improvement have been used to produce cross bred cattle. The application of such technologies for propagation and improvement of indigenous breeds is a relatively rare phenomenon, one of the reasons for which may be the reluctance of the farmers,

owning these breeds to accept new and established techniques for reproduction.

1. Technologies such as artificial insemination, frozen semen production, progeny testing, embryo transfer technology should be used, after proper evaluation where ever required

2. National gene bank should maintain the germplasm in the form of semen & embryo. Regional gene banks should meet the requirements of National gene bank

Data Base

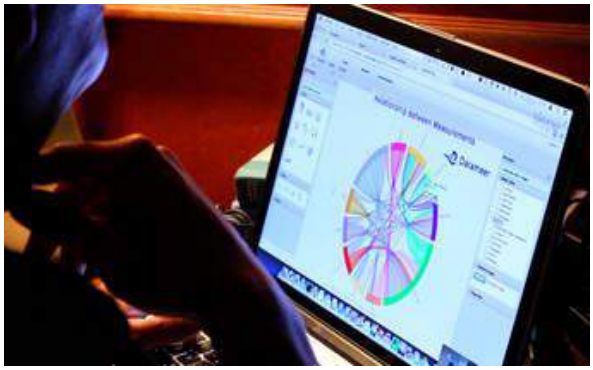
A reliable data base should be developed with regard to all the details of Indigenous breeds, including their breeding tracts, numbers, characterization, gene make up, the institutional farm where they are being preserved and / conserved. The national level data base for cattle and buffalo developed by NDDB may be utilized for this purpose. A breeding network should be set up by computerizing and net working all AI outlets, semen stations, breeding farm and Gaushala.

Creation of Public Awareness

Available information on different breeds should be published in the form of pamphlets, books, calendar etc. This will create awareness and motivate farmers to conserve the important breeds. Some farmers are the proud owner of the popular breeds of their area. Such farmers, if encouraged through financial & veterinary help will help in preservation of breeds. Breeds shows should be arranged for local breeds and owners should be rewarded for maintaining pure local breeds. Publish success stories on local breed conservation and innovative utilization.

CONCLUSION

Although cross breds are economically viable but the F 2 populations have shown deterioration and decrease in milk yield. To maintain the performance of these cross breds at desired level, large number of progeny tested bulls are required. Indigenous breeds can be made commercially viable within few generations and there is no organized



efforts have been made to improve the genetic potential of indigenous breeds. Cross breds are more productive as compare to indigenous breeds but their tendency to wilt under Indian conditions of low input and harsh climate, susceptibility to tropical diseases warrants the conservation and development of indigenous breeds. Usefulness of various indigenous breeds has not been fully explored. The non-renewable energy resources are bound to exhaust sooner or later if this happens then we may have to fall back on our animal wealth for providing draught power and hence we can not take risk of letting these breeds go extinct. The domesticated breeds are integral part of our eco-system, culture and heritage. Thus there is imperative need to develop our indigenous breeds for milk production, draught power etc.

Horse Milk an Alternative to Human Milk

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The horse (*Equusferus caballus*) is one of two extant sub-species of *Equusferus*. It is an odd-toed ungulate mammal belonging to the taxonomic family Equidae. It has an integral relation with human civilization from ancient time. Horse mainly used as transportation purpose. Very recently due to some adverse effect on cow milk protein on children health so researchers are in search of such milk have resemblance to human milk and alternative to cow milk.The nutritional and therapeutic properties of horse (Equuscaballus) milk have been known since ancient time mainly central Asia and eastern Europe, where koumiss and other fermented horse milk products with claimed health benefits

COMPOSITION OF MILK

Horse's milk gross compositionconfirm the closer resemblance to human milk for lactose, protein and ash levels when compared with cow, sheep and goat milk. Despite the high lactose content in horse's milk, the average energy content is lower in horse milk as compared with human milk.

Protein fractions

Horse's milk protein content is higher than human milk and lower than cow milk. Casein in horse milk is also intermediate relative to human and cow milks. The whey protein fraction, indeed, represents approximately 40% in horse's milk, slightly more than 50% in human milk and less than 20% in cow's milk. From this point of view horse's milk is more similar to human milk. The richness in whey protein content of horse's milk makes it more favorable to human nutrition than cow's milk, because of the relatively higher supply of essential amino acids. Horse's milk casein is composed mainly of equal amounts of β-casein and α-casein.

The proportions of the mainαs-casein fractions, i.e. αs1- and αs2-casein, is still under study k-casein in horse's milk has also been identified Horse's milk casein micelles are the largest as compared to both human and cow's milkcasein micelles. In cow's and horse's milk has a spongy structure, while in human milk it is reticular, fairly regular and very loose, due to numerous canals and caverns. Horse's and human milk forms a finer, softer precipitate when casein are

hydrolyzed, which is physiologically more suitable for infant nutrition because it is more easily digestible than the firm coagulum of cow's milk.The free amino acid content of horse milk more rapidly available to gut absorption, is intermediate between the lower values in cow milk and the higher values of human milk.

Bioactive protein in horse milk

The lactoferrin content of horse's milk is intermediate between the lower values of cow milk and the higher values ofhuman milk. Recent researchers have been reported for the presence of various type of growth factors in horse milk those have immense therapeutic value.

Fat

Horse's milk fatcontent is lower than both those of human and cow milks . Horse and human milks are similar in milk fat diglyceride and triglyceride distribution, with polyunsaturated fatty acids (PUFAs) being higher in horseand human milk fats than in cow milk fat. In horse's milk palmitic acid (C16:0) is preferentially associated with the sn-2 position and in human milk, palmitic acid is also located in the sn-2 position. On the other hand C16:0 in cow's milk is equally located in 1 and 2 positions. Horse's milk is richest in phospholipids when compared to human and cow's milk. The sterol fraction in horse's, human and cow's milk is constituted partially by cholesterol (about 0.3–0.4%) of the lipid content in all milks.

Horse milk contains higher α-linolenic acid (ALA) and linoleic acid (LA) (i.e., essential fatty acids, EFA) that are precursors of omega-3 and omega-6 PUFA, respectively . ALA (C18:3n 3) and eicosapentaenoic acid (EPA; C20:5n-3) give rise to prostaglandins such as prostacyclin (PGI) with vasodilatory effects. The LA to ALA ratios of 1.3-2 make horse milk also suitable for infant nutrition. Horsemilk'ssaturated-to-unsaturated fatty acids ratio is about 1.2 , which suits human and infant nutrition.

Minerals

All macrominerals in horse milk vary significantly during lactation.Average content of Ca and P in horse milk is higher than human milk but lower than cow milk. The concentrations of K, Na, and Mg in horse and donkey milk appear to be similar to those in human milk. Fe and Zn are reported to be similarto or slightly higher than the levels in human milk.

Vitamins

Vitamin C in horse milk is equal or slightly higher than human milk but other fat soluble vitamins are present more in human milk as compare to human milk.

Horse milk alcoholic beverage

The use of fermented horse milk isan ancient tradition in central Asia, where Koumiss or Airagare considered beverages with health-promoting properties. Koumiss, a lactic-alcoholic beverage derived from horse milk, is an effective combination of raw milk and

indigenous microbial populations, mainly lactic acid bacteria and yeast whose diversity is of increasing interest.

Horse milk suitable for those people affected by Cow milk protein allergy

Recent clinical evidence has renewed the interest in horse milk because of high tolerability in infants with cows' milk protein allergy. Although the use of extensively hydrolysed proteins or soy-bean derived formulae is preferred in the treatment of this disease, alternative foods, such as horse milk, are required for highly problematic patients. Due to its compositional resemblance to human milk and its palatability, when horse .It is considered a valid substitute of hypoallergenic formulae but the low fat content must be appropriately balanced in the infant's diet. However, for their low fat content and the unique fatty acid composition, horse and donkey milk and their derivatives could become valuable foods for elderly consumers.

Horse milk as cosmetic therapy

Horse milk fat is considered an important ingredient in Mongolian cosmetics because of its high polyunsaturated fatty acid content. Milk proteins are also described as naturally activein skin hydration and skin ageing prevention.

Jackfruit Byproducts

as Non Conventional Feed Resources for Ruminants

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Livestock is an integral part of Indian agricultural economy and plays an important role in providing livelihood support to the rural population. Increasing in livestock population and decreasing land for feed and fodder cultivation has widened the gap between the availability and requirement of animal feed and fodder. According to the 12th five year plan there is shortage of dry fodder (10%), green fodder (35%) and concentrate (33%) in India. Inadequate nutrition in ruminants is often been associated with heavy economic losses to the farmers in terms of animal weight and condition losses, reduced reproductive capacity and increased mortality. One of the ways to overcome this situation is to identify potential non conventional feed resources (NCFR). Many of the NCFR are currently designated as wastes to the extent that they have not been shown to have an economic value, so if these wastes can be utilized and converted by animals into valuable products for human benefit, then it will become new feed resource of importance. NCFR may be a tree fodder, an agro-industrial byproduct, fruit and vegetable byproduct etc., which are not conventionally included in the livestock ration. So use of agro-industrial byproducts/waste into animal feed resources is a great challenge for the nutritionists. This will help to reduce the energy and protein deficiency during the scarcity period and simultaneously may reduce the competition for the conventional feed stuffs among human and animals.

Jackfruit waste can be used as a new feed resource in ruminant feeding which is usually in the southern parts of the country. This waste material includes jackfruit leaves and fruit wastes. The leaves are mainly relished by the small ruminants whereas the fruit waste has been given to large ruminants and to some extent small ruminants, especially goats also. India is the second largest producer of jackfruit in the world and is considered as the motherland

of jackfruit. In southern India, the major area under jackfruit production is in Kerala and it was regarded as heavenly fruit in the ancient periods. Total jack fruit production in India is about 1176000 MT over an area of 67000Ha in 2012-13 (Source: Hand Book on Horticulture Statistics 2014, Govt. of India).

Jack fruit leaves

Jack fruit leaf is traditionally used by framers in Kerala as stable roughage for goats and has an annual yield of 150-200 kg/tree. Researchers shown that the intake of jack leaves by goats is more when fed in hanging with branches rather than as leaves are offered alone as the goat's basic instinct is to browse. These leaves can be included in the ration up to level of 10-20%. These leaves are found to have high nutritive values and fairly good source of minerals. In goats, intake of jack fruit leaves is around 50-60g/kg b.wt on dry matter basis.

One of the major limitations of jack fruit leaves is the presence of anti-metabolites or plant secondary metabolites. The most widely occurring one is the poly phenolic compound called tannins, which can limit animal performance by reducing intake and digestibility of feed. They can bind to the dietary proteins or salivary proteins or digestive enzymes, thereby reducing the protein utilization and enzymes activity, ultimately resulting in lesser animal performances. But lesser quantity of 2-3 % of tannins in diet is beneficial to the animal as it reduces the occurrence of bloat and increase by-pass protein content. The chemical composition as well as the tannin content of the jackfruit leaves is given below.

Table 1: Chemical constituents of jack fruit leaves on dry matter basis

Parameters	Contents
Dry Matter (%)	36.6
Total Ash (% DM)	11.5
Organic Matter (% DM)	89.5
Crude Protein (% DM)	14.0
Crude Fat (% DM)	3.6
Crude Fiber (% DM)	19.5-22
Neutral Detergent Fibre (NDF) (% DM)	36.5
Acid Detergent Fibre (ADF) (% DM)	26.9
Lignin (% DM)	7.5
Gross energy (kcal/kg DM)	14.2
Calcium (g/kg DM)	1.5
Phosphorus (g/kg DM)	3.2
Potassium (g/kg DM)	20.5
Magnesium (g/kg DM)	1.9
Zinc (mg/kg DM)	107
Copper (mg/kg DM)	5
Iron (mg/kg DM)	449
Secondary metabolites	
Tannins (eq. tannic acid), g/kg DM	146.9
Tannins, condensed (eq. catechin), g/kg DM	132.3

Many methods can be used to deactivate tannins and other secondary compounds in temperate and tropical forages in order to improve their nutritive value. The methods are based on the theory that tannins are hydro soluble polymers which form complexes, essentially with proteins. These complexes are broken under conditions of high acidity (pH 7.5). The treatment of tanniniferous feed sources with alkalis (urea, sodium hydroxide, potassium hydroxide, etc.) and oxidizing agents (potassium dichromate, potassium permanganate, etc) decreased their total extractable phenols and tannins and/or condensed tannins contents. However, the main disadvantage of these chemical treatments is the loss of soluble nutrients. The benefits from the use of polyethylene glycol (PEG) as tannin inactivating agent are well documented. PEG is an inert and unabsorbed molecule that can form a stable complex with tannins, preventing the binding of tannins to protein. Therefore, PEG releases forage proteins from tannin-protein complexes and improves their nutritional value leading to improved performances in sheep and goats. Researchers found that PEG did not affect the diet intake but the CP digestibility of the diet increased from 37% without PEG to 71% with 50 g of PEG/day in goats fed adlibitum with foliage of *Pistacia lentiscu*. However, the high cost of this reagent limits its use in practice and in some cases utilization of alkalis, oxidizing agents and PEG could contribute to environmental pollution. Charcoal as a powder or as tablets has been widely used among humans for centuries to cure indigestion and, more importantly, as an antidote to detoxify poisons. It is also used as an antidote in veterinary medicine. It was

found that the habit of eating wood charcoal by the Zanzibar red colobus monkey (Procolobus kirkii), which consumes a diet of foliages containing high levels of phenolic material, is known to reduce or eliminate such toxicity by binding part of the phenolic compounds to the charcoal, thus preventing their gastrointestinal absorption. Charcoal has also been used in the diets for livestock to reduce anti-nutritional effects of secondary compounds in feeds. The effects of charcoal on elimination of harmful substances are reported to be due to the adsorption of a wide range of compounds such as phenols, alkaloids and salicylates.

Jack fruit waste

The ripe jack fruit consists of three parts the bulb (29%), seeds (12%) and the rind portion (54%). On a whole more than 50-59% of the fruit will be inedible to humans and these are considered as waste which consists of the rind, outer core portion and the pericarp. These can be

used as livestock feed, especially in large ruminants like cattle and buffaloes along with the roughages and concentrate diet. Palatability studies showed that animals relished these waste nicely. The average DCP and TDN values of these jack fruit waste varies 4-17% and 65-72.08%, respectively which can very well call as a moderate energy and protein feed. The chemical composition includes 7.9% CP, 14.1% crude fibre, 0.80% calcium and 0.10% phosphorus. This is a rich source of energy, having 65.3 % NFE. The waste from ripe fruits is more palatable than waste from raw fruits. A trial conducted in cross bred cows on second lactation showed that the jack fruit waste can be used to replace the concentrate mixture of a lactating cow to an extent of 30%. There was no significant difference in the milk yield or milk composition between jackfruit supplemented group and the control group without jack fruit addition in ration. One of the major drawbacks is the highly perishable nature of the waste due to high moisture content. So feeding can be done as such in the same day or can be store for days after drying it in sun. One of the recent methods is the conversion of the waste into silage by the process called ensilage. Well-made silage can be opened within one month or can be stored for six months or more, provided the cover should not break down and no air should enter the stack (Anaerobic condition).

Preservation of jack fruit waste for livestock feeding

Silage Making

Silage is a fermented feed resulting from the storage of high moisture crops under anaerobic conditions in a structure known as silo. When the green is stored in an airtight silo, its fermentation by microbes result in production of lactic acid, acetic acid and formic acid, which prevent decomposition and growth of unwanted organisms. Eventually, the acids kill most of the microbes and preserve the silage as long as (10-15 year) anaerobic condition is maintained.

There are several advantages of silage making.

- Silage preserves up to 85 per cent of nutritive value of crop.
- Silage can ensure supply of quality forage in lean period. When green production in excess, it can be preserved for future use by silage making.
- The produced silage from a given area can be stored in less space compared to when stored in dry condition.
- A cubic foot of silage contains about three times more dry weight of feed than a cubic foot of long hay stored in the heap

Fruit, fish waste, vegetables and root crops are increasingly integrated into tropical farming systems and provide a wide range of valuable wet by-products and residues which are often underutilized or wasted. The ensiling of such by-products is a simple conservation method and a most effective way to improve animal feed resources. Jack fruit rind and leaves can be used as a

ensiling material but further researches in this aspect is required as not much work has been done using jack fruit ensilage. This will help the farmers to store the jack fruit waste in a nutritional as well as environmental friendly manner to use it for the lean period or scarcity period. The major problems usually encountered are the seasonality of supply and their high moisture content. High moisture by-products often have high nutritive value. It is difficult and expensive to dry them so all too frequently such by-products often become contaminating wastes that quickly go sour, mouldy and lose much of their soluble nutrients as effluent. The advantages of ensiling such material include:

- For feeding when such by-products are not being produced.
- Increasing feed resources and an insurance for high nutrient demands, such as milking cows.
- If low cost, reducing total feed costs.
- Can improve their palatability.
- Can reduce toxicity to safe levels (in vegetables or cassava leaves).
- Can destroy harmful bacteria (in poultry litter or fish wastes).
- Can constitute a major proportion of diets.

Principles of ensiling fruits/ vegetable by-products

The basic principles are the same as those for fresh forages, so attention must be paid to ensuring anaerobic conditions and there should be sufficient acid in the silage to restrict the activities of undesirable bacteria. To achieve successful silage, attention should be given to:

- Moisture content _ this should be at least 50% for ease of compacting to eliminate air. Excessive moisture, more than 75%, can lead to an undesirable fermentation, producing a sour silage reducing palatability and hence intake. Adding water or using absorbent materials will allow the manipulation of moisture content.
- Length of chopping _ the finer the chopping, the better the compaction. .
- Time to fill the stack _ the quicker the better, and it should be covered each night during filling to reduce invasion of air.
- Fermentable energy _ these silages require a stable low pH to minimise biological activity. The final pH depends on the carbohydrate content, which may be sufficient in the material being ensiled or from added sources. For example, protein-rich by-products with low sugar or starch contents are difficult to ensile so should be mixed with energy-rich by-products such as waste bananas, molasses or root crops.
- Once opened, every effort must be made to reduce aerobic deterioration. Ensiling in layers separated by plastic sheets can reduce the size of each package of silage. Plastic bags are easy to handle as well as making excellent mini silos.

- Well-made silage can be opened within one month or can be stored for six months or more, provided the cover does not break down and allow air to enter the stack.

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Dietary Cation Anion Difference (Dcad)

and Its Role on Periparturient and Postpartum Dairy Cows

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Dairy cows will be in great demand for energy, protein and minerals immediately after parturition due to the synthesis and secretion of milk after a dry period. Energy and protein demand are major determining factors and are taken care usually avoiding the changes in mineral element dynamics. The onset of lactation causes a severe and rapid drain on blood calcium. Colostrum contains about 2.1g Ca/l and if this blood calcium is not replaced as rapidly as it is drained via bone calcium release (resorption) or intestinal absorption of calcium, cows will become hypocalcemic with some developing clinical milk fever. Research indicates that cows with clinical milk fever produce 14% less milk in the subsequent lactation and their productive life is reduced approximately 3.4 years when compared to non-milk fever cows (Block, 1984; Curtis et al.1984). A diet that reduces blood pH (acidic condition) through a high level of anion (Cl, S etc) causes the concentration of blood calcium to increase and reduce the incidence of clinical milk fever. This basic concept of nutrition resulted in the development of an innovative concept called Dietary Cation Anion Difference (DCAD) in animal feeding. DCAD is a way to balance the electrical charges of the cations and anions in the diet affecting cow's blood buffering capacity.

WHAT IS DCAD? HOW TO CALCULATE?

The term dietary cation-anion difference (DCAD) was coined by Sanchez and Beede (1991). It refers to the numerical difference between the sum of certain dietary cations (positively charged minerals such as Na^+, K^+) and certain dietary anions (negatively charged minerals such as Cl^-, S^-) in the diet from all the sources including water which is the similar to Anion gap (AG) concept used in human medicine (where HCO_3^- is substituted for S^-).

DCAD is calculated by different formulae, Mongin (1980) was one of the first to propose a three-way interrelationship among dietary Na, K and Cl. His proposed formula was the sum of Na + K - Cl. DCAD is measured in mEq/kg dry matter or mEq/100g dry matter.

Other formulae used for calculation are

DCAD (mEq) = (Na + K) – (Cl + S) (most commonly used)

DCAD (mEq) = (Na + K + 0.15 Ca + 0.15 Mg) – (Cl + 0.6 S + 0.5 P)

DCAD (mEq) = (Na+K+0.15 Ca+0.15 Mg) – (Cl+0.20 S+0.30 P)

Most commonly DCAD calculated using monovalent ions rather than all cations and anions (because monovalent ions are more bioavailabile and less interactive with other substances).

If calculated DCAD in the diet comes positive value (more cations than anions) leads to the production of more blood buffers and less hydrogen (alkalinity) which can be used for acidosis prevention and if it is negative (more anions than cations) leads to the reduction of blood buffers and allows for accumulation of hydrogen (acidic) which is useful in peri parturient period to counteract hypocalcaemia.

Commonly used cationic and anionic salts:

Cationic salts- Sodium and potassium salts like sodium bicarbonate, sodium carbonate, potassium carbonate.

Anionic salts- sulphate and chloride salts like ammonium sulfate, ammonium chloride, calcium chloride, calcium sulphate, magnesium sulphate, magnesium chloride

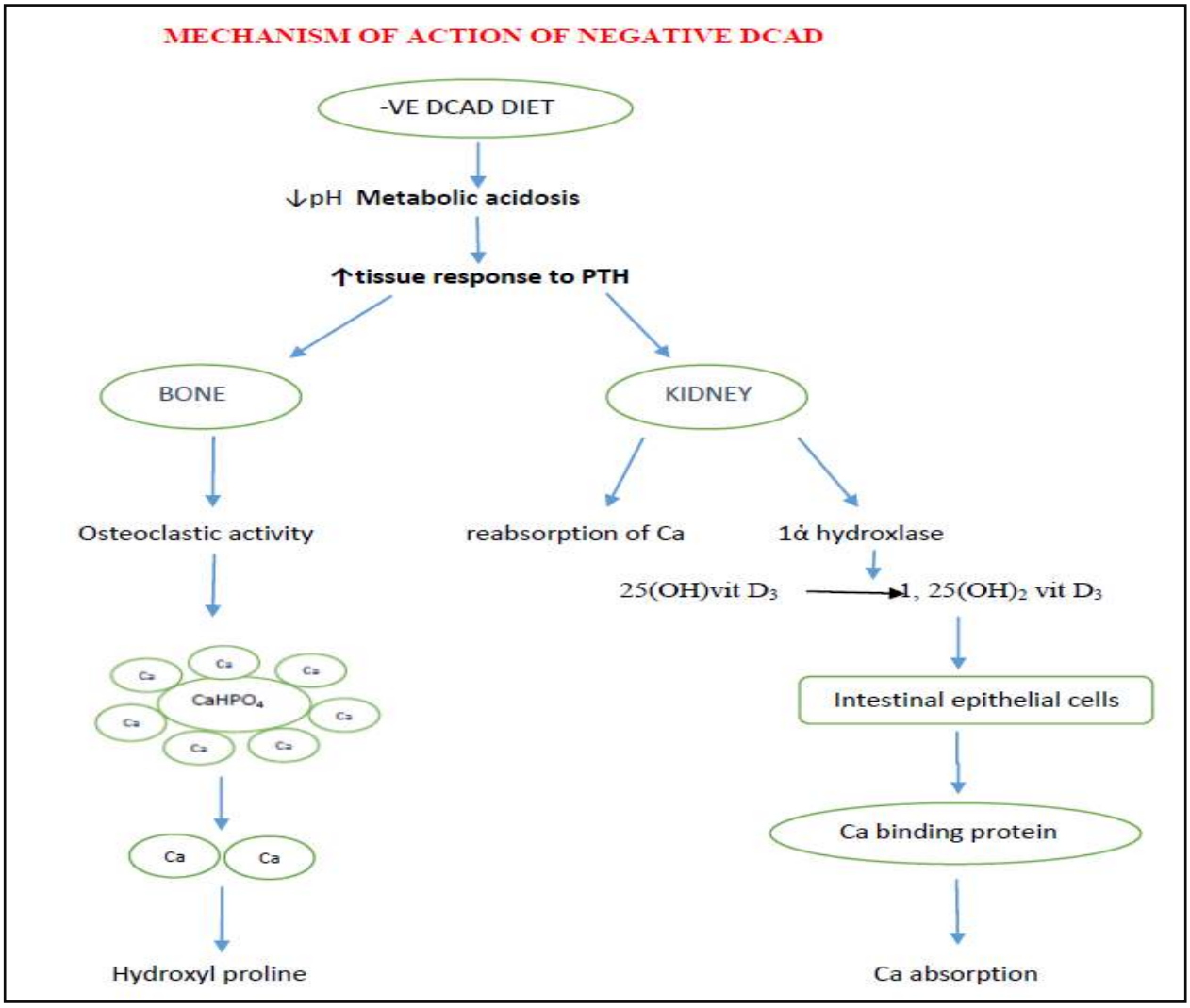
DCAD IN PERIPARTURIENT ANIMAL

The peri-parturient period of 4 weeks before and 4 weeks after calving is characterised by greatly increased risk of diseases. Normal blood plasma calcium is 9 to 10 mg/dl which comes between 2.52 and 3.6 mg/dl in subclinical hypocalcaemia and below 2.52 mg/dl in clinical hypocalcaemia (milk fever). Physiological controls over Ca homeostasis include hormones calcitonin (hypercalcaemic hormone) from the thyroid gland, secretion of which is stimulated in response to elevated blood Ca concentrations and Parathyroid hormone (PTH) which is released from the parathyroid gland in response to lowered blood Ca. PTH increases intestinal absorption of Ca and resorption from bone. Important point to be considered is that till today no case of milk fever has been reported due to deficiency of PTH rather it is only because of in sensitization of PTH receptors on bone and intestine preventing resorption and absorption of Ca respectively because of metabolic alkalosis condition created at the time of calving it may be due to feeding high forage diet (rich in K cation) than protein rich diet (mostly anionic). In order to prevent this metabolic alkalosis condition feeding anionic salts (negative DCAD): -100 to -200mEq/kg dry matter from 3weeks before the expected date of calving will create necessary acidic condition favouring calcium resorption and absorption thereby preventing the milk fever occurrence.

Feeding negative DCAD causing metabolic acidosis thereby directly increasing bone mobilization of calcium by

(1) Creating the necessary acidic environment for lysosomal and mitochondrial enzymes in the osteoclasts (bone mobilization cells) to operate.

(2) allowing for the rapid production of other lysosomal and cytoplasmic acids in these cells, such as lactic and hyaluronic acids.

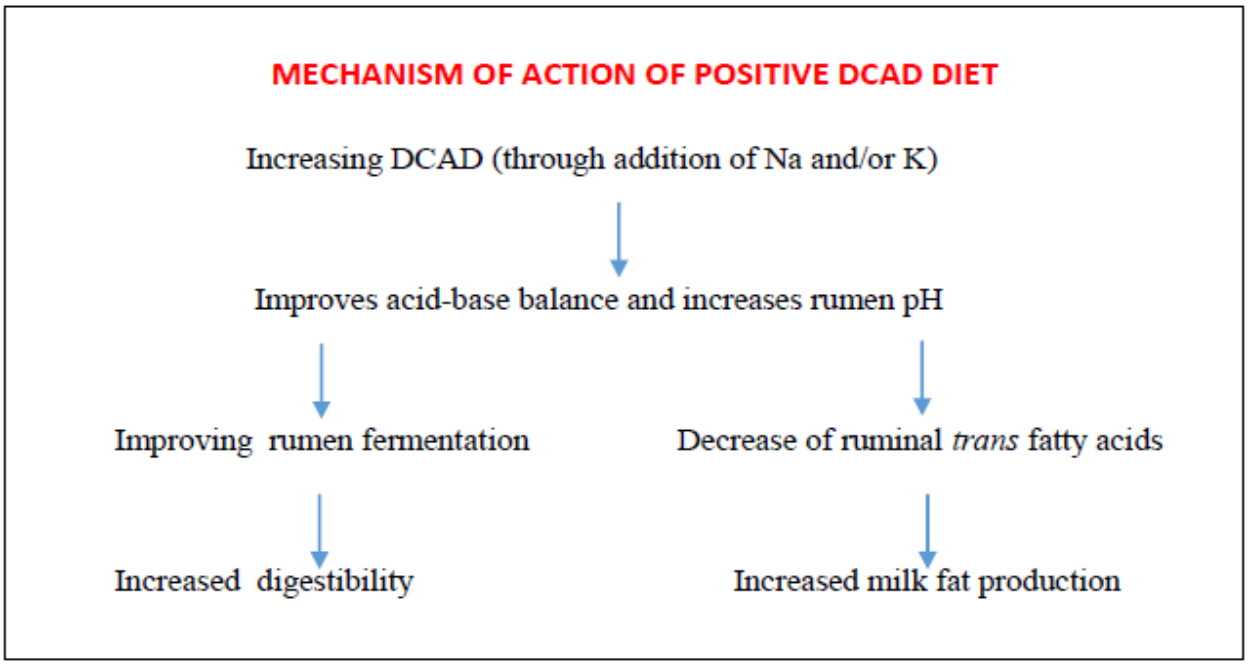


(3) Allowing a localized reduction in pH around the bone cells to allow for bone mineral dissolution

Systemic acidosis resulting from negative DCAD can be checked by measuring urine pH with simple pH paper, pH of around 6.3 to 6.5 is considered as optimum to assume systemic acidosis and effect of negative DCAD is positive.

POSITIVE DCAD IN POSTPARTUM ANIMALS

Advanced feeding practices to meet the nutrient requirement of cows with high concentrate feeding which decreases ruminal pH due to increased volatile fatty acids (VFA) production mainly propionate decreasing the milk fat synthesis. Research results conducted with sodium bicarbonate and potassium salts (+DCAD) divert the electrical composition of diet towards more alkaline to counteract the slight ruminal acidosis. The optimum DCAD level should be based on the cow's milking status. For early and mid-lactating cows diet should have a highly positive DCAD level (adding cationic salts), between +35 to +45 mEq / 100g of DM or +350 to +450 mEq / kg of DM. This level helps improve feed intake and milk production without affecting milk fat and protein percentages.



To raise DCAD through good nutrition, add supplemental sodium, potassium or both to the ration, without additional sulfates or chlorides. Generally, increase in feed intake with increasing DCAD levels in the diet is noticed which may be due to increased rumen pH that makes the ruminal environment alkaline, which is pre-requisite for optimum ruminal microbial activity.

Higher DCAD levels also help during heat-stress conditions, when cows naturally have decreased feed intake and problems with low blood bicarbonate and rumen acidosis. Heat-stressed cows lose potassium through sweat and milk, often making them deficient. Potassium is present in milk in greater quantities than even calcium. Therefore, to maintain high milk production, dairy cows need dietary potassium to avoid deficiencies. Potassium also appears to play an important role in insulin production, protein metabolism and in controlling the cow's cell pumping. It is also important to supplement magnesium in rations when feeding extra potassium, and subsequently, to monitor potassium fertility levels on farms.

CONCLUSIONS

- Feeding negative DCAD diet (-10 to -20mEq/100g DM) for 3 weeks before calving will create sufficient acidic condition to increase Ca^{+} in blood preventing the risk of milk fever.
- Feeding positive DCAD diet (+35 to +45mEq/100g DM) in lactating animals and in hot weather condition maintains the optimum ruminal pH for microbial activity, increases feed intake, milk yield and good health condition.

Growth of Skeletal Muscle in Farm Animals –An Overview

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Abstract

The most abundant tissue in farm animals is skeletal muscle. Understanding the process of muscle growth is an important aspect in livestock sector in general and meat industry in particular. The total number of muscle fibers is mainly determined prenatally and muscle fiber number remains almost unchanged during postnatal growth, while various environmental and genetic factors affect the size and number of muscle fibers postnatally. Satellite cells play a major role in postnatal growth, repair and maintenance of skeletal muscle. As the age increases number of satellite cells decreases. Species, gender, nutrition, exercise and additional growth promoting agents like growth hormones, clenbuterol and steroids are common factors associated with muscle fiber number and size. Moreover aging deteriorates muscle status of animals. Some major genes can also be manipulated to improve muscling in animal like myostatin and callipyge gene.

Introduction

Skeletal muscle is the single most abundant tissue in an animal, representing up to 50 % of body mass in some athletic species such as the dog and horse. Muscle growth in animals is mainly due to an increase in length and girth of the muscle fibers (Hypertrophy) without forming new muscle fibers (Wegner *et al*., 2000). Muscle fiber hyperplasia in animals is largely completed during gestation and fixed about the time of birth reported by most authors, while many factors postnatally will affect the size and number of fibers. The growth potential of the muscles is determined by the number of prenatally formed muscle fibers and the speed of postnatal hypertrophy. Postnatal muscle fiber hypertrophy strongly depends on the total number of muscle fiber within a muscle. Majority of the nuclei of a mature skeletal muscle are presumably derived from satellite cells (Chung and Johnson, 2008). The growth rate of the individual muscle fiber is lower at high fiber number and higher at low fiber numbers. The number of muscle fiber correlated inversely with fiber thickness, whereas both parameters are positively correlated with cross sectional area of the muscle (Rehfeldt *et al*., 2000).

Role of satellite cells in muscle growth

Satellite cells are quiescent, non-fibrillar, mononuclear cells located between the

basal lamina and the myofiber plasma membrane (Mauro, 1961). In a newborn animal, 30% of muscle nuclei are satellite cells, but the number decreases between 2 to 10% in mature animals (Cardasis and Cooper, 1975). This becomes a challenge in optimizing skeletal muscle hypertrophy in more mature cattle due to the small population of progenitor cells available to contribute to the existing muscle fibers. During late pre - and postnatal development, a large number of satellite cells fuse into both primary and secondary fibers to contribute new nuclei to growing muscle fibers (whose nuclei cannot divide), so that more than 90% of the nuclei of a fully mature muscle are presumably derived from satellite cells (Zhang *et al*.,1998). In order to maintain the satellite cell population necessary to support muscle hypertrophy in mature animals, the cells in quiescence must be activated to allow them to progress through the cell cycle and contribute nuclei to the existing muscle fiber. At the end of postnatal growth, satellite cells enter a phase of quiescence but can be activated if the muscle tissue is damaged or in response to further growth demands. This fact has led to the suggestion that they represent a type of stem cells (Collins *et al*., 2005). Satellite cells are capable of differentiating into other cell types in addition to muscle cells, such as adipocytes and fibroblasts (Kuang *et al*., 2008). After activation by various environmental stimuli related to growth, satellite cells undergo asymmetric proliferation and differentiating into myoblast. These newly generated myoblast fuse with existing muscle fibers to increase the muscle fiber size, as well as the number of nuclei in muscle fibers (Yan *et al*., 2013).

Factors affecting muscle fiber numbers and size

1. Species :

Species specific differences in muscle mass are primarily due to differences in the total number of muscle fibers. The evolutionary increase in muscle fiber size is limited by physiological reasons in the normal cell function is maintained only as long as a certain limit in cell size is not over exceeded. Difference in muscle mass is related to muscle fiber number or size i.e., comparing identical muscles between pig and cattle are mentioned in Table.1 that cattle exhibit 3 to 4 times higher fiber numbers and same or even smaller size muscle fibers than pigs (Rehfeldt *et al*., 2000).

Table1. Muscle fiber number of longissimus muscle in adults of different species.

Species	Fiber number (in million)	Fiber diameter (µm)
Pig (domestic)	0.66 -1.09	40 – 80
Cattle	2.51 – 3.77	55 - 67

2. Gender:

Intact males mostly exhibit larger fibers than female or male castrates. A difference in muscle fiber number between males and females arises by hormonal action. Testosterone stimulates the longitudinal growth of existing myofibers and in this way increase the fiber number per muscle cross section. Additionally, difference in fiber number related to different physical activity between male and female muscles. Moreover estrogen improves muscle

protein in fiber and also acts as anti-inflammatory agent during exercise; therefore less muscle damage is reported in females. Estrogen play a more direct role in hypertrophy or growth of muscles.

3. Nutrition :

Postnatal malnutrition is able to induce muscle fiber loss depends both on the intensity (quantity and quality) and on the time period (development stage and duration) of dietary restriction. Severe restriction (starvation) cause fiber loss, whereas moderate under nutrition extensively affects fiber hypertrophy by means of reduce nuclear protein accumulation. During early postnatal life, the elongation of existing myotubes which increased the apparent fiber numbers cannot be completed if the animals are undernourished. The majority of muscle fibers form during the fetal stage, and nutrient fluctuation during this stage produces long-term effects of offspring health. Nutrient restriction during mid gestation reduces muscle fiber numbers, whereas restriction during late gestation reduces both muscle fiber sizes and the formation of intramuscular adipocytes in ruminants (Du *et al*., 2010).

4. Physical activity/ Exercise:

Activity induced muscle growth is accompanied by change in muscle fiber size and number. Endurance training leads to minor changes in skeletal muscle mass whereas strength training induces marked hypertrophy of exercising muscle. Muscle disuse resulting either from experimental designs (Plaster cast immobilization, hind limb suspension, and denervation) can lead to severe muscle loss. Progressive high-resistance exercise leads to muscle fiber hypertrophy by two partial mechanisms, the induction of satellite cell activation and recruitment that leads to increase of muscle protein synthesis.

***5. Growth- promoting Agents*:**

a. Growth Hormone :

In cattle, the growth hormone stimulating response in fiber size is largely dependent on muscle and fiber type. Growth hormone stimulates muscle fiber hypertrophy by an increase number of nuclei in the multinucleated myofiber, increase cytoplasmic volume of the myofiber, or both.

b. β – agonist :

Growth promoting effects on muscle by stimulating fiber growth are exerted by β- adrenergic agonists in various species. Some β- adrenergic agonist e.g. clenbuterol are able to increase skeletal muscle mass and decrease fat deposition in cattle, sheep, pig and poultry. These so-called "repartitioning effects" proved desirable for the livestock industry to improve feed efficiency and meat quality. β- agonist have therapeutic potential for attenuating muscle wasting associated with sarcopenia (age-related muscle wasting), cancer cachexia, sepsis, disuse, burns, HIV-AIDS, chronic kidney or heart failure, and neuromuscular diseases such as the muscular dystrophies.

c. Steroids (Estrogens and Androgens) :

Androgenic and estrogenic steroids significantly enhance feed efficiency, rate of gain, and muscle growth of feedlot cattle; and they have consequently been used as growth promoters in the beef cattle industry for nearly 60 years. The studies in both humans and animals have shown that testosterone treatment increases muscle fiber diameter and the

number of myonuclei present in muscle fibers in a dose-dependent manner. Administration of both trenbolone acetate and estradiol- 17 β, as implants, increased carcass protein accumulation 8 to 10 % in yearling steers (Chung and Johnson, 2008).

6. *Influence of major genes*

In various species, mutations of several major genes influence muscle fiber number and (or) muscle fiber size and fiber type composition of skeletal muscle. The major genes are following:

a. *Myostatin gene in cattle :*

The condition of double-muscling (DM) seen in several cattle breeds such as Belgian Blue (Fig. 1) and Piedmontese is a particular case of excessive muscle fiber formation (hyperplasia). Skeletal muscles of DM cattle contain almost double the number of fibers compared with other cattle breeds, whereas the fibers are of the same size or slightly larger at age. In DM cattle, the double-muscled phenotype arises from mutations in the myostatin gene.

Figure 1: A fullblood Belgian Blue bull showing the double muscling phenotype

b. Callipyge *gene in sheep:*

The callipyge condition in sheep is an example of extreme muscular hypertrophy, associated with extensive muscling in the loin and hindquarters (Fig.2). It is caused by a mutation of the callipyge gene located on ovine chromosome 18. Expression of this phenotype is the only known case in mammals of paternal polar over dominance gene action.

7. *Aging*

The progressive loss of skeletal muscle mass and strength in the very old animals and humans is an important aspect of frailty that is often referred

Figure 2: Normal and extensive hypertrophy in hindquarters.

to as sarcopenia, and it is largely responsible for the weight loss, weakness and impaired locomotion in the aged group. In sarcopenia, fast-twitch (type-IIb) fibers are preferentially lost, whereas slow-twitch (type-I) fibers are more commonly loss in obese individual. Skeletal muscle regeneration is impaired with age and Individual myofibers undergo atrophy or die due to the combined effects of general aging changes in many systems, especially the hormonal and nutritional status, reduced physical activity and a loss of specific nerves (Grounds, 2002). The regenerative ability of satellite cells and number are decline during aging because of age related changes in endocrine factors that alter the myogenic potential.

CONCLUSION

Available studies clearly show that the fetal stage is crucial for skeletal muscle development, as well as for adipose and connective tissue development. Postnatally, there is limited scope to increase the muscle fiber number; however, the environmental and genetic influences can be used to develop practical approaches for altering muscle fiber number in farm animal production.

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Understanding Distinctive Behaviors In Companion Animals

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Abstract:

Most experienced dog owner are familiar with common dog behavior including aberrant behaviors. Understanding behavior problems provides the dogs with intervention in existing management practices. Proper training and socialization is essential component for controlling behavior problems. Barking in dog catches attention towards the clues like warning signal, playfulness or excitement, attention seeking, anxiety, boredom. Sign of true separation anxiety comprised of barking, chewing, unmannered toilet behavior. On the basis of social interaction, dogs are classified into two types, such as submissive and aggressive. Submissive dog are easily managed in human pack as compared to aggressive dogs. Growling, showing teeth, snarling, snapping and biting are all aggressive behavior which harms human being or other animals. Incidence of dog bites increasing day by day due to lack of awareness. We should stay calm and stand still like tree when chased by dog and also avoid screaming for self protection. Bites can be controlled by sterilizing; vaccinating and treating street dog with the purpose of defeating deadly zoonoses.

Cats and dogs are generally considered as companion animals however under Indian condition dog is animal of choice especially in urban culture. Some breeds work as herd protection dog, living among sheep without close human contact. Dog may be trained to produce sniffer for solving criminal cases and also for heat detection in dairy herd. The dog likely to originated from the grey wolf 12000-14000 year ago. Domestication and selective breeding have led to selective breeding have led to variation not only from wolf to dog but also between breeds (Gary, 2014). Variation creates difficulty in interpreting behavior of other dog breeds. Socialization with different breeds of dog is important component of intra-specific communication. Animals express all behavior and instinct when kept in group. Social organization of wolf is used for dog and same model extended to include the

human-dog relationship. However it was reported that interaction between dogs may be influenced more by their specific experiences with each other rather than by overall social structure or hierarchy of group (Bradshaw et al., 2008). Human being and dogs are provided with completely different communication system therefore it is essential to have knowledge of basic behavior of dog for better interaction, management and control (Udell et al., 2008). Communication begins with accepting, understanding cause with tolerance and finishes with positive response. Better relationship with dog starts by working to recognize the meaning and causes behind common behaviors. One could live with a pet/ companion animal without infringing its right (Regan, 1984).

Common behaviors of dog:

Panting

Dogs used to sweat through the pads of their feet. They control heat load by expelling it through there mouth when they pant. Dog some times also pant to cope with pain.

Barking

Most dog bark howl and whine to some extent however excessive barking is always considered as behavior problem. Cause of vocalization should be determined. Common barking in dog catches attention towards the clues like warning signal, playfulness or excitement, attention seeking, anxiety, boredom or reaction towards other dogs.

Chewing

Chewing of toys, objects, shoes, cloths etc. are common in dogs. It occurs mainly to relieve irritation of erupting teeth in growing dogs. Some dog may show the said behavior due to separation anxiety especially with their owners. Other causes include boredom, lack of exercise or excess energy, anxiety and curiosity especially in puppies. Dog should be encouraged to chew right thing like chew toys. Useful items should be kept away from suffering dog. Sharp scolding at the time of chewing unwanted material and replaced with chew

toy. Head halter or muzzle can be used in dogs.

Digging

It is natural instinct in dog robustly expressed in terrier breed of dog because of their hunting histories. Dog in natural pack will dig to hide or uncover foods such as rodents. A small excavation dug in cool earth to provide comfort against heat. Other reasons for digging behavior include boredom or excess of energy, anxiety or fear and to escape or gain access. Digging can be controlled by proper training and by providing additional exercise. A sand box can be kept aside of concrete surface house to satisfy natural instinct in dog.

Jumping up

Jumping up is a dominance behavior in dog. Initially it appears like play behavior or enthusiastic greetings, if encouraged it may create problem as aggressive behavior shown prominently by dogs. Simply the owner should turn away to ignore and avoid the habit. Owner should never make a eye contact, speak or touch while dog is in raised posture. When dog relax and remain still, calmly he may be rewarded.

Aggression

Aggression in dog characterized by growling, snaring, showing teeth, attacking and biting. If it is due to disturbed health, the dog recovers as a result of proper treatment. Training (Plate-1) is also used for controlling the behavior aberration. Successful bondings require identification of aggressive animal and cull them from group. Aggression increases markedly when stranger animals are introduced in group.

Plate-1

Biting

Biting can be traced back to instinct and pack mentality. The dogs could be reacting with aggression, fear or nervousness or defense, pain or sickness, protection to young ones or properties due to disturbed mind set or predatory instinct. Teaching bite inhibition technique, proper training and socialization is essential component for growing dogs.

Separation anxiety

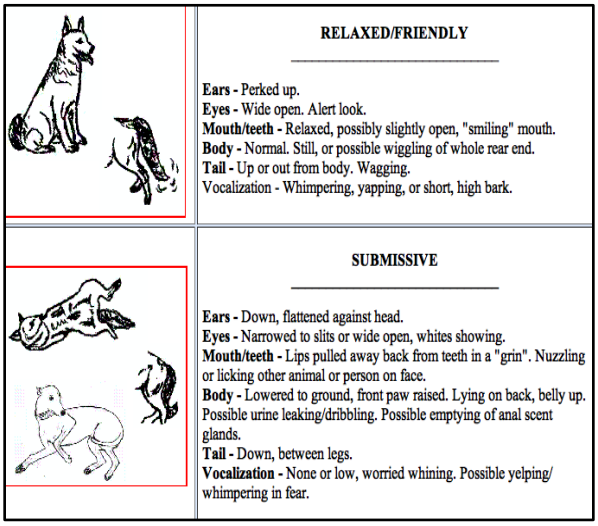
Dogs lives play and travel in packs. It is therefore natural for them to feel anxious when they are separated from there group-mates. Behavioral manifestation includes barking, chewing, unmannered toilet behavior. Sign of true separation anxiety comprised of anxiousness in dog when owner prepare to leave, misbehavior is common during first 15-45 minutes after separation, dogs follow owner constantly with respect to voice, view and touch of owner.

Good foods, nice long walk may be required before leaving dogs alone in the house in calm resting mode. Separation anxiety requires dedicated training, behavioral alteration and desensitization exercises. Medication may be last choice to control separation anxiety.

Undesirable elimination behavior

For controlling disturbed elimination pattern, dog should be thoroughly checked to rule out health problems. The common cause include submissive or excitement urination, territorial marking, anxiety, attention seeking, lack of proper housebreaking (training for toilet

manners) work out. Serious behavioral modification is required using strict



training.

Begging

It is bad habit in dogs; however some dog owners unfortunately encourage it. Begging habit is common cause of problems like obesity and digestive problems. When owner use to sit down to eat, they need to give order to dog to stay preferably where he will not be able to stare at tray, if necessary dog may be confined.

Chasing

It is common predatory instinct in dog. Dogs used to chase other animals, people and moving cars or bikes. All these can lead to dangerous out come. Dedicated training is required throughout life of dog to attend owner all the time. Routine management to suffering dog includes: Dog should never kept un-leashed, dog should be trained to come when called, whistle or noisemaker can be used to catch dog attention when he prepare to chase. Stay aware and watch for potential triggers which stimulate chasing in dogs, and that should be strictly restricted.

Dominant Vs submissive dog: AHS (2007); HSUS (2000)

Dominant dog	Submissive dog
Mounting on other dog male or female it doesn't matter	Submissive urination when greeting other dog
Stealing or guarding toy or food	Turning away when other dog stare
Getting attention from other pack mate	Always loss a tug of war
Leading the pack always	Showing attention and affection to other dogs, especially by licking at mouth
Making other dog wait for them	Backing off when other dogs want to take food or toy
Never licking other dog especially on mouth	Rolling on their back to display their belly
Always wins when dog play tug of war	
Starting and winning contest	

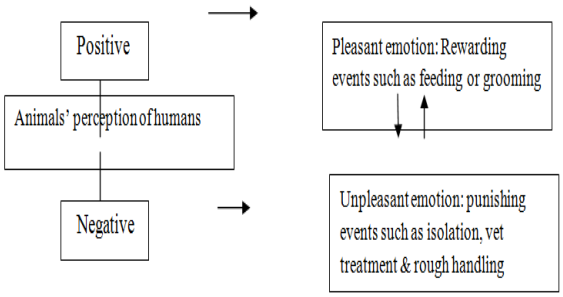
- Submissive dogs are easier to keep at bottom of our family pack structure and will acquire a position subordinate to human pack with less work.
- It is very stressful for a canine animal to have to be pack leader to humans because the humans do not listen to everything they want. Therefore when the human leave without the dog's permission, the dog will upset and some time destructive. But when the human are in charge, the dog will relax and not worry because he knows that leader will back.
- The owner should be the leader of the pack rather follower (Rooney et al., 2000). Following point should be

practiced to control your dogs like spay or neuter the dog, train for obedience, should not be allowed to access our bed or furniture without permission, rewarding desired behavior.

- Feeding bitch with docosahexaenoic acid during transition period has been shown to improve the puppy's brain and retinal development and trainability (Gary, 2014).

Human animal interaction: [Waiblinger et al., 2006]

1. Body language in dog:



2. Posture:

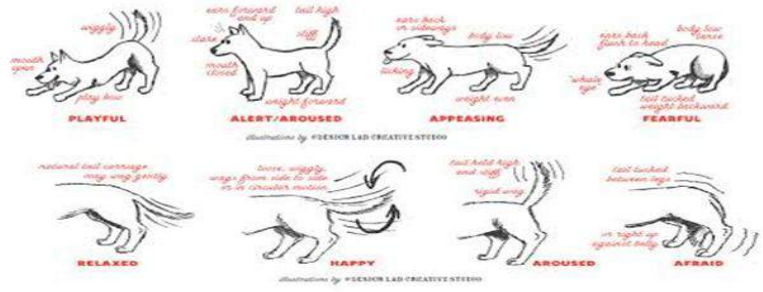


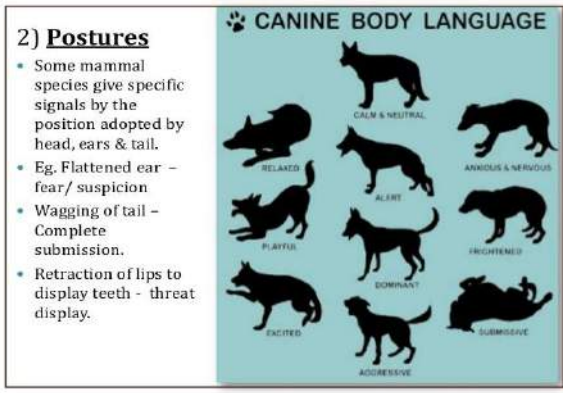
Figure 1: Posterior body language

Figure 2: Facial expressions:

3. Eye language:

1. Happy or relaxed or neutral**:** Iris is visible easily.
2. Aroused or Anxiety: Pupil dilated and vein under eye may also rise
3. Whale eye: White of eye is visible, clear cut sign of stress, fear or arousal.

Precautions to survive dog bites:



We should stay calm and stand still like tree when chased by dog avoid screaming (Yin, 2011; Yin, 2014). We should face side way and avoid staring at dog and keep arm folded and never wave our hand around them. Running away should be avoided as it will trigger a chase response to them. We should try to put some objects like purse or book between dog and us. As dog calm down we can back away. Back should never be turned towards dog as he may bite as we are not looking at him. Carrying a stick or yell should be avoided. Dog actually bite out of fear and if the person they defensively charge or snap at scream and flails, it triggers and even stronger survival attack response. Most dog rush toward us on street are not out to bite. Safe policy is to keep ourselves stay relaxed to avoid dog bite.

Controlling dogs and Rabies:

If dog or other companion animals required to be killed, gentle handling and careful standard euthanasia protocol (Tasker, 2008) will be more acceptable method. Over 55, 000 people are killed by rabies world wide every year, mainly by dog bites (WHO, 2005); Municipal authority attempted to kill street dogs by shooting or beating. However such attempts are not just inhumane but also ineffective due to high prolificacy among survivors. Since 1996, an NGO named "**Help in suffering**" has been working in city of Jaipur, India with humane approach by capturing street dog, sterilizing, vaccinating (against rabies) and also treating for other diseases and then released. This approach showed a drastic decrease in rabies case in viscinity (Reece, 2007).

CONCLUSION

Understanding dog behavior help us to equip to recognize unwanted behavior and controlling accordingly. It gives indication to provide the dogs with proper exercise, discipline and affection. Growling, showing teeth, snarling, snapping and biting are all aggressive behavior which harms human being or other animals. Proper precaution should be taken to reduce incidence of dog bites like stay calm and stand still, avoid running away and try to put something between you and dog. Street dog can be sterilized, vaccinated and also treated for other disease to control deadly zoonoses.

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Boswellia Serrata

And Its Pharmacological Importance

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Traditionally, herbal plants have been used widely and frequently in treating a variety of ailments. Owing to its safety and efficacy it has gained importance since conventional treatment has always been associated with numerous side effects. Among the plants known for medicinal value, species belonging to the family Burseraceae are very popular for their therapeutic potential. Boswelliaserrata, is one such herb known for its various medical evidences.

Historical Background

Boswelliaserrata (BS), a member of family Burseraceae, is a large sized deciduous tree indigenous to India. Known by several names such as Indian olibanum, Indian frankincense, Salai, Salia, Salaiguggal, Kundur, Dhup, Shallaki, Luban, Parangi, Sambrani, Gajabhakshya etc[1], its use in traditional Indian medicine has been described in Ayurvedic texts - Charaka Samhita, 1st – 2nd century AD and Astangahrdaya Samhita, 7th century AD[2].

The bark of this tree exudes an oleo-gum-resin which is used in curing various ailments. In classical Unani texts, *BS* has been noted for properties like anti-inflammatory, anti-pyretic, antiseptic, emmenagogue, carminative, thrombolytic, hemodynamic, cardiotonic, anthelminticand as an antidote[3]. After 20th

Figure 1: oleo gumresin oozing out from the bark

Figure 2: dried gum resin of BS

century, *BS* vanished from medical treatment due to lack of scientific evidence. In 1986, its anti-inflammatory properties[4] were first described in the Regional Research Laboratory in Jammu, India. Later, in 1991, its inhibitory effect on leukotriene synthesis[5] was revealed thereby making it a subject of interest in the scientific world.

Phytochemical studies on *BS*

Boswelliaserrata contains 5-10% essential oils, 7.5-15% volatile oils, 30-60% pure resins, tetracyclic &pentacyclicterpenoids, ~65% polysaccharides and ~23% mucus[6-9]. Among the pentacyclic and tetracyclic triterpenes, a variety of boswellic acids[10] and tirucallic acids[11] have been identified, respectively.

Pharmacological studies on *BS*

The higher and lower forms of the natural resinous terpenoids of *BS* are pharmacologically active in which boswellic acid (BA) is the dynamic functional group[23]. The most prominent of BAs is the β-boswellic acid[24] and AKBA (3-O-acetyl-11-keto- β-boswellic acid) is the most bio-active fraction with potent anti-inflammatory property[25].

Side effects & Toxicity

It appears that the extracts of *Boswelliaserrata* are relatively safe and well tolerated though mild gastrointestinal symptoms were witnessed in some clinical trials. However, the unwanted effects were reversible after omission of the treatment[26]. Toxicity studies of *BS* in various animal models showed no pathological changes at doses up to 1000mg/kg. The LD_{50} of *BS*has been established at >2g/kg[27].

CONCLUSION

Phytotherapy has gained popularity due to toxicity and side effects of allopathic medicines. Many valuable herbs have been evaluated both pre-clinically and clinically. The evidence based evaluation on the metabolites of *Boswelliaserrata*has clearly revealed that the therapeutic effects justify its recorded efficacy in folklore literature.

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Table 1: Chemical composition of different fractions of *BS*

OILS	RESIN	GUM
α & β pinenes[12]	α, β & γ boswellic acids[15]	Moisture[20]
Phellendrene[13]	α & β amyrin[16]	Diastase
Cadinene	β-sitosterol[17]	Oxidase
Camphene	Methyl chavicol[18]	Xylose[21]
p-cymene	Alcohol serratol	Arabinose
d-borneol	Acetoxytirucallic acid	Galactose
Verbenone, Verbenol	Ketotirucallic acid	4-O-methyl-glucono-arabino-galactan[22]
α-thujene[14]	Hydroxytirucallic acid	
d-limonene	β-boswellic acid[19]	
d-emonene	Acetyl- β-boswellic acid	
Geraniol	11-keto-β-boswellic acid	
Elemol	Acetyl-11-keto-β-boswellic acid	

Table 2:Evidence based scientific validation of *BS*

THERAPEUTIC ACTION/EFFECTS	MECHANISMS STUDIED	SCIENTIFIC REFERENCES
Analgesic	Reduction in spontaneous motor activity	Menon and Kar, 1969
Anti-hyperlipidemic	Enhanced cholesterol excretion	Zutshi*et al*., 1980
Immunomodulation	Decreased primary antibody synthesis Inhibition of immunohemolysis	Sharma *et al*., 1988
Anti-arthritic	Reduced degradation of glycosaminoglycans Inhibition of 5-Lipoxygenase (5-LOX) activity Inhibition of leukotriene synthesis	Reddy *et al*., 1989 Ammon *et al*., 1991 Kimmatkar*et al*., 2003

Anti-complementary	Reduced *in vitro* immuno-hemolysis by inhibition of C3-convertase enzyme of the classical complement pathway. inhibition of alternate complement pathway.	Knaus U and Wagner H. 1989
Anti-asthmatic	Inhibition of 5-LOX Mast cell stabilization Inhibition of nitric oxide (NO) malondialdehyde leukotriene C4 (LT-C4)	Ammon *et al*., 1991 Pungle*et al*., 2003 Houssen*et al*., 2010
Polyarthritis	Inhibition of 5-LOX formation in polymorphonuclear cells	Ammon *et al*., 1992
Anti-inflammatory	Inhibition of 5-lipoxygenase (5-LOX) 5-hydroxyeicosatetraenoic acid (5-HETE) Leukotriene B4 (LT-B4) Leukocyte elastase NO IL-1β TNF-α Mitogen activated protein kinase (MAPK)	Singh G B, 1992 and Ammon *et al*., 1993 Safayhi*et al*., 1997 Gayathri *et al*., 2007
Ulcerative colitis	Non-competitive inhibition of 5-LOX	Gupta at al., 1997
Hepatitis-C virus	Inhibition of hepatitis C-virus protease	Hussein *et al*., 2000
Anti-atherosclerotic	Inhibition of LPS-induced NO Increase in serum HDL Prevention of thrombus formation	Pandey *et al*., 2005 Kokkiripati*et al*., 2011
Anti-diarrheal	Inhibition of intestinal motility through L-type calcium channels	Borrelli*et al*., 2006
Wound healing	Fibroplasia Collagen synthesis Wound contraction	Mallik *et al*., 2010
Anti-microbial	Disruption of microbial membrane	Raja *et al*., 2011
Anti-hyperglycemic	Inhibition of islet-destroying cytokines	Shehata*et al*., 2011

Anti-cancer	Inhibition of phosphorylation of extracellular signal-regulated kinase Suppression of proliferation and apoptosis related tumor Reduction in number of dysplastic cells Inhibition of COX-2 signaling cascades Partial up-regulation& modulation of tumor suppressor genes Suppression and down-regulation of cancer-associated biomarkers	Park *et al*., 2011 Liu *et al*., 2012 Takahashi *et al*., 2012 Yadav *et al*., 2012
Diuretic	Increased electrolyte excretion	Asif *et al*., 2012
Anti-oxidant	Sparing glutathione scavenging DPPH Inhibition of nitrite formation superoxide generation	Afsar*et al*., 2012
Anti- depressant	Inhibition of Nitric oxide Oxidative stress Pro-inflammatory cytokines	Prabhakar*et al*, 2013

Initiation Of Poultry Farming:

For The Beginners

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Chicken and its product (egg)is one of the major sources of food or meat, aside from pork and fish. Poultry Farming is little capital intensive but if starting on a micro scale (Home back yard) where in a small space at back yard, it is not. Starting at a small scale is the best way to enter and learn the business. Generally, poultry farming means, raising various types of domestic birds for the purpose of producing foods like eggs and meat. Nowadays, most of the people are using the poultry as the synonym of chickens. Because chickens are the widely raised poultry birds. Along with chickens ducks, geese, turkeys, quails, peacock etc. are also popular domestic poultry birds.

BENEFITS OF POULTRY FARMING

1. Poultry farming is a profitable business opportunity for the Entrepreneurs.
2. It provides a great employment source for the people working within farm.
3. There is a great demand of poultry products like egg without any social taboos.
4. As a commercial production now foreign breeds are available which are much productive.

5. If we start poultry farming it is not expensive at small scale production.

STARTING A POULTRY FARM

1. Infrastructure needed: First requirementis land, second is capital and third one is equipments (cages, feeders, drinkers, incubator, heaters, egg tray). Poultry farming can not be started in a populated environment or residents due to the smell that is associated with poultry rearing and the subsequent health impact, so rural area or in farms is a best option as land as well as labour is cheaper. While selecting land, a great source of sufficient amount of fresh and clean water should be there. Area must have to be free from all types of harmful animals and predators. Market should be near so that products can also be easily

transported to the urban area for sell. The height of the shed is raised by 6-7 feet using concrete pillars. The distance between two pillars is 10 feet. Two feet wide concrete platforms are made over the pillars. When constructing platforms projecting angles or iron rod, the inter-platform distance is 6-7 feet depending upon the type of the cages used. The total height of the house is 20-25 feet and the width is 30-33 feet.

2. Farming system: Three system are there namely Extensive system, Semi-intensive system and Intensive system.

a) Free range/Extensive system

This system is adopted only when adequate land is available to ensure desired stocking density by avoiding overcrowding. We can rear about 250 adult birds per hectare. A range provides shelter, greens, feed, water and shade. Foraging is the major source of feeding for birds. Shelter is usually provided by temporary roofing supported by ordinary poles. The fields are generally used on rotational basis after harvesting of crops by moving of birds from one field to another depending on cropping programme. All categories of birds can be reared in this system. This system is most preferred for organic egg production.Advantage are less capital investment, cost of housing is least, feed requirements are less since birds can consume fairly good amount of feed from grass land and fertility of soil can be maintained.

b) Semi-intensive system

As the name indicates birds are half-way reared in houses and half-way on ground or range, i.e. birds are confined to houses in night or as per need and they are also given access to runs. The houses are with solid floors while runs are fields only. The success of rearing depends on maintenance of condition of runs to reduce the contamination. Runs can also be used on turn basis. The stocking density rate on an average for adult birds is 750 per hectare. This system is usually adopted for duck rearing. The feeding and watering facilities are provided in the pen. Benefits are more economical use of land compared to free range system, protection of birds from extreme climatic conditions and control over scientific operation is some extent possible.

c) Intensive system

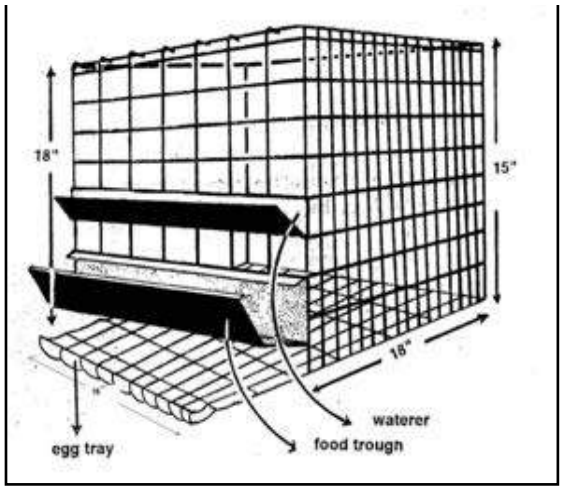
Birds are totally confined to houses either on ground / floor or on wire-netting floor in cages or on slats. It is the most efficient, convenient and economical system for modern poultry production with huge numbers. Advantages are minimum land is required for farming, farms can be located near market area, day-to-day management is easier, the production performance is higher as more energy is saved due to restricted movements, scientific management practices like breeding, feeding, medication, culling etc. can be applied easily and accurately and the sick birds can be detected, isolated and treated easily.

3. Selection of breeds: A high quality productive breeds should be selected for getting better economic returns. For commercial egg production select high productive layer breeds and for commercial meat purpose select highly meat productive broiler poultry breeds. Broiler poultry breeds are breeds that consume food, grow faster and so convert into meat within short time.

Another type is Cockerels, are also like broiler but growing rate is slower than broilers because of hardy and better adaption with the environment they are also used. Layer are type that are commercially use for egg production and can lay eggs upto 300 eggs/year.

4. Management of chicks

Before chicks arrive at home; make sure that;A brooder is in place, Paraffin lamps/electric bulbs/charcoal stove is available, Litter for the floor is available1m^2 will accommodate 20 chicks upto 4 weeks old.Temperature control: 35 ^{0}C for day-old chicks, 24-27 ^{0}C for one week.



6. Cage

Cage system is enough spacious in starting as in a free range system enough space requirement is there. The distance from one house to another house will be at least 40 feet. Suitable drainage system inside the house should be there. Always clean the house and equipment in a regular basis.At 16 weeks of age, pullets (hens which have not yet started to lay) are placed into cages. Floor space for battery cages ranges upwards from 300 cm^2 per bird.

Floor space requirements

Type	Age (in weeks)	Deep-litter (ft^2)	Cages (ft^2)
Egg-type chicken	0-8	0.60	0.20
	9-18	1.25	0.30
	>18	1.50	0.50
Meat-type chicken	0-4	0.30	-
	4-8	0.75	-

7. Feeding

Two major feed ingredients required for

poultry feed are maize and soybean meal. In case of soybean meal,

prices fluctuate depending upon supply and demand position for its exports.Feeder are of two types linear and circular. Linear feeders are usually made of galvanized iron. Number of linear feeders is = 2 × (length of the feeder) ÷ feeder space with all measurements in cm. Circular feeder are semi-automatic feeders and can hold 5 to 7 kg feed in its cone at a time and when completely full, the feed will suffice 4 to 7 days depending upon the age and number feeding on them. Number of hanging feeders = 1.3 × (Circumference ÷ feeder space) in cm.

7. Watering: Waterers or drinkers are used to provide water to the birds. Waterers are available in different sizes, design and shape that is pan/jar type, linear waterer/channel type waters (attached with cages for providing continuous supply of water. Arrangement of drinkers should be at an equal distance of 0.6 m between any two feeders and feeder and a drinker.

8. Lightening: To reduce the harmful effects of feather pecking, cannibalism and vent-pecking, hens in battery cages (and other housing systems) are often kept at low light intensities (e.g. less than 10 lux).

9. Health : The birds in farm need regular health check-up. They need proper vaccines and medications to prevent diseases and promote growth. There should be a consultant, a veterinary doctor who would be in charge of giving vaccinations and providing proper health care for the birds. Chicks need more care after they hatch especially within their first 3 weeks.

10. Marketing of products: Regular monitoring of demand and supply should be there. Instead of concentrating all marketing efforts in the big urban centers, it is necessary to improve infrastructure and develop rural markets where there is a good demand. Infrastructure facilities using modern equipment and machinery for processing preservation and marketing of eggs and poultry meat are required. If the local market located so far from the farm then the products should be carefully transported.

Biosecurity Strategies To Minimise Disease Occurrence And Spread

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The term "Biosecurity" is concerned with the protection and safety of dairy cows (Cullor, 2004). Therefore, biosecurity is increasingly important to include in daily routines for farm management as well as veterinary practice (Anderson, 2010). Dairy farms considering expansion will have to respect sound biosecurity measures in order to maintain disease free herds and sustain maximum production. Infectious diseases can enter a herd through purchased additions or be carried onto a farm by other animal species including humans (Wallace, 2003). Therefore, strict quarantine procedures, more thorough sanitation, increased testing for pathogens and less contact between animals are important (Cullor, 2004). By identifying some of the diseases that are likely to be of greatest risk, prevention and control measures can be developed and implemented to focus on the ones that are most likely to create problems (Wallace, 2003).

Biosecurity means reduce/prevent the introduction of new diseases onto a farm from outside sources. 'Prevention is always better than cure' - because reducing the diseases entering a unit means less time is spent treating the diseases, drug and vet costs are reduced, and herd productivity is not compromised. One of the greatest disease threats to a cow or calf is from other cattle, whether through direct contact or through surfaces, equipment or people contaminated by diseased animals. This threat is greatest when cattle are brought together into housing, particularly at calving, when stress reduces the effectiveness of the animal's immune system. Proper vaccination plays an important role in disease prevention. Medication can also be used once animals are seen to be sick. However neither of these can offer complete, effective and economical protection against the wide range of disease organisms that threaten cattle. Biosecurity completes the armoury of protection, excluding disease organisms from the animal's environment. This is the only way that the cycle of disease can be broken. It is particularly important against the threat of so-called "management diseases", such as calf pneumonia and calf scours which cost the beef and dairy industries large sums of money every year through death, poor growth, poor feed conversion and the cost of medication. Biosecurity can only be achieved through regular and comprehensive routines, using products that are proven to be effective against viral, bacterial and fungal disease organisms. In consideration of the

biosecuirity and hygiene requirements of a dairy farm operation there are many factors involved. Key sides of the issue are the aspects related to the maintenance of the health of the stock, protecting the production potential of the herd and the protection of the quality of the product dispatched from the farm, be that milk or livestock such as calves. Consideration must be given to the maintenance of the required standards in all area of the farm including cubicles, calving facilities, calf rearing, collection areas, milking parlour and dairy. Apart from the obvious need to protect the stock from disease either onto or within the farm, as with all food production chains, the safety of the consumer has to be a paramount consideration. Dairy farm workers provide the first line of defence in keeping dairy cows healthy and content. There are four basic goals for any farm's biosecurity programme:

- ✓ Prevent the spread of disease, both onto the farm and between animals on the farm,
- ✓ Improve animal welfare by keeping the animals healthy,
- ✓ Indentify the disease early if it gets on the farm, and
- ✓ Protect the safety of the food supply.

Following guidelines should be keep in kind consideration:

1. Manage the introduction and movement of livestock in a way that minimises the risk of introducing or spreading infectious disease.

- ✓ Check animals for health status before purchasing.
- ✓ Purchase livestock from suppliers who have a food safety or quality assurance program and can provide information about animal treatments and the health status of their animals.
- ✓ Segregate, observe and treat (as required) newly introduced animals.
- ✓ For livestock that leave and return to the property (e.g. following shows, agistment, contract joining) assess their vulnerability to infection, hygiene arrangements and contact with other livestock while away. If risky, separate. Observe and treat (if needed) the animals before returning them to companions.
- ✓ Inspect and maintain adequate boundary fences.
- ✓ Keep vulnerable stock away from livestock of unknown health status.
- ✓ Take additional precautions if buying through saleyards as these represent a high biosecurity risk.

2. People, equipment and vehicles entering the property are controlled to minimise the potential for property contamination.

- ✓ Limit the unnecessary movement of people and vehicles onto and around the property.
- ✓ Where possible minimise the number of entry points and restrict access to the farm.
- ✓ Define and where appropriate signpost 'permitted access areas' for farm personnel (e.g. veterinarians, livestock agents, AI technicians, hay contractors), delivery and pick-up vehicles (e.g. milk tankers, livestock and feed transporters) and service personnel (e.g. utility company technicians, government officers) and notify relevant operators prior to entry.

- ✓ Keep the milking parlour and associated facilities clean and hygiene at all times.
- ✓ Clean vehicles and equipment if moving from a high-risk area to a lower-risk area.
- ✓ Encourage the use of protective clothing and personal cleanliness when visitors move onto farm.
- ✓ Provide facilities in 'permitted access areas' for farm contractors and visitors to clean boots and equipment on arrival and before departure.
- ✓ Use a Visitor Register to record and monitor the management of visitor activity.
- ✓ Minimise the lending and borrowing of equipment between properties. If lent, ensure it is cleaned before and after use.

3. Feed and water Facility:

- ✓ Inspect stock feed on delivery for evidence of pests, damage and contaminants and manage appropriately. Clean out feed storage areas before unloading new feed.
- ✓ Manage effluent dispersal to minimise disease spread through the contamination of pastures, stockfeed and water.
- ✓ Store stockfeed in a manner that prevents contamination by livestock, vermin, wildlife, feral and domestic animals and other feed types.
- ✓ Rotate stocks to ensure that the oldest deliveries are used first.
- ✓ Cleanout feed bins, water troughs regularly (washout and disinfect).
- ✓ Ensure the quantity and quality of water provided is suitable for livestock.

4. Minimise the potential for wildlife and domestic or feral animals to introduce diseases to livestock.

- ✓ Monitor and manage vermin, feral animal and wildlife populations to prevent impact on stock.
- ✓ Coordinate with neighbours and other local community members to maximise the effectiveness of actions to control weeds and pest animals.
- ✓ Minimise access by feral and domestic animals and wildlife to waste in rubbish dumps (secure waste disposal).
- ✓ Implement control programs for weeds and disease carrying vectors as required.
- ✓ Regularly undertake property inspections to assess possible biosecurity breaches and/or potential for breaches. Correct where necessary.

5. Prevent and control animal diseases on farm by regularly monitoring livestock health.

- ✓ Assess the health status of livestock and implement practices that will protect them from known diseases already in your region.
- ✓ Ensure all personnel responsible for the management and husbandry of livestock are aware of the importance of early detection and reporting of animals exhibiting signs of sickness or deaths.
- ✓ Increase the frequency of inspections of livestock during periods of higher risk, such as increased insect and wildlife activity or growing periods for weeds.
- ✓ Record animal health activities and treatments to maintain herd/flock health history to identify changes,

assist herd/flock management and develop effective herd/flock health strategies.

- ✓ Seek early advice from a veterinarian or government officer in relation to any unusual sickness or death.
- ✓ Ensure all personnel working on-farm are vaccinated for identified risk diseases and, where necessary, vaccinate livestock against zoonotic (animal to human) diseases.
- ✓ Isolate (as required) and treat diseased or vulnerable animals in the event of a disease outbreak.
- ✓ Dispose of carcasses as soon as practical in a way that takes into account environmental and public considerations.
- ✓ Inspect livestock regularly, including during regular management and husbandry procedures, to ensure the early detection of ill animals.

6. All staff understand the importance of the biosecuirity requirements for the operation in which they work and can implement the agreed practices for which they are responsible.

- ✓ Ensure all staff understand their role in the implementation of biosecuirity practices on farm.
- ✓ Good farm hygiene is the responsibility of all the staff on the farm, make sure that all employees know the farms biosecuirity policy and explain the policy to all visitors.
- ✓ Ensure staff responsible for livestock husbandry know how to identify sick and injured livestock.
- ✓ Ensure all staff know what to do in the event of a suspected emergency animal disease.

7. Disposal of dead animals and waste is managed to minimise the spread of disease.

- ✓ Secure and contain disposal areas where possible to prevent access by livestock, feral and domestic animals and wildlife.
- ✓ Select disposal areas to avoid the potential spread of contaminants by water.
- ✓ Dispose of carcasses and waste in a segregated area, where possible, taking into account environmental and public considerations.
- ✓ Ensure controls for the potential spread of disease from effluent are in place.
- ✓ Use vegetation in plantations or windbreaks to reduce effluent transfer.
- ✓ Ensure government requirements for carcass, effluent and waste management are adhered to where applicable.

CONCLUSION

Careful attention to the points discussed can dramatically reduce the cost of disease on a farm and improve quality of production and profitability.

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Hindgut Fermentation In Horses

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Hindgut fermentation is a digestive process seen in monogastric herbivores, animals with a simple, single-chambered stomach. The microbial fermentation occurs in the digestive organs that follow the small intestine, namely the large intestine and cecum. Examples of hindgut fermenters include proboscideans and large odd-toed ungulates such as horses. In contrast, foregut fermentation is seen in ruminants such as cattle which have a four-chambered stomach which digests cellulose. Hindgut fermenters generally have a cecum and large intestine that are much larger and more complex than those of a foregut or midgut fermenter. Hindgut fermenters are able to extract more nutrition out of small quantities of feed. The large hind-gut fermenters are bulk feeders: they ingest large quantities of low-nutrient food, which they process more rapidly than would be possible for a similarly sized foregut fermenter. The main food in that category is grass, and grassland grazers move over long distances to take advantage of the growth phases of grass in different regions. The ability to process food more rapidly than foregut fermenters gives hindgut fermenters an advantage at very large body size, as they are able to accommodate significantly larger food intakes. Hindgut fermenters are subdivided into two groups based on the relative size of various digestive organs in relationship to the rest of the system: colonic fermenters tend to be larger species such as horses, and cecal fermenters are smaller animals such as rabbits and rodents. However, in spite of the terminology, colonic fermenters such as horses make extensive use of the cecum to break down cellulose. Also, colonic fermenters typically have a proportionally longer large intestine than small intestine, whereas cecal fermenters have a considerably enlarged cecum compared to the rest of the digestive tract.

DIGESTIVE ANATOMY OF THE HORSE

The digestive system can be classified into two functional parts: the foregut and the hindgut. The foregut is comprised of a small, simple stomach followed by a long, narrow small intestine. The stomach and small intestine are where most of the protein, fat, vitamins, minerals and about half of the soluble carbohydrates are

enzymatically digested and absorbed in a manner similar of Pig. The hindgut is comprised of the caecum and the colon. The hindgut functions in a manner similar to the rumen of cattle in that it is a large, voluminous organ which contains billions of bacteria and protozoa which ferment fibre and the remaining soluble carbohydrates into volatile fatty acids which are then absorbed into the bloodstream and utilised as a source of energy by the horse. The horse is therefore classified as a **hindgut fermenter** or **non-ruminant herbivore** and is somewhere between a ruminant and a monogastric in its utilisation of feedstuffs. Horses are classified as herbivores, or roughage eaters. Unlike most other herbivores, the digestive system of the horse is considered monogastric rather than ruminant.

Although the horse lacks the complex forestomach of a ruminant, unique characteristics of its large intestine, or hindgut, allow the horse to utilize cellulose and other fermentable substrates in much the same way as ruminants.The large intestine of the horse has a greatly enlarged cecum which serves as a fermentation vat. Billions of bacteria and protozoa produce enzymes that break down plant fiber, In the horse, this fermentation process occurs posterior to the area where most nutrients are absorbed, and as a result, horses do not obtain all of the nutrients sysnthesized by microorganisms in the large intestine.

Hind Gut Fermentation and its importance

- Hind gut fermentation is a mode of digestion similar to rumination.
- The main similarity is that a large population of bacteria ferment feedstuffs – particularly fibre.

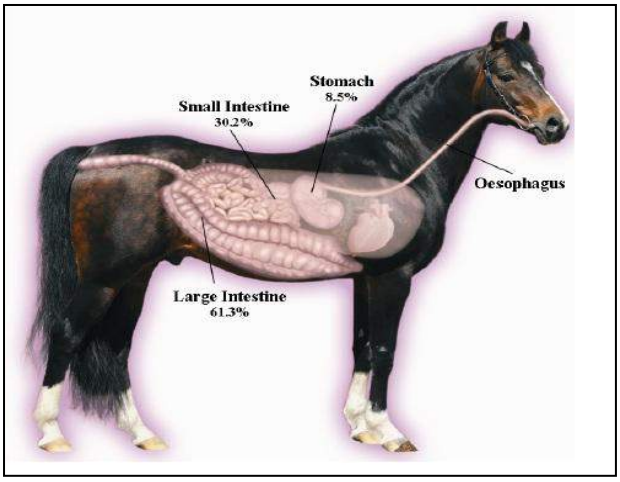


Fig 1: Depicts the Anatomical proportion of Digestive system of Horse

- The main difference is that the site of fermentation is in the caecum and colon which is at the end of the digestive tract hence the term 'hind gut fermenter'
- Hind gut fermenters are single stomached animals with enlarged chambers to house the fermenting microbial.
- Clearly the dimensions of the gut components are different between species, but are in proportion to the size of the animal.
- The horse is generally considered to represent the best model for nutrition of hind gut fermenters because most research has been conducted on domesticated species.

Hindgut Fermentation in Horse

Microbial digestion (fermentation):

There are three main distinctions between microbial fermentation of feed and digestion brought about by the horse's own secretions:

- The β-1, 4-linked polymers of cellulose are degraded by the

intestinal micro flora but not by the horse's own secretions.

- ❖ The cell walls of plants contain several carbohydrates (including hemicellulose) that form up to half the fibre of the cell walls of grasses and a quarter of those of clover. These carbohydrates are also digested by microorganisms, but the extent depends on the structure and degree of encrustation with lignin, which is indigestible to both gut bacteria and horse secretions.
- ❖ During their growth the microorganisms synthesize dietary indispensable (essential) amino acids.
- ❖ The bacteria are net producers of water-soluble vitamins of the B group and of vitamin K2.

Products of fermentation

The microbial fermentation of dietary fibre, starch and protein yields large quantities of short-chain VFAs as by-products, principally acetic, propionic and butyric acids. This fermentation and VFA absorption are promoted by:

- ➢ The buffering effect of bicarbonate and Na^+ derived from the ileum.
- ➢ An anaerobic environment.
- ➢ Normal motility to ensure adequate fermentation time and mixing.

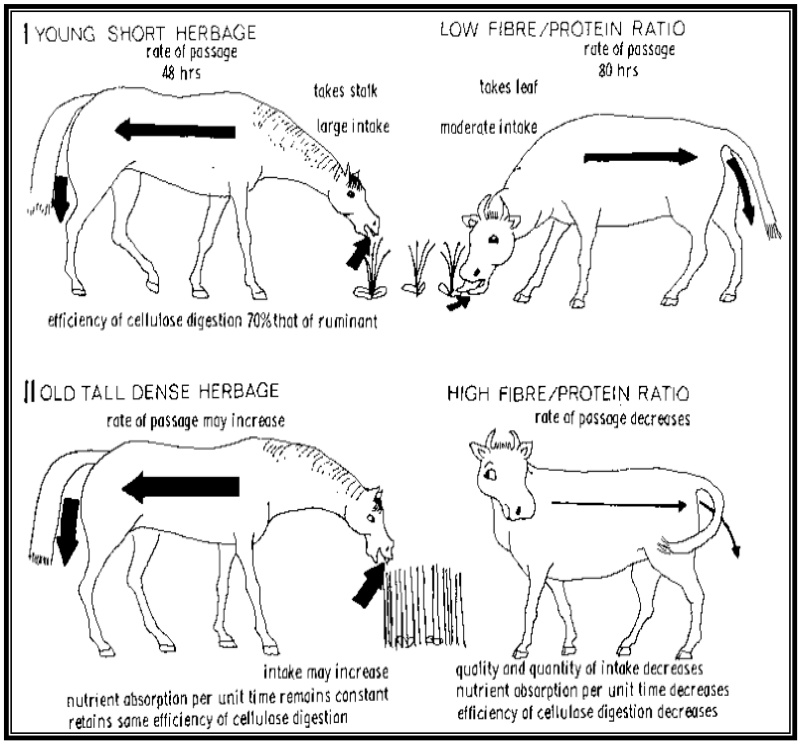
Acetate and butyrate are major products of fibre digestion, whereas the proportion of propionate increases with increasing proportions of starch left undigested in the small intestine. In the pony, limited evidence indicates that 7% of total glucose production is derived from propionate produced in the caecum.

VFA, fluid and electrolyte absorption in the large intestine

The VFA produced during fermentation would soon pollute the medium, rapidly producing an environment unsuitable for continued microbial growth;

Proportion of VFAs in digesta to body weight (BW) in four herbivores (Elsden *et al*., 1946).

SPECIES	g VFA/kg BW
Ox	**1.5**
Sheep	**1.5**
Horse	**1.0**
Rabbit	**0.5**



In addition to this absorption there is the vital absorption of large amounts of water and electrolytes (sodium, potassium, chloride and phosphate).

Fluid absorption

The largest proportion of water that moves through the ileocaecal junction is absorbed from the lumen of the caecum and the next largest is absorbed from the ventral colon. This aboral decline in water absorption is accompanied by a parallel decrease in sodium absorption. In the pony, 96% of the sodium and chloride and 75% of the soluble potassium and phosphate entering the large bowel from the ileum are absorbed into the bloodstream.

VFA and lactic acid production and absorption

These proportions also differ in the organs of the large intestine. Thus, proportionately more propionate is produced as a consequence of the consumption of a starch diet and the caecum and ventral colon yield more propionate than the dorsal colon does. Many bacteria have the capacity to degrade dietary protein, so yielding another blend of VFA.

Absorption of VFAs is accompanied by a net absorption of NaCl. This in turn is a major determinant of water absorption. The ingestion of a large meal can cause a 15% reduction in plasma volume, ultimately resulting in renin–angiotensin, and then aldosterone, release. Most of the ruminal butyrate is metabolized in the mucosa before entering the bloodstream, in horses all VFAs pass readily to the blood. Lactic acid produced in the stomach is apparently not well absorbed from the small intestine. On reaching the large intestine some is absorbed, along with that produced locally, but much is metabolized by bacteria to propionate.

Microbial activity inevitably produces gases – principally carbon dioxide, methane and small amounts of hydrogen – which are absorbed, ejected from the anus, or participate in further metabolism. The gases can, however, be a severe burden, with critical consequences when production rate exceeds that of disposal.

Protein degradation in the large intestine and amino acid absorption

Microbial growth, and therefore the breakdown of dietary fibre, also depends on a readily available source of nitrogen. This is supplied as dietary proteins and as urea secreted into the lumen from the blood. Despite the proteolytic activity of microorganisms in the hind-gut, protein breakdown per litre is about 40-fold greater in the ileum than in the caecum or colon, through the activity of the horse's own digestive secretions in the small intestine.The death and breakdown of microorganisms within the large intestine release proteins and amino acids. The extent to which nitrogen is absorbed from the large intestine in the form of amino acids and peptides useful to the host is still debated.

Isotope studies indicate that microbial amino acid synthesis within the hind-gut does not play a significant role in the host's amino acid status. Absorption studies have shown that, whereas ammonia is readily absorbed by the proximal colon, significant basic amino acid absorption does not occur. S-amino acid absorption may occur to a small extent.

Urea production

The digestion and fermentation in, and absorption from, the large intestine, account, in net terms, for 30% of dietary protein, 15–30% of dietary soluble carbohydrate and 75–85% of dietary structural carbohydrate. The salient causes of variation in values for each of the principal components of the horse's diet are:

- The degree of adaptation of the animal;
- The processing to which the feed is subjected; and
- The differences in digestibility among alternative feedstuffs.

Manipulation

Increased digestibility was observed in this study when yeast was supplemented with the low quality hay, and is probably related to the yeast culture enhancing a negative condition in the hindgut created from a poor quality diet. Further, studies have shown numerical increases in digestibility of CP (Switzer *et al*., 2003) and ADF, NDF, and hemicellulose (Godbee, 1983) when yeast culture was supplemented in the diet of mature horses. More research is needed to expand these observations.

Yeast supplementation with low quality hay, DM, OM, NDF, ADF, cellulose, hemicellulose, DE, and CP all showed numerical increases, with all except OM and DE significant ($P < 0.15$). It appears that yeast culture supplementation favourably enhance digestion. Yeast culture and other probiotics favourably alter the microbial environment in the hindgut (Fuller, 1997). The p^H is maintained more desirably, and yeast culture provides additional nutrients for the microbes to thrive, thus increasing the total number of viable organisms (Fuller, 1997). Yeast culture can provide enhanced microbial environment conditions and/or increase the total number of hindgut microorganisms, then digestibility of forages may be improved, since the hindgut and more specifically the activities of the hindgut microorganisms are responsible for fibre degradation. A possible added benefit for feeding probiotics is therapeutic and helps when an animal is diseased or in poor nutritional health.

A more extensive use of non-starch carbohydrate feeds to allow a manipulation of the dietary carbohydrate composition, aiming at modifying the relative proportions of sugars, starch, and fermentable fibre in the ration, may cause beneficial alterations in the energy and glucose metabolism of the exercising horse (Lindberg). Yeast supplementation increase apparent calcium digestibility ($P=0.08$) (Brown, 2004). More positive effects is observed in growing horse trials (Glade and Sist, 1988), with mares in gestation or lactation (Glade, 1991), and geriatric horses (Switzer *et al*., 2003). Positive results were also observed when horses were supplemented with a dried, live yeast culture (Koul *et. al*., 1998), rather than when supplemented with a killed yeast culture.

Hindgut fermenters have an enlarged hindgut as opposed to foregut, as the ruminants do, for microbial fermentation to take place. Hindgut fermentation provides advantages and disadvantages.

Post-Gastric (Hind Gut fermenters)

- Mainly equides, Elephants, Koalas, Wombats, Possums, Rabbits and Rodents.

Strengths :

- More rapid rate of digesta passage & processing of digestible fraction.
- Low quality component is excreted so the animal can begin eating again.
- Selective fermentation after enzymatic activity Cell contents digested in the stomach & duodenum, fibre is fermented in the colon.
- Features of Post-Gastric Fermenters - Soluble nutrients (sugars & amino acids) are absorbed before fermentation no microbial costing to digestibility of cell contents. Some bacterial vitamin synthesis & absorption.

Weaknesses

- Lower digesta retention time, thus less effective fermentation via microbial cellulases.
- Location of caecum makes regurgitation impossible.
- Some microbes and products (vitamins & protein) are lost in faeces.
- No recycling of nitrogen.
- The large intestine of horses and other hindgut fermenters is a fermentation system analogous to the rumen. The process of fermentation that occurs in the hindgut is essentially identical to that which occurs in the fore stomachs of ruminants.
- Most importantly, horses survive as herbivores because volatile fatty acids are produced in large quantities, absorbed through the caecal and colonic epithelium, and distributed for use throughout the body.
- One significant difference from the ruminant strategy is that that large quantity of microbial protein generated in the equine large gut is wasted because there is no opportunity there for significant absorption of amino acids.

The Products of Fermentation

The principle VFA is acetic, propionic and butyric acids, which collectively provide for the majority of a herbivore's energy needs. The ratio of these VFA's varying with diet, although the majority product is always acetate. On a diet high in fibre, the molar ratio of acetic to propionic to butyric acids is roughly 70:20:10.

In caudal fermenters, much of the dietary protein is digested and absorbed prior to the large gut, but in ruminants, all dietary protein enters the rumen. The bulk of this protein is digested by microbial proteases and peptidases. The resulting peptides and amino acids are taken up by microbes and used in several ways, including microbial protein synthesis. However, large quantities of amino acids ingested by fermentative microbes are deaminated and enter some of the same pathways used for carbohydrate metabolism. The net result is that much of dietary protein is metabolized to VFAs.

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Role Of Prostaglandins

In Bovine Reproduction

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Prostaglandins are tissue hormones and are also known as 'autocids' or 'local hormones'. There are four prostaglandin groups, which are A,B,E and F according to their structure and function. Out of these, PGF2α and Prostaglandin E are the most important ones which have direct effect on reproductive organs and fertility. Prostaglandins are synthesized from arachidonic acid. Fluprostenol, Cloprostenol, Dinoprost, Tiaprost and Luprostiol synthetic PGF2α analogues (Tenhagen and Heuweisier, 1999). Prostaglandins have ecbolic properties and used to expel intraluminal uterine contents as well as cause lysis of the corpus luteum.PGF2α and its analogues are applied in different ways including intramuscular intrauterine, intravenous, intraovarian, intracervical and intravulvo-submucosalroutes. PGF2α acts as a potent luteolytic agent, which causes functional and morphological regressionof the corpus luteum in cattle (Colak et al., 2008).It alsocauses the myometrium contraction and partialcervical relaxation.

Role of prostaglandins in management of anestrus

Cows diagnosed as anestrous include cows that fail to ovulate and those that ovulate in the absence of behavioral estrus. For management of anestrum, prostaglandins may be in used in conjunction with progesterone. A progesterone releasing intravaginal device (PRID) is inserted in vagina for 7 days and a single injection of prostaglandin is administered one day before implant removal. Animal returns to cyclicity with in approximately 56 hrs after prostaglandin injection. In anestrum due to persistence of corpus luteum, a single dose of PGF2α results in function and structural regression of corpus luteum ultimately leading to onset of ovarian cyclicity with in 48-72 hours.

Managament of diseased uterus with prostglandins

The deficiency of myometrial contraction after parturition results in reduced uterine clearance and thus may results in retention of placenta, endometritis or pyometra. If the corpus luteum persists, serum progesterone level increases. Under the influence of progesterone, blood supply to uterus decreases and also the infilteration of leucocytes.

Administration of prostaglandin results in luteolysis leading to decrease in progesterone level and increase in estrogen level and thus stimulation of uterine defence.In diseased uterus, like in case of endometritis and pyometra, there is deficient production of endogenous prostaglandins. Exogenous administration of luteolytic doses of PGF2α (cloprostenol sodium @ 500 Ug and dinoprost @ 25 mg) results in demise of corpus luteum and increase in myometrial contractability which helps in expulsion of the exudate accumulated in the uterine lumen.

Role in enhancement of breeding efficiency

Reproductive disorders occur frequently in dairy cows and and can dramatically affect reproductive efficiency. Some of these disorders include cystic ovaries, twinning etc. twinning is generally considered undesirable in dairy operations because it frequently results in abortion and thus reduced reperoductive efficiency. Reproductive efficiency can also be increased by estrus synchronization and artificial insemination. Estrus can be synchronized in large number of animals and the animals can be inseminated at a predetermined time without detection of external signs of heat. This reduces labour cost and ultimately results in improved reproductive efficiency and pofitability.

Other applications of prostaglandins

1. Premature induction of parturition
2. Termination of unwanted pregnancy
3. Resumption of postpartum ovarian cyclicity
4. In Superovulation and embryo transfer

CONCLUSION

Prostaglandins alone or in combination with other hormones can be efficiently used in management of anestrus, synchronizing estrus in postpartum cows and in improving reproductive effeciency and profitability of dairy herd.

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