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Dwindling Breeds of Livestock

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The Dwindling Breeds of Livestock in India

A.R. Ahlawat and H.A. Sharma

Department of Animal Genetics and Breeding
College of Veterinary Science & A.H.
Junagadh Agricultural University, Junagadh-362001

Livestock breeds are important components of global biodiversity, particularly because they provide the genetic basis to response changes in future breeding goals. Their extinction would mean the loss of genetic resources that help animals overcome disease and drought, particularly in the developing world. Though certain species of wild animals have hogged the attention of conservationists, India is losing its precious wealth of genetic resources in domesticated animals. Native breeds are being lost due to misdirected crossbreeding with exotic stock, indiscriminate crossing of native stocks and slaughter of animals for export. Though domestic purebred animals are well-adapted to adverse climatic conditions and disease, because of their low productivityare gradually being replaced by crossbreeds.

The Indian subcontinent is amongst the 12 mega biodiversity resource centres in the world. The spectrum of bio-diversity is exceedingly vast and varied in this subcontinent. During the domestication process of livestock and birds, a large number of breeds/types of cattle, buffaloes, sheep, goats, pigs, horses, camels, mithuns, yaks, dogs, cats, chickens, ducks, geese, turkeys, guineafowls and pheasants have evolved over time through natural selection and some human effort.

More recently, modern breeders have applied the science of genetics and breeding to produce more efficient, high producing farm animals mainly through crossbreeding with exotic germplasm. In the process, the populations and genetic base of several valuable indigenous/native breeds and strains of animals are shrinking rapidly. As a well-known fact, the indigenous or native breeds have been found to have certain unique characters like specific milk protein type, which is more beneficial for human health than milk from exotic and cross breed cattle. The native breeds have following merits over exotic breeds viz. better disease resistance than exotic breeds, more suitability for low input management system, better survival in local environment and suitability for draught work. In addition, existence of superior indigenous breeds can provide valuable research inputs for developing superior breeds. It is therefore important that the local/indigenous breeds of cattle are conserved, developed and proliferated.

PREFERENTIAL BREEDING

One of the major reasons why domestic animals in India came to be neglected was blind acceptance of Western notions of what constitutes a 'good breed'. Breeds-a selected group of animals of the same species, with distinctive inheritable traits-have adapted to local conditions over thousands of years. In this period, genes for many fitness traits have been tested. Each breed thus consists of a unique pool of genes. Some highly productive exotic breeds were promoted in the last three decades to meet the rising demand for animal products. The semen (or germplasm) of these 'elite' breeds was used extensively for crossing with indigenous breeds, leading to large-scale propagation of a few exotic breeds at the cost of the native breeds, some of which are now truly endangered.

Indigenous breeds have abilityto adjust their productivity to adverse climatic conditions and availability of food. They can thrive welleven on low quality nutritional feed. They are resistant to diseases peculiar to the region in which they have evolved. 'Elite' breeds, however, are productive only in ideal, disease-free conditions. In the long run, exotic breeds are economically not viable. Though domestic animals have unique genetic traits, due to faulty breeding policies and lack of proper monitory their economic value has not been established.

In case of cattle and poultry, it was realised many years ago that populations of native breeds are declining alarmingly. However, realising the potential of genes of domestic and wild animals found in India, developed countries took samples of their tissues and patented them. These countries are now selling germplasm of Indian breeds to India for a profit, even as they are on the verge of extinction in their home country.

THE RESERVOIR OF GENETIC RESOURCES

There are various types of domestic animal genetic resources exist in India. There are 40 breeds of cattle and 13 breeds of buffalo. Among the smaller hoofed animals, 42 breeds of sheep and 26 breeds of goat have been identified. Nine breeds of camel are known, and six breeds of horses are native to India. There are 17 breeds of domestic fowl, in addition to native pigs, mithun and yak (19th livestock census, 2012).

With a repository of one-ninth of the germplasm of cattle breeds in the world and all breeds of the riverine buffalo (as distinct from the swamp buffalo, found in Southeast Asia), India is definitely rich in these resources. Its share of world genetic wealth in sheep, goat and cattle is around 20 percent, 33 percent and 16.5 percent, respectively. Ladakh and the Northeast are also home to some unique domesticated breeds (FAO, 2012).

The adaptation of native breeds to Indian conditions comes with a cost of low productivity. Therefore, introduction of genes from exotic breeds was considered by those interested in raising productivity-farmers and the Indian government in the past during 1960's.

ROLE OF ARTIFICIAL INSEMINATION

Artificial insemination is the easiest way to spread the genes of higher genetic merit. Due to lack of scientific knowledge at the ground level workers, continuously increasing demands of animal product and defective breeding policies led the indiscriminate crossbreeding through

artificial insemination. As the first (F_1) generation were found to higher productive, result of indiscriminate crossbreedingappeared to be an easy way to produce animals with higher productivity. Starting in the 1960s, exotic germplasm was used to increase the productivity of native animals. However, this led to loss of many of the local breeds. Moreover, since the imported breeds were not adapted to their new environment, their performance over generations declined.

A number of animal husbandry scientists have expressed dissatisfaction with Indian crossbreeding programmes. Initially, crossbreeding with Jersey and Holstein germplasm was to be under taken on nondescript cattle to improve their performance. The programme was actually implemented using well-defined breeds whose performance was satisfactory. But, later on as the successive generations of crossbred cattle have shown a decline in milk yield.

Moreover, cattle diseases have been imported along with exotic germplasm. Certain diseases to which Indian cattle were resistant have become sensitive and even fatal with the import of some of new strains of microbes. It is not merely coincidence that increased mortality due to foot-and-mouth disease,blue tongue, theileriosis and many of other diseases, has coincided with the import of foreign germplasm.

CATTLE BREEDS

There are 40 well defined breeds of cattle in India, constituting around 20 percent of the country's total cattle population. The remaining 80 per cent of the cattle are referred to as non-descript and are generally named after the region from which they originated. For optimal productivity of the animal, attention should be paid to the breeding partners that should possess good characteristics such as high milk yield, but it is practiced.

There is great variation in body size, colour, pattern, horns and other physical characteristics of Indian breeds, apart from yield and use. The indigenous cattle breed Zebu (*Bosindicus*) differs substantially from the European (*Bostaurus*). Zebu can be classified into three sub-types: dairy breeds, dual-purpose breeds (used for draught, with medium milk yield), and draught cattle. Like other native animals, Indian cattle are well-adapted to adverse tropical climatic conditions and resistant to many diseases. It is precisely for these qualities that they have been used for crossbreeding in other countries viz. Brazil, Mexico, USA and Venezuela. But in India the number of pure-bred cattle has declined drastically due to indiscriminate crossbreeding (Kumar and Singhal, 2006). The Siri cattle of Sikkim and the local cattle of Himachal Pradesh and the hills of Uttar Pradesh are excellent for draught work at high altitudes. The cattle of Assam and Bengal are useful for agricultural operations on small holdings and terraces. The Hariana breed, renowned in rural north India for its draught power and milk production, specially in its native tract in Haryana (Rohtak, Bhiwani and Sonepat, and adjoining areas of Rajasthan, Punjab and Uttar Pradesh) is facing the effects of the Green Revolution. Mechanisation and commercialisation of agriculture (which led to shrinking areas for grazing), over-enthusiastic crossbreeding and the emergence of buffaloes as commercial

dairy animals have sounded the death knell for the breed. There is need to reverse thetrend of decline in pure bred local breedsin their native tract. Improvement of such local breeds should be carried out by selecting superior dams and bulls for breeding as the animal husbandry department in many of the states do not possess enough semen of superior bulls.

The fate of a breed depends on the number of pure-bred females available for perpetuation of the breed. In some breeds this number is dismally low. Hence,it seems that Red Sindhi, Sahiwal and Punganur cattle breeds are heading towards extinction. Genetic dilution of the Siri breed in Sikkim is likely to threaten its existence in the future. The 10 per cent increase in cattle population in the state between 1982 and 1995 is due entirely to increase in crossbred cattle.While these cases show lack or misdirection of effort, the case of the Vechur cow is an ideal example of conservation of a near-extinct breed through certain interests.

BUFFALO BREEDS

With a population of nearly 108.7million, the buffalo is mainly used for dairy purposes. India possesses nearly all breeds of riverine buffalo, many of them are good milch breeds such as Murrah and Nili-Ravi in Haryana and Punjab, Jaffrabadi, Surti and Mehsana in Gujarat, and the Nagpuri in Maharashtra and Andhra Pradesh. The Bhadawari breed of Uttar Pradesh is known for its high butterfat milk. The eastern states have swamp-type buffaloes that can be used to plough paddy fields. The wild Asiatic buffalo is found in the Kaziranga reserve forest in Assam and other north-eastern states. Many view the germplasm of the Bhadawari extremely valuable for conservation. Bhadawari buffaloes have a high milk yield and are good draught animals. However, a preliminary nbagr survey of 40 villages in its native tract in Uttar Pradesh and Madhya Pradesh some years ago revealed that just one village had 20 buffaloes, while the rest had only two or three. The pure Bhadawari species has dwindled to a population of only several thousand because of cross species breeding with the Murrah buffalo. In the area of Uttar Pradesh, India, Murrah buffalo traits are becoming more common. The Bhadawari and the Toda (raised by the Toda tribe in the Nilgiri hills) breeds are heading towards extinction. Unless the native breeds could be put to some economic use, conservation efforts will not serve any purpose. For conservation, the breed has to be utilised, for which its genetic traits need to be investigated and mapped.

Though Murrah is famous and most widely used breed of Indian buffaloes, the fate of Murrah buffalo in its home tract (Rohtak, Jind and Sonepat districts in Haryana) is no better due to continuous decline in purebred Murrah buffalo. There was an 11 per cent increase in milk production in Haryana between 1982 and 1987, average milk yield had declined. This is an alarming trend, since India is supposed to have the best buffalo germplasm in the world. The decline has been attributed to mismanagement. Superior animals have been ignored by breeders and artificial insemination facilities are inadequate. Farmers favour natural breeding of their buffaloes and select bulls on the basis of body weight rather than their dairy merit. Therefore,

successive generations just do not show the genetic potential for high milk yield.

Another disturbing trend is increase in the number of high-yielding buffaloes exported from rural areas. The cost of maintaining buffaloes when not in milk and declining yields over the years induces affluent farmers to sell them off to slaughter houses in cities, from where the beef is exported. When buffaloes which have the genetic potential for high milk yield are slaughtered, the number of fertile generations is reduced to one or two, affecting the number of breeding females. Hence, there is no replacement of these animals in the breeding tract leads to decline in population.

Toda

There are various factors that affect the Toda buffalo population. Deforestation and shrinking of pasture land/savannah grazing land (the original pasture land has been reduced due to afforestation programme by forest department by planting eucalyptus and wattle trees) are the main causes for decline in population. Now a days, due to modern civilization full time pastoralism is decreased among Toda tribals. Besides, the Toda buffaloes are being preyed upon by wild animals viz. panthers, tigers and red dogs.

SHEEP AND GOAT BREEDS

The wide genetic variability in the sheep and goat population is present in India. The total sheep in the country was 65.06 million numbers in 2012, declined by about 9.07% over previous census in 2007 (19th livestock census, 2012). According to the Scherf(2000), there are 60 breeds of sheep in India. This list includes both well recognized and lesser known breeds along with some wild species. Large-scale introduction of Merino type of sheep by the government in the last few decades has led to near extinction of native breeds which yield wool in Jammu and Kashmir.Nilgiri sheep is a breed of sheep found only in Nilgiri district of Tamil Nadu State in India. It is bred in the hilly parts of Nilgiri and known for its fine wool. This breed is facing extinction since there is no demand for wool in the state and slaughtering is indiscriminate. The population of Nilgiri sheep has reached to around 10,000 some years ago and is continuously decreasing.

Muzaffarnagari, one of the largest breeds of sheep, is native to western Uttar Pradesh. Small land holdings and growth in agriculture has reduced grazing opportunities for these sheep, endangering their existence. Others breeds whose populations have shown a decline are the Malpura, Chokla and Jaisalmeri in Rajasthan; the Changthangi and Tibetan from the higher Himalayan rangesdue to smaller flocks are scattered inlarge area offragileecology;Gurej, Bhakarwal, Karnah andPoonchi breeds of Jammu and Kashmir due to Indiscriminate crossbreeding with exotic fine wool breeds. The Malpura, which yields a substantial amount of wool, is bred by nomads in Jaipur, Tonk, SawaiMadhopur, Chittorgarh and Bhilwara districts in Rajasthan. These areas fall in the migratory route of Marwari sheep, which yield more wool. Farmers cross the former with the latter for improved wool productivity.

Mandya breed of sheep which is a native of Karnataka has also shown a declining trend. The high incidence of cryptorchidism has been attributed as the reason for decline in population. Garole

breed of sheep, native of West Bengal,though not endangered, indiscriminate crossbreeding to improve its wool productivity may threaten its existence. India is a rich repository of goat genetic resources having 26 well-recognized goat breeds. According to 19th census, 2012the Goat population has declined by 3.82% over the previous census and the total Goat in the country was 135.17 million numbers in 2012.Goats are widely distributed and well-adapted to the climatic conditions in the regions they inhabit. Well-known breeds which are endangered are the Changthangi and Chegu in the higher Himalaya, the coarse-hairedGaddi goat of Himachal Pradesh,Jakhrana breed of Rajasthan and Beetalbreed of northwestern India.

POULTRY BREEDS

There are 17 indigenous breeds of chickens, which have evolved from the Red Jungle Fowl. All of them are facing extinction. The Red Jungle Fowl, originally found all over India, is now confined to the Terai forests of Uttar Pradesh and Assam. The Aseel (originally found all over Andhra Pradesh, up and Rajasthan) and Kadaknath (native to Jhasma and Dhar districts in western Madhya Pradesh) are rarely seen today. The Naked Neck, Aseel and Kadaknath, which are highly prized for their meat, have been replaced by high egg-laying, fast-growing European and North American broiler breeds. Though Indian poultry breeds have some unique traits, due to lack of information in local community about native poultry breeds and introduction of modern varieties are near to extinction.The Naked Neck, for instance, which originates from the west coast of India, has a bare neck, apparently due to a thermoregulatory gene which helps it to cope with heat stress. In USA, Naked Neck is widely used due to this quality for crossbreeding with White Leghorn. These developed crossbreed have good adaptability to heatstress, which is not found in exotic breeds.Meat of Kadaknath has good Medicinal values. Besides these, a large variety of duck, turkey, partridge and quail are found in different parts of the country.

CAMELS

Camel population has decreased by 22.48% over the previous census and the total population of camels in the country was 0.4 million numbers in 2012. Two thirds of the total camel population in Rajasthan. The rest are found in Gujarat, Haryana, Punjab, Uttar Pradesh and Madhya Pradesh. Due to mechanisation and modern approaches the utility of camels is decreased. The double-humped Bactrian camel is practically extinct in India. The one-humped Malvi breed is already endangered.The Jaisamleri and Mewari breeds of camel, native of Rajasthan facing the condition of endanger. The population of both the breeds has decreased in the native tract considerably due to crossbreeding with the Bikanericamelspracticed by the camel owners. This lead to which declining in population.

CONCLUSION

The germplasm of well-defined breeds constitute a valuable genetic resources, which needs to be consumed on priority basis. The rich biodiversity of these species is progressively being practiced due to unplanned breeding.

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Figure 1. Malpura

Figure 2 Malvi Camel

Figure 3 Mandya

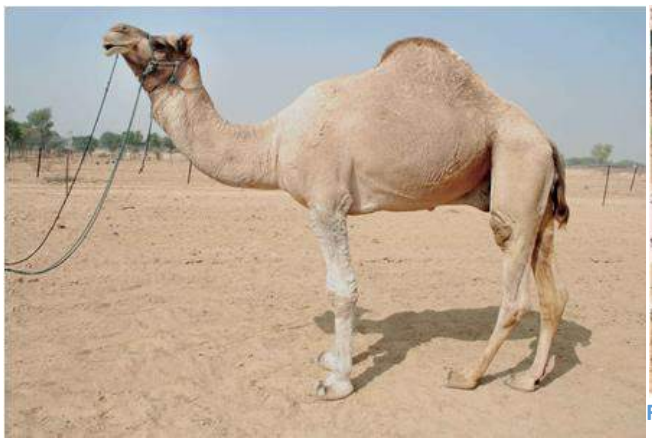


Figure 4. Mewari

Figure 5. Muzzafarnagari

Figure 6. Panganur

Figure 7. Nilgiri

Figure 8. Sahiwal

Figure 9. Toda

Figure 10. Double Humpled Camel

Figure 11. Siri

Figure 12. Changthangi

Figure 13. Asil

Figure 14. Gaddi

Figure 15. Kadaknath

Figure 16. Garole

Reproductive Attributes In Equines

Tarun Kumar Varun[1], *Mokshata Gupta[2], Narender Kumar[3] and Zulfqar ul Haq[4]

[1]*Division of Dairy Cattle Nutrition, NDRI, Karnal- 132001, Haryana*
[2]*Division of Animal Nutrition, IVRI, Izatnagar, Bareilly, UP -243122*
[3]*Division of Livestock Production Management, IVRI, Izatnagar, Bareilly, UP -243122*
[4] *Division of Animal Nutrition, SKUAST- Jammu, R.S.Pura, J&K, 181102*
*Corresponding Author - mokshtagupta1407@gmail.com

A large portion of the equine industry is involved with the breeding and care of mares. Economic considerations of the equine breeding business make it necessary for owners to understand the reproductive cycle and how it can be managed. This knowledge is important for all mare owners, regardless of whether they are involved with breeding in their own operations, or whether they send their mares to a breeding facility. The mare is seasonally polyestrus, having an anovulatory period during the short light days of late fall and early winter, and beginning to ovulate as the days become longer during the winter. The complete estrus cycle is typically about 3 weeks, with 5 to 7 days of estrus and approximately 2 weeks of diestrus. Hormonally, estrous behavior in the mare is initiated by estradiol that is secreted by the follicle, while estrous behavior is suppressed by progesterone, secreted by the corpus luteum. Mares are unusual among the ungulates in that they periodically exhibit estrous behavior during the anovulatory period. This is maybe due to the release of estrogenic steroids secreted by the adrenal cortex. The display of sexual behavior by the mare throughout the year is thought to facilitate maintenance of the horse's social structure, in which the male remains with a group of females year round, in contrast with most ungulates in which the females and males only come together during the mating season. Peak fertility in horses occurs at approximately 6 to 7 years of age. Fertility begins to decline at around 15 years of age as mares become more difficult to get in foal and the rate of pregnancy loss increases.

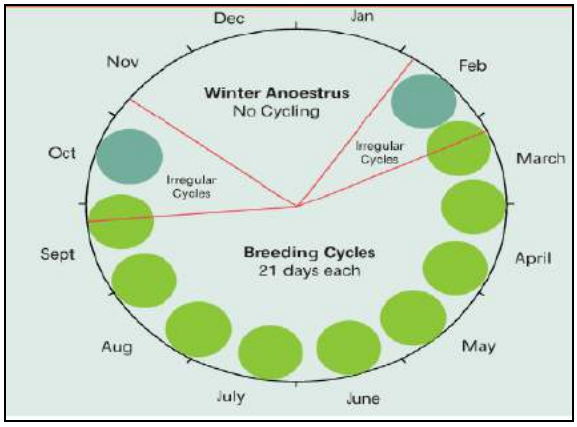
PUBERTY

It may be defined as the age or time at which the generative organs become functional and reproduction may occur. In the mare, puberty is indicated , along with outer secondary sex changes, by the appearance of estrum and ovulation. The onset of puberty in the horses is 10 to 24 months (average- 18 months).

THE REPRODUCTIVE CYCLE OF THE MARE

The mares that have reached puberty there is definite physiologic function rhythm of the reproductive system, called the estrous cycle.

The mare has a reproductive season and a non-reproductive season, both of which are regulated by light. The reproductive season begins in the spring when light levels increase and continues through the summer. The non-reproductive season, known as anoestrus, occurs in the autumn and winter when there is little natural light.



Mares therefore cycle naturally from March/April through to September/October. The peak of the breeding season is in May, June and July. Two other periods are known as the spring and autumn transitional stages. One occurs just before the mare becomes reproductively active in the spring and the other occurs just before anoestrus in the winter. During these periods mares are generally irregular in their cycles and sexual behaviour. The mare's breeding cycle is, on average, 21 days, but this may vary greatly between individual mares. For a period of around five to seven days within the 21-day cycle the mare is 'in heat', 'in season', "in oestrus' or 'receptive' to the stallion. The other 14 to 16 days the mare is 'out-of-season', 'in dioestrus' or 'not receptive' to the stallion.

SIGNS OF ESTRUS

Palpation and teasing are the two most common management tools used in the detection of heat. Rectal palpation and ultrasonography will help define the time of ovulation, and thus aid in mating management. Parameters of follicular size, follicular consistency, cervical size and consistency, and uterine tone can be monitored through rectal palpation. With real-time ultrasonography, we can determine follicular size, early ovulation, uterine changes characteristic of estrus, and abnormalities of the reproductive tract. Expression of estrus is most easily determined by using a "teasing" system, which involves introducing the stallion to the mare, allowing handlers to observe the mare's reactions. The stallion may begin nuzzling, sniffing, and biting the mare to test her level of receptivity. These same actions may or may not be returned by the mare. By observing her reactions, handlers will be able to recognize when she is ready to accept the stallion, the primary indication that she is in heat. Other primary signs of estrus include "winking" of the vulva, squatting or lowering of the pelvis, lifting of the tail, and frequent urination. Secondary behavioral signs include social behavior such as seeking-out the company of other mares, geldings, and handlers.

COPULATION OR COITION

It is the insertion of the erect penis into the vagina and the subsequent ejaculation of the semen. This occurs only during estrum

in the domestic animals. An exception to this occurs in the certain barren mares early in the breeding season that exhibit a prolonged period of acceptance punctuated occasionally by true estrum and ovulation. In the mare, the penis may be forced against the relaxed dilated cervix and some semen might be ejaculated into the cervix or uterus.

Lifting tail, squatting and urination

Pregnant mares need turnout

PREGNANCY DETERMINATION

Several management techniques are used for pregnancy determination. One of the simplest ways is to watch for signs of heat. A mare may be pregnant if she exhibits no signs of heat 18 to 20 days after her last ovulation. However, some mares may not cycle because of follicular or corpora luteal abnormalities, or they may have silent heat periods in which external signs of estrus are not evident. These problem mares would not be bred again if absence of heat was the only factor used to determine pregnancy. Because of these situations, other methods for pregnancy determination are commonly used.

Mares are most often rectally palpated 18 to 45 days following the last day of insemination. In recent years, real-time ultrasonography has gained attention for use in pregnancy determination. Ultrasonography can be used to obtain a visual image of the mare's reproductive tract, and thus to detect pregnancy before palpation is normally performed. Ultrasonography is normally used following the 14th day post-breeding, but it can detect pregnancies as early as 10 days post-ovulation.

GESTATION PERIOD

At about 35-40 days of pregnancy, the CL of pregnancy degenerates, followed by the development of successive follicles, some of which ovulate and form accessory corpora lutea that degenerate by 150 days. This provides for the ovarian secretion of progesterone and the maintainance of pregnancy until 90-120 days of pregnancy when progesterone secretion by the placenta is sufficient to maintain pregnancy. The average equine pregnancy lasts for 340 days. Pregnancy length can range from 310 to 374 days. Foals born earlier than 300 days are unlikely to survive. Many owners become concerned if a pregnancy exceeds the expected duration.

In general, mares will foal when they are ready.

PRE-BREEDING MANAGEMENT OF MARE

The first step in raising a healthy foal is to have a healthy mare. If the mare is not in good health her reproductive system is unlikely to perform optimally. Age should also be considered. 2-3% of younger mares are problem breeders, while 20-25% of older mares (13yrs +) are problem breeders. In general, a mare's fertility decreases after she is 12 to 13 years of age.

The mare's body condition should be evaluated to ensure that she is neither too thin nor overweight when it is time to breed her.

TIMING OF BREEDING

Optimal timing of covering/insemination	
Natural covering/fresh semen	24-48 hours before ovulation
Chilled semen	12-18 hours before ovulation
Frozen semen	6 hours before to 6 hours after ovulation

Breeding on the foal heat (six to ten days post-foaling) should only be considered if the mare has had a normal delivery, passed her placenta (the afterbirth) within four hours of delivery and experienced no other apparent problems.

Mares are usually receptive to being bred for five to seven days. They normally ovulate during the last 24 to 48 hours of that heat period but accurately predicting exactly which day a mare will ovulate is impossible with teasing alone.

The traditional natural breeding strategy is to cover a mare every 48 hours during her heat, beginning on the second day of showing oestrus signs. This is continued until she is no longer receptive to the stallion. The average fertile stallion's semen will last for at least 48 hours in the mare. The main disadvantage with this strategy is an increased risk of the mare developing a uterine infection and overuse of a busy stallion. Semen is not sterile, and every natural covering introduces contaminants and bacteria as well as sperm into the uterus. A healthy, young mare with good perineal conformation can clear contamination within 48 hours. This sort of mare is less likely to become infected as a result of breeding.

When the mare is bred 48 hours or less before her ovulation she should only need to be bred once during the cycle.

Artifitial Insemination (A.I.)

The use of artificial insemination (A.I.) has increased during the past couple of seasons.

Its advantages are:

The addition of antibiotics to semen extenders reduces venereal transmission of bacterial diseases, where the stallion serves as a carrier. Treated semen also reduces the risk of infection in susceptible mares. Decrease the risk of breeding injuries to both the stallion and the mare.

- Semen collection with an artificial vagina allows evaluation of semen quality and assists in the early detection of infertility problems in the stallion.
- Reduced need to transport the mare and young foals.
- The best stallion for the mare can be used irrespective of location.
- Prevent the transmission of infection

A.I. is a highly effective, convenient and safe method of horse breeding.

Dummy used to collect semen

Post breeding management of mare

After a mare has been inseminated, daily teasing should continue and scanning performed to confirm she has ovulated and gone out of heat. Administration of the hormone LH (luteinising hormone) helps to ensure ovulation after insemination. Examination of the mare's reproductive tract by the vet within the first six to twenty four hours after breeding also means any abnormal build up of uterine fluid will be identified quickly and treated.

Repeated examination and teasing of the mare after breeding helps to detect double ovulations (which can result in twin pregnancies) when they occur.

Mares which fail to conceive after covering are expected to begin teasing back 16 to 18 days after ovulation. Ultrasound scanning for pregnancy should begin by day 15/16 after ovulation. Twin pregnancies identified prior to day 16 after ovulation are easier to manipulate and reduce due to the mobile nature of the embryo in the uterus up to this time. Follow-up pregnancy examinations are recommended between day 28 and day 30 for detection of a heartbeat and to monitor continued normal development of the identified embryo and tone of the uterus.

Management of breeding stock

Breeding stock should therefore be managed in ways that will minimise the risk of spread of infection between horses:

- Pregnant mares should be kept separate from all other stock. Where possible mares should foal at home and go to the stallion with a healthy foal at foot. Mares from sales yards or overseas are a particular risk and should be grouped away from pregnant mares. Mares in late pregnancy should not travel with other stock, particularly mares which have aborted recently. Any foster mare introduced to the premises should be isolated, particularly from pregnant mares, until it has been proved that her own foal's death was not caused by EHV. Disinfection of housing, equipment, and transport vehicles on a regular basis with appropriate disinfectants.

CONCLUSION

Strict hygiene should be followed whenever handling breeding mares or stallions to prevent reproductive infectious diseases, including Contagious Equine Metritis (CEM). CEM is spread primarily by breeding, either by natural service or artificial insemination (AI). Grooms, handlers and breeding technicians or veterinary personnel can also spread the disease if good hygiene is not practiced when working with either breeding mares or stallions.

"Take care of your horse and she'll take care of you!"

Feed Requirements, Feed Formulation and Diets of Laboratory Mice and Rats

*Mokshata Gupta[1], Tarun Kumar Varun[2], Kanti Raje[3], Shilpa Choudhary[4], Nirmala Muwel[5] and Lokesha E[6]

[1,3,4,5,6] Division of Animal Nutrition, IVRI, Izatnagar, Bareilly, UP – 243122
[2]Division of Dairy Cattle Nutrition, NDRI, Karnal- 132001, Haryana
*Corresponding Author email- mokshtagupta1407@gmail.com

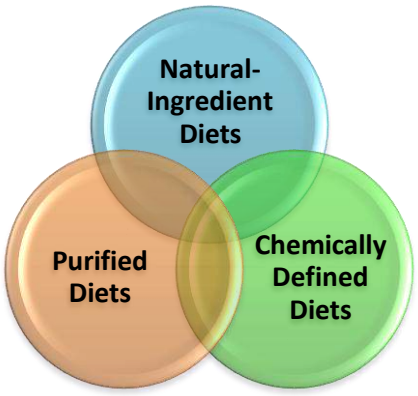
GENERAL GUIDELINES FOR FEEDING AND DIET/FEED FORMULATION

A laboratory animal's nutritional status affect their ability to reach genetic potential for growth, reproduction, longevity and their response to pathogens and other environmental stresses. Nutritionally balanced diet is essential for their welfare and to ensure that experimental results are not biased by unintentional nutritional factors. They require about 50 nutrients in appropriate dietary concentrations. Feed palatability, feed intake, nutrient absorption and utilization, and excretion can be affected by various physico-chemical characteristics of feeds like sensory properties, anti-nutritional factors, physical form, chemical conditions, etc. Various biological factors may also affect their nutrient requirements. In rats, microbial activity occurs inside colon, and various microbially produced nutrients are not available to the host (especially rats and other rodents) unless the feces are consumed.

DIET/FEED FORMULATION

It is the process of selection of the type and amount of ingredients (eg: vitamin and mineral supplements) to be utilized in the formulation of a diet containing known concentrations of nutrients. Type of ingredients may vary with the species to be fed and the purpose of experimention or production. Target nutrient concentrations is decided on the basis of certain factors like estimated nutrient requirements, possible nutrient losses during manufacturing and storage, bioavailability of nutrients from ingredients, potential nutrient interactions, etc.

COMMONLY USED DIETS FOR LABORATORY MICE AND RATS



A) Natural-Ingredient Diets

Commercial diets for laboratory animals are the best example of natural-ingredient diets. These are formulated by using agricultural products and by-products, mill by-products, processed mineral sources, high protein meals, etc. Their cost of production is relatively low and, if proper care is taken during ingredient selection, is palatable for these animals. However, variation in the composition of the individual ingredients can lead to changes in the nutrient concentrations of these diets. The composition of individual ingredients is affected by soil and weather conditions, use of fertilizers and chemicals, manufacturing methods, and harvesting and storage procedures, with the result that no two production batches of feed are identical. Its another disadvantage is the chances for contamination with heavy metals, pesticide residues, etc. These diets are not appreciable for studies related to determination of micronutrient requirements, for immunological studies that may vary with antigens in diets, or for toxicological studies which are sensitive to low concentrations of contaminants.

B) Purified Diets

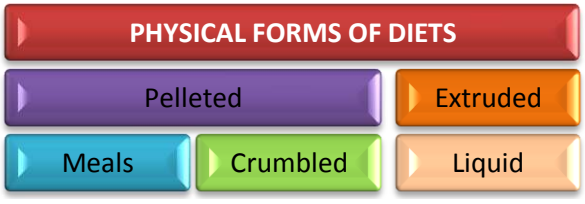
They are formulated with a more refined and restricted set of ingredients which are pure and invariant like casein & soybean protein isolate (as a protein sources), vegetable oil & lard (as sources of fat and essential fatty acids), sugar and starch (as a carbohydrate sources), a chemically extracted form of cellulose (as a source of fiber), and chemically pure inorganic salts & vitamins. Here, the nutrient concentrations are less variable and more easily controlled through formulation but the ingredients may contain variable amounts of trace nutrients. The chances for chemical contamination is low. These diets are mostly used in the studies of specific nutritional deficiencies and excesses. But, these are expensive to formulate, therefore, they are not readily consumed by all species.

C) Chemically Defined Diets

These diets are formulated using most elemental ingredients like individual amino acids, specific sugars, essential fatty acids, chemically defined triglycerides, inorganic salts, vitamins, etc. These diets represent the highest degree of control over nutrient concentrations. Unfortunately, these are not readily consumed by most species of laboratory animals and are highly expensive for general use. These diets are utilized in germ-free and low-antigen studies.

PHYSICAL FORMS OF DIETS FOR LABORATORY RAT AND MICE

Various types of diets are used for laboratory animals. The selection of the most appropriate diet is decided on the basis of certain factors like purpose of adding test substance, amount of control required over the nutrient composition, probable effects of feed microbes, diet acceptance by the animal, economic issues, etc. The different forms of diets for laboratory animals are as follows:



A) Pelleted diet: This is most commonly used. It is prepared by adding water to the mixture of grounded ingredients and then forcing it through a die of particular shape and size; the diet is then dried to firmness. Binders can be used to improve pellet quality. These are easy to handle, store & use; decrease dust in animal facilities; prevent selective feeding; and thus minimizes wastage.

B) Extruded diets: Here, the meal is forced through a die under pressure and at high temperature after steam has been injected, so the product expands when it emerges from the die. They are less dense than pelleted diets and are not commonly used for laboratory rodents due to increased wastage during feeding and higher production costs.

C) Meals: This form allows the incorporation of additives and test compounds after the diet has been formulated. These diets usually cake under certain storage conditions and sometimes dust generated from the feed may be hazardous if toxic compounds have been added. These problems can be prevented by adding jelling agents and water to the meal so as to form a jelled mass that can be cut into cubes for feeding.

D) Crumbled diets: These are prepared by crushing pelleted or extruded diets and screening particles to the most appropriate size for a particular age or size of laboratory animal. These diets are convenient to use, although, they are not frequently used for rodents.

E) Liquid diets: These diets are mostly used in studies of the effects of alcohol on nutrient utilization and requirements. Neonatal animals can be fed with these diets without having any harmful effect.

INGREDIENTS COMMONLY USED IN FEEDS OF LABORATORY RATS AND MICE

Foodgrain and their By- Products: Maize bran, maize gluten, Rice bran or solvent extracted rice bran and polishing, Wheat bran, etc.

Oilcakes and Meals: Copra cake, coconut cake, Cottonseed oil cake (up to 5 percent by weight), Groundnut oil cake, GUAR meal (up to 5 percent by weight), Maize germ oil cake, Mustard oilcake, Safflower cake, Sesamum cake, etc.

Animal Products: Blood meal, Meat meal, Fish meal, Liver residue, Casein, meat scrap, Dried skimmed milk, etc.

Minerals, Vitamins and Supplements: Bonemeal (steamed), Calcium pentothenate, Choline chloride, Common salt, Dicalcium phosphate, Folic acid, Limestone, Niacin, Riboflavin supplement, Vitamin A supplement, Vitamin E supplement, etc.

Greens: Berseem (*Trifolium alexandrium*) leaf meal, Lucerne (*Medicago sativa*) leaf meal, etc.

Table: Commonly used ingredients for rat and mice along with their inclusion level (%)

INGREDIENTS	PERCENTAGE (%)
Wheat crushed	62
Maize crushed	30
Wheat bran	07
Salt	01

FEEDING OF LABORATORY MICE

Under natural conditions, they are herbivorous in nature, that is, they prefer a wide range of fruit or grain.

In laboratory studies, it is necessary to avoid biological variation and for this purpose, they are almost always fed only commercial pelleted mouse feed. On an average, the total feed intake is about 15 g per 100 g of body weight per day and water intake is about 15 ml per 100 g of body weight per day. Milk is added @ 5 ml per mice for cooking semi-solid halwa.

FEEDING OF LABORATORY RATS

In their natural habitat, they scavange for their food and will eat almost everything. They are omnivores in nature and need protein to keep themselves in a healthy condition. As a natural foragers, they are fed twice a day. Larger strains will eat upto 30 grams per day where as smaller strains will eat about 15 g. To limit the chances of selective feeding, ensure that first portion is finished before feeding the second one. Another alternative to avoid selective feeding is to provide them with mono-component diet where all essential ingredients are available in an easy to eat biscuits. Human food should not be given to them, as this may be high in calories, sugary or contains too much fat.

Maintainance energy requirement of adult rat is 114 Kcal ME/BW $Kg^{0.75}$. It has been reported that the requirement for fat rats is about 15% lower than normal rats. It is also well established that fasting heat production per kg metabolic body size is greater in working and producing animals compared to non-working ones. This may be due to difference in food intake. Decrease in food intake by rats leads to decrease in energy expenditure and in the maintainance energy requirement. Energy requirement for growing, pregnant and lactating rats are higher proportionate to productivity status. They perform best with inclusion of glucose in their diets.

Milk is added @ 10 ml per mice for cooking semi-solid halwa.

REQUIREMENTS FOR COMPOUNDED FEEDS FOR LABORATORY MICE AND RATS AS PER BIS SPECIFICATIONS

Compounded feeds for laboratory rats and mice shall be in various forms like crumbs, cubes or pellets. The feed should be free from rancidity, musty odour, toxic ingredients, adulterants, moulds and insect infestation. The nutrient requirements as per BIS are as follows:

Moisture, percent by weight, Max
- 10 %

Crude protein (N x 6.25), percent by weight, min - 24 %

Ether extract , percent by weight, Min
- 05 %

Crude fibre, percent by weight, Max
- 06 %

Total ash, percent by weight, Max
- 09 %

Acid insoluble ash, percent by weight, Max
- 01 %

Calcium (as Ca), percent by weight, Min
- 0.6 %

Available phosphorus, percent by weight, Min - 0.3 %

L-lysine, percent by weight, Min
- 1.0 %

Methionine and cystine, percent by weight, Min - 0.8 %

L-arginine, percent by weight, Min
- 0.2 %

Essential fatty acids, percent by weight, Min
- 0.2 %

Vitamin A, IU/kg, Min
- 2700

Vitamin D, IU/kg, Min
- 200

Vitamin E, mg/kg
- 40

Riboflavin, mg/kg, Min
- 6

Calcium-D - pantothenate, mg/kg
- 20

Nicotinic acid (amide), mg/kg, Min
- 60

Vitamin B1 2, pg/kg, Min
- 10

Choline, mg/kg, Min
- 1100

GENERAL GUIDELINES FOR FEEDING OF LABORATORY RAT AND MICE…..

- Freshly prepared nutritious diet in the form of commercial pellets should be given. It should be supplemented with small amounts of fruit, vegetables, cooked egg, grains, seeds, etc.
- They should be fed twice a day - morning and evening and any left-over food should be removed. They are mainly fed at dawn/dusk, and drink mostly during the night.
- Fresh clean drinking water should be available all times.

-Provide water bottles instead of bowls so as to avoid contamination. Clean them regularly to avoid build-up of algae/bacteria build-up.

-Water bottles should be checked twice a day so as to ensure that they're never thirsty.

- Ensure that drinkers aren't leaking
- Availability of multiple drinkers so as to avoid competition.

- They should not be fed with the food designed for rabbits/guinea pigs/hamsters/other herbivores

because they won't meet their nutritional protein needs. They need essential amino acids, fatty acids, vitamins, minerals, etc from their diet as they cannot produce these on their own.

- Avoid the feeding of harmful foods (e.g. chocolates,onion, citrus fruits, grapes, etc).
- They like sweet, fatty food, but if they are eaten in excess will leads to obesity and other health related problems.
- Offer food in open bowls (ceramic rather than metallic) - allows them to carry food and eat it wherever they want.
- New foods should be introduced gradually. Don't change the diets overnight as they can be fearful of new foods.
- They eat their own fresh faeces as it helps them to absorb all the nutrients that they need to stay healthy. Stopping of this natural phenomenon could cause nutritional deficiencies or health related problems.
- The natural foraging behavior of the rats should be encouraged. They should be encouraged to forage for food items including handling and manipulating their food. This phenomenon includes:
  - Wide variety of appropriate food items should be given, so that they will have a control over their own food choices. This is very essential as rats often develop individual preferences for a particular foods
  - Hiding of food items in some safer places as they are happily involved to find their hidden favourite food items
  - Mixing of food items with fresh bedding during cage cleaning and scattering of food items around their cages
  - Whole or intact food should be given so as to stimulate them

Seeds (e.g. sunflower), nuts (e.g. peanuts) should be given occasionally so that they can manipulate their food in their paws during eating

- Various food items should be given rather than just one for a group of rats, so as to avoid competition among them
- Always provide food enrichment as part of their daily food allowance, and not in addition to it.

Milking Management At Dairy Farm

***Vikash Sharma[1] and Lalit[2]**

[1]Ph.D. Scholar, Department of Veterinary Pathology, LUVAS, Hisar
[2]Ph.D. Scholar, Department of Animal Genetics and Breeding, LUVAS, Hisar
[1]Corresponding Author: sharmavikashjind@ gmail.com

Milking is the defining activity of dairy farming. Consumer demands high standards of milk quality, so milking management aims to minimize microbial, chemical and physical contamination. Milking management covers all aspects of the process of obtaining milk fromanimals quickly and effectively, while assuring the health of the animals and the quality ofthe milk. The suggested good dairy farming practices for milking hygiene are set out under the following headings:

1. Ensure milking routines do not injure the animals or introduce contaminants12 into milk.
2. Ensure milking is carried out under hygienic conditions.
3. Ensure milk is handled properly after milking.

(A) Ensure milking routines do not injure the animals or introduce contaminants into milk

(a) Identify individual animals that require special milking management

Individual animals should be easily identifiable by all people who come in contact with them. The system used should be permanent, allowing individual animals to be identified from birth to death. Additional temporary identification systems should be in place on farms to manage animals that require special handling at milking, such as treated or diseased animals, or animals

producing milk that is not suitable for human consumption.

(b) Ensure appropriate udder preparation for milking

Wash and dry dirty teats before milking. Only milk animals with clean, dry teats. Check the udder and teats for any abnormalities which may indicate clinical mastitis.The foremilk may be extracted and checked for abnormalities before each animal ismilked. This may be a regulatory or contractual requirement for dairy animals in some countries.

(c) Milk animals regularly using consistent milking techniques

Incorrect milking techniques can result in a higher mastitis risk and injury to the animal. The correct technique for machine milking is to prepare animals properly before milking; attach the cups to clean, dry teats, avoid unnecessary air cup attachment, avoid over milking; remove cups gently and when necessary,

apply teat disinfectant to each teat after milking.

The correct technique for hand-milking is to restrain the animal to be milked using a method that does not cause pain or injury; ensure the milker's hands are clean and dry; prepare the teats for milking, ensuring they are clean and dry, handle the teats gently, ideally using the 'fist-grip' method, avoiding any discomfort, pain or injury to the animal, use buckets that are non-corrosive, easy to clean and disinfect.

(d) Segregate milk harvested from sick or treated animals for appropriate disposal

Animals whose milk is unfit for human consumption should be milked last or with a separatebucket or system. Store or discard abnormal milk in a manner appropriate to the riskposed to people, animals and the environment.

(e) Ensure milking equipment is correctly installed and maintained

Manufacturers' and national recommendations should be followed for construction, installation, performance and maintenance of the equipment used for milking. Materials used for milking equipment that come into contact with milk and with cleaning and disinfectingfluids should be made from adequately resistant materials.

(f) Ensure a sufficient supply of clean water

A sufficient supply of clean water should be available for milking operations, for cleaning the equipment that comes into contact with milk and for cleaning the milking area. Standards regarding thequality of water used in milk production are mandated in many countries, including the useof potable water in cleaning surfaces that come into contact with milk.

(B) Ensure milking is carried out under hygienic conditions

(a) Ensure housing environment is clean at all times

The housing area should be designed to

provide good drainage, ventilation and to avoid animal injury; of suitable size and have adequate loose bedding which is maintained in a hygienic condition. Regularly clean the passage to remove manure.

(b) Ensure milking area is kept clean

The milking area should be designed to allow it to be kept clean and tidy. It should be easy to clean; have a clean water supply; have waste handling facilities; and have sufficient temperature regulation, ventilation and light.

(c) Ensure the milker's follow basic hygiene rules

The milker should wear suitable and clean working clothes, keep hands and arms clean especially when milking, cover cuts or wounds; and not have any infectious disease transmissible via milk.

(d) Ensure milking equipment is cleaned and when necessary, disinfected after each milking

Establish a routine to ensure milking equipment is clean before each use. If

mobile milkingequipment is used, this may mean cleaning between each use. Use chemicals approved for the cleaning and/or disinfecting of milking equipment. Use water of suitable quality heated to the required temperature.

(C) Ensure milk is handled properly after milking

(a) Ensure milk is cooled or delivered for processing within the specified time

Cool milk as soon as possible after milking to the required storage temperature and withinthe specified time. Cooling times and storage temperatures should conform to limits set by the relevant authority. Limits on the time taken between milking and delivery to the milk collection centre may exist in developing countries where the cooling or processing of milk is under taken off the farm.

(b) Ensure milk storage area is clean and tidy

Milk should be stored away from the milking area. The milk storage area should be clean and clear of accumulated rubbish, any products or chemical substances notin constant use and any feedstuffs have hand washing and drying facilities; and be easy to clean and have pest control practices in place.

(c) Ensure milk storage equipment is adequate to hold milk at the specified temperature

The storage equipment should be capable of holding milk at the required temperature until collection, and be constructed of materials that do not taint the milk. Bulk tanks should be built to recognized standards and milk refrigeration systems should have a regular maintenance and service programme to prevent breakdowns.

(d) Ensure milk storage equipment is cleaned and when necessary, sanitised after each milk collection

To ensure milk storage equipment is clean before use, clean and, when necessary, sanitise it after each milk collection. Milk contact surfaces should be sanitised as required in accordance with national recommendations and regulations.

(e) Ensure unobstructed access for bulk milk collection

Provide unobstructed access to the milk storage area to enable the safe collection of milk. Access to the milk collection areas should be free of animal pathways, mud and other potential contaminants.

Good dairy farming practices forimproved early lactation performance and higher peak milk yield:

1. Get cows off to a good start with a successful dry period

Research over the past ten years has clearly demonstrated the impact of dry period nutrition and management on postpartum health and performance. If we are dissatisfied with milk cow performance, then evaluate the dry cow program. Key goals for dry cows include: maintain dry matter intake (DMI) (28 to 32 lb per day).

2. Reduce the risk of subclinical milk fever

Low blood calcium or hypocalcaemia during the first week of lactation. Low blood calcium is correlated with ketosis, elevated somatic cell count, delayed uterine involution, metritis, depressed feed intake, and reduced milk yield.

3. Optimize feed intake immediately after calving

Provide: 10 to 15 gallons of warm water with drinkable drench, access to fresh TMR, 5 to 10 lb of alfalfa/grass hay, and maintain cleanliness and freshness at the feed bunk.

4. Optimize cow comfort

In the fresh cow group: stocking density at 80 to 85% of capacity, 14 to 21 days in fresh cow group, bunk space 30 to 36 inches per cow, minimize social stress (especially for 1st calf heifers), prevent isolation situations where cows are separated from normal herd mates. Invest in cow cooling for dry and lactating cows.

5. Maintain rumen health/prevent ruminal acidosis

Provide a flake of alfalfa/grass hay for the first 5 days after calving, early lactation diet should contain plenty of good quality digestible fiber (31 to 35%NDF), maintain fiber mat with consistent feed intake and avoid empty bunks, provide free choice buffer, and monitor buffer intake. Minimize the risk of slug feeding or diet sorting that may result in rumen acidosis (low rumen pH; sour stomach).

6. Identify cows with a history of metabolic or health problems

Cows that have a history of milk fever, ketosis or mastitis are likely to be repeat offenders. Added attention to cows with a predisposition towards health problems will allow to do some preventative maintenance. An example would be moving cows carrying twins or first calf heifers into the dry group early as data indicates a correlation with a 7 to 10 day earlier calving date.

7. Evaluate body condition score (BCS)

New industry recommendations suggest a target BCS of 3.0 at calving vs. the previous recommendation of 3.5. A lower BCS at calving allows for 0.5 to 1.0 units of BCS within herd variation as a safety margin to avoid overweight cows that have a higher risk for ketosis, fatty liver, and are often more difficult to breed back.

8. Feed additives

Following additives: ionophores (increased glucose availability), choline (improves liver health and function), protected amino acids (meet amino acid requirements without over-feeding protein), supplemental protected fat (increases energy intake), and yeast culture (stabilizes rumen fermentation).

9. Avoid anti-nutritional factors

Such as feeds containing mold, wild yeast, and poorly fermented feeds. Mold counts > 100,000 colonies per gram likely decrease feed intake and diet digestibility.

John's Disease in Animals

Vikash Sharma*[1], Lalit[2] and Sakshi Tiwari[1]

[1]Department of Veterinary Pathology, LUVAS, Hisar
[2]Department of Animal Genetics and Breeding, LUVAS, Hisar
*Corresponding Author: sharmavikashjind@ gmail.com

Johne's disease also known as paratuberculosis is a chronic enteritis of ruminants caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP). Johne's disease mainly effects wide range of animals including domestic cattle, sheep, goats, buffaloes, camelids and wild ruminants. In clinically infected animals there is chronic watery diarrhea, weakness, emaciation and eventually death. Clinically as well as subclinically infected animals shed bacteria in feces and milk which contaminate feed and water which become a source of infection. Fecal-oral rout is the main rout of transmission and young calves are more susceptible. It is economically very important disease in livestock due to decrease in milk yield, working efficiency and culling of infected animals.

Etiology

The disease is caused by *Mycobacterium avium* subsps. *paratuberculosis* (MAP) which is an an aerobic, acid-fast and slow growing bacteria. There are three Strains of MAP named as Bovine, Ovine and Scottish strain. MAP is resistance to heat, cold, ultraviolet light (UV), gamma irradiation and common disinfectants but can be killed by phenolic and cresylic disinfectants.

Transmission

- Fecal-oral route is the main route of transmission
- Ingestion of contaminated feed and water
- Colostrum and milk from subclinical or clinical infected cows
- In-utero transmission

Clinical Signs Symptoms in cattle

- Watery Diarrhoea – intermittent or continuous
- Progressive weight loss
- Hide-bound condition
- Inter-mandibular oedema
- Progressively animal becomes weak and recumbent
- No fever
- Normal appetite

Symptoms in sheep and goat

Watery diarrhoea

- Usually diarrhoea does not occure
- soft feces
- Emaciation

Post-mortem findings

- Emaciation

- Thickening of intestinal wall
- Presence of corrugation
- Mesentric lymph node enlarged
- Corrugated intestine
- Enlarged mesenteric L.N.

Corrugated intestine

Diagnosis

Diagnosis is based on clinical signs, post-mortem lesions, histopathology and diagnostic tests such fecal smears, fecal culture, polymerase chain reaction (PCR), delayed–type hypersensitivity (DTH), interferon Assay, enzyme linked immuno–sorbent assay (ELISA), agar gel immunodiffusion (AGID), complement fixation test (CFT).

Treatment

Satisfactory treatment for Johne's disease is not available.

Vaccination

Live-attenuated and heat-killed vaccines against johne's disease are available in some countries. The main advantage of vaccination is the prevention of clinical cases but vaccination may cause a reaction at the site of injection and may also interfere with eradication programmes based on immunological testing.

Opinions for the control of Johne's disease

- Should be managed as herd/flock problem rather than as health problem of individual animals
- Farmers should buy animals from 'un-infected ('test-negative) herds' as replacement stock
- In an infected herd, exposure of susceptible/ healthy animals must be reduced by separating infected animals and timely removal /culling
- In infected herds and flocks, young and new borne animals must be segregated and should not be exposed to contaminated manure, colostrum and milk
- Herds must be periodically tested for appearance of positive and clinically infected animals
- Breeding of infected animals should be restricted. If not so; the new born animals from infected mothers should be removed
- Stress to animals must be minimized to maintain their health and immunity
- Farm animals, grazing lands etc. should not be accessible to wild animals specially ruminants.

CONCLUSION

We should focus on prevention & control of Johne's disease as treatment is not available. The potential role of MAP in the etiology of Crohn's disease needs future investigation. Successful vaccine against MAP infection would be valuable and welcome development.

Equine Infectious Anemia

Vikash Sharma[1], Amrender Nath Tiwari[2], Sakshi Tiwari[1] and Adya Prakash Rath[1]

[1]Deptt. Of Veterinary Pathology LUVAS,Hisar
[2]Vet Serv Diagnostics
**Corresponding author:sharmavikashjind@gmail.com*

Equine Infectious Anemia (EIA) is also known as Swamp Fever, Slow Fever, Equine Malarial Fever and Coggins Disease. EIA is an infectious disease of Equidae caused by equine infectious anaemia virus (EIAV) and is characterized by anemia, intermittent fever and severe weight loss. Once an animal is infected with the virus, it is infected for life. First case of EIA was reported in France in 1843. In india1st case was reported during 1987.

ETIOLOGY

EIA is caused by Lentivirus of the family Reteroviridae having two copies of single stranded RNA which is closely related to HIV in humans.

TRANSMISSION

- Haematophagous insects- Horse fly and Stable fly
- Iatrogenic
- Intrauterine
- Recently evidence of the infection of pulmonary epithelial cells by EIAV suggesting an aerosol transmission

Incubation period

Incubation period ranging from a week to 45 days or longer whereas some horses remain asymptomatic until they are stressed.

Species affected

- Infect all members of the Equidae
- Clinical cases occur in horses, ponies and in mules but some horse adapted viral isolates replicate to low levels without clinical signs in donkeys

Morbidity and mortality

Morbidity -100%
Mortality- upto 50%

Public health importance

There is no evidence that equine infectious anemia is a threat to humans.

Geographical distribution

Distribution of EIA is nearly worldwide but appears to be absent from a few countries including Iceland and Japan.

Prevalance in india

Nasal haemorrhages

In India 1st case was reported in 1987 in a thoroughbred horse from Karnataka state.The last positive cases of EIA were reported in October 1998 (two cases from Uttar Pradesh) and February 1999 (one case from Delhi). One thoroughbred horse

showing presence of EIAV antibody was detected in September 2012 from Haryana state.

SYMPTOMS

Acute case:

- Pyrexia(upto 108F)
- Extreme weakness
- Excessive thrust
- Anorexia
- Depression
- Anaemia is not a prominent feature - gradual reduction in circulating RBC
- Oedema of lower abdomen
- Sublingual and nasal haemorrhages
- Death may occure within one month
- Pregnant animal may abort
- RBC count- about 4million/mm3

Subacute case:

- Relapsing fever
- Symptoms are similar acute type but less severe
- Gadual weight loss
- Debility
- Oedema of dependant parts
- Unsteady gait
- Icteric mucus membrane
- RBC count-1.5 million/mm3

Chronic case:

- Animal appear in good health
- Mild fever at intervals
- Oedema may be there under thorax and abdomen
- RBC count- 2-3 million/mm3

Post-mortem lesions

- Splenomegaly
- Hepatomegaly
- Generalized lymphadenopathy
- Ventral subcutaneous edema
- Vassel thrombosis
- Mucosal and visceral hemorrhages

Microscopic lesions

- Liver- Non-suppurative hepatitis with infiltration of macrophages and lymphocytes
- Kidney- Cellular infiltration in the cortex region, glomerulonephritis characterized by thickened basement membrane with inflammatory cells and immune complexes

In inapparent carriers necropsy findings are usually normal and microscopic lesions are usually mild or absent.

Samples to be collected

- Serum sample for serology
- Blood sample for RT-PCR, Virus isolation and Inoculation in test animal

Diagnosis

EIA should be suspected in any horse with a history of recurrent fever and weight loss(Dwight Bennett, DVM, PhD, professor emeritus at Colorado State University)

Virus isolation and identification:

Icteric mucus membrane

Inoculating blood from suspected animal on to leukocyte cultures and then virus production in cultures can be confirmed by detection of specific EIA antigen by

- ELISA
- Immunofluorescence assay
- Molecular tests

- Inoculating into susceptible horses: Usually, 1–25 ml of whole blood is inoculated and antibody status and clinical condition are monitored for at least 45 days

Polymerase chain reaction:

- Nested PCR method
- Primer sequences from the gag region of the proviral genome

Agar gel immunodiffusion test (Coggin's test):

Coggin's test ia a prescribed test for international trade and reagents for AGID are available commercially from several companies.

Enzyme-linked immunosorbent assay:

- Four ELISAs(One competitive and three non-competitive) are approved by the USDA
- The competitive ELISA and two non-competitive ELISAs detect antibody produced against the p26 core protein antigen
- The third non-competitive ELISA incorporates both p26 core protein and gp45 antigens

Vaccination

- An attenuated live vaccine, developed in the early 1970s, was extensively used in China between 1975 and 1990
- The strategy for EIA control has shifted from vaccination to quarantine to avoid the interference of vaccine antibodies with diagnostic tests and Like other lentiviruses, EIAV is highly mutable

Treatment

- No effective treatment
- Good management can reduce the potential of infection

A test positive animal

- Positive animal should be euthanized
- If an owner elects not to do so, the animal must be quarantined from all other horses and is not allowed to travel (no less then 200 yards seperation and under the supervision of a State or Federal animal health official)
- Recommend supportive therapy

Euthanasia is not only option

- One farm in southern Florida is devoted to the care of EIA-positive horses(Florida Research Institute for Equine Nurturing, Development, and Safety (FRIENDS)
- It is FRIENDS' policy to allow researchers to draw blood samples from the horses at the farm in order to continue progress towards a vaccine and/or cure for EIA.

Guidelines for prevention and control

- Use disposable needles and syringes, one per horse during medications
- Sterilize dental tools and other instruments before using them on another horse
- Test all horses for EIA at least annually
- Stable owners should request current negative Coggins certificates before introduce
- New horses should be quarantined for 45 days
- They should be retested if exposure to EIA is suspected
- All stable areas should be kept clean, dry, and waste-free to discourage breeding sites for pests
- Horses at greater risk should be tested frequently every 4-6 months.
- Horse show and event managers should verify current negative Coggins certificates for all horses entering the premises

Growing Kiwifruit as Diversified Fruit Crop in the Mid Hills of Arunachal Pradesh

Thejangulie Angami*, Rupankar Bhagawati, Anup Chandra, Letngam Touthang, Badapmain Makdoh and Sikimoni Baruah

ICAR (Research Complex) for NEH Region, Arunachal Pradesh Centre, Basar, West Siang District – 791101, Arunachal Pradesh

Email of corresponding author: thejaangami@yahoo.com

ABSTRACT

With nearly one third of the total geographical area of the state of Arunachal Pradesh falling under temperate climate. The state enjoys the unique advantage of growing temperate fruit crops especially kiwifruit in particular which had been a recent introduction in the state. At present, Arunachal Pradesh is emerging as India's kiwifruit production state. The article focuses on the technical know-how about the scientific production technology of kiwifruit which can be a successful guide for the growers of the state who are engaged in hill orcharding as most of the growers are not aware about the scientific production technology for higher and quality produce which is the major limitation in the state.

INTRODUCTION

Arunachal Pradesh, situated in the sub Himalayan ranges in North Eastern Region of India possess huge unexplored land under temperate climate and has the unique advantage of growing temperate fruit crops especially in view of saturation of land, climate and other factors. Nearly one third of the total geographical area of the state towards north falls under temperate climate. The estimated area under temperate climate is 27, 91,433 ha and estimated cultivable area for temperate fruit is 6, 97,858 ha (Govt. of Arunachal Pradesh, 2012). Among the temperate fruit crops, Kiwifruit or Chinese gooseberry, a deciduous vine bearing rusty brown colour fruit with hairy surface belonging to the family Actinidiaceae, is among few recent introduction in the state which have surpassed in popularity, preferences and interests among the growers due to its favourable properties for easy maintenance, good taste and nutritional values.

VARIETAL STATUS

Since Kiwifruit is a dioecious plant, it bears pistillate and staminate flower separately. Hence, both male and female plants are required to be planted in the plantation. Following are some cultivars which have been introduced in India:

Female cultivars:

Abbott: Early to mid-maturing cultivars. Medium sized fruits, recommended for mid altitudes

Allison: It is an early ripening; Medium sized fruit and heavy bearer

Bruno: This cultivar requires comparatively less chilling period. Large fruit size. The fruits is dark brown having very dense, short and bristly hair

Hayward: Most popular cultivar of the world, late cultivar. Recommended for higher altitudes and requires comparatively more chilling hours. Fruits are exceptionally large. It is superior in flavour with high sugar and ascorbic acid content

Monty: It is a late flowering cultivar but fruit maturity is not late (Mid-season cultivar). Medium size fruit recommended for mid altitude

Male cultivars:

Tomuri: It is a good pollinizer for Hayward and the Flowers appear usually in groups of 5

Allison (Male): Recommended for plantation with different cultivars. *viz.* Bruno, Abbott, Allison & Monty

CLIMATE AND SOIL

Kiwifruit is grown successfully at mid hills of Arunachal Pradesh ranging from 800-1500 m above MSL. A rainfall of about 1500 mm per year is sufficient. For high yield and quality fruits it requires 600-800 chilling hours below 7^{o}C to break its rest period. At high temperature (>35^{o}C), leaf scorching is the main problem. Well drained sandy loam soil having pH 5-6.5 are ideal.

PROPAGATION

The plants are propagated by both seeds and vegetative means. Seed require stratification for breaking the dormancy; therefore seed should be kept at 4.4^{o}C for 4 weeks in sand or sphagnum moss grass. Seeds should be sown in late winter in rows at 10 cm apart and 1-2 cm deep, cover the seed with FYM and mulch with paddy straw. Seeds are germinated 15-20 days after sowing. After one year, plants are transplanted in the field in Feb-Mar. In the coming dormant season it can be used as rootstock for tongue and whip grafting. Propagation through cuttings from soft wood, semi hardwood and hardwood are successful. Semi hardwood cuttings containing 3 buds of 0.5 to 1.00 cm thick with short inter nodes and 15-20 cm lengths are taken from current season's growth in July. Hard wood cuttings are taken from well matured shoots during dormant season (January-February) and treated with 2500-5000 ppm IBA for rooting (Fig. 2).

PLANTING

Planting distance varies according to training system. In T-bar system, a spacing of 4m to 5m between rows and 5m to 6m between plants is required. December- January is the ideal time for planting. Since Kiwifruit is a dioecious plant, therefore, inter planting of male plant is essential for fruit production. Planting of male and female plants in 1:6 or 1:8 ratio is common. Every third plant in alternate row should be a pollinizer (male).

POLLINATION

Kiwi fruit are pollinated mainly by honey bees, a small group of 3-4 colonies at the end of each block of 0.5 – 0.75 hectare for even dispersal of forager over the orchard is advised.

(CANOPY MANAGEMENT) TRAINING AND PRUNING

The main aim of training is to establish and maintain a well formed framework of main branches and fruiting arms. Kiwifruit can be trained in a simple T-bar trellis system. A strong growing shoots is

grown as main trunk in the 1st year and secondary and tertiary arms are tied with wire in 2nd and 3rd year respectively. Pruning is done to maintain a balance between vine growth and optimum profitable fruit production. Kiwifruit require to be pruned two times in a year, in summer pruning (June-July), fruity shoots are headed back beyond 6-8 buds from current season, criss-cross and shading shoots are thinned out. During winter (January) when plants are in dormancy, fruiting laterals is headed back to two vegetative buds beyond the last fruit (Fig.1).

ORCHARD FLOOR MANAGEMENT

Because of heavy vegetative growth, kiwifruit plants remove heavy amount of manures and fertilizers. A dose of 20 kg FYM, 0.5 kg NPK mixture is applied per plant each year. At bearing stage, it requires 850-900g N, 500-600g P, 800-900gK and 20-25 kg FYM. Two third of N is applied in January and the rest after fruit set in April-May. Water requirement is high because of vigorous vegetative growth and larger leaf surface area. In general, fully grown vine requires 80-100 litres of water. Young plants are to be irrigated at 2-3 days interval. Mulching of tree basin with dry grasses or hay grasses is recommended to conserve moisture during dry season. Inter- crops like legume vegetables can be grown during initial two years.

(CROP REGULATION) FRUIT THINNING

Size of fruit is an important aspect for marketing. Fruit size will be small if the plant is allowed to bear heavily. Hence, fruit thinning is recommended to obtain good size fruits to ensure marketability. This is achieved by thinning out small and malformed fruits, keeping not more than 6 fruits per bunch (Fig. 3). Fruit thinning should be done at early stages of fruiting.

HARVESTING AND YIELD

It takes 4-5 years to start bearing worthwhile fruits and 7-8 years for commercial production. In Arunachal Pradesh, the fruit ripens during October/November depending upon variety and climate. However fruit mature slightly earlier at lower elevation. Jindal, 2016 reported that during harvesting period rain stops and temperature slides down providing less chance of road blockade and spoilage thereby ensuring possibility of supply for longer periods without creating glut and fetching good prices. For long distant market fruit should be harvested when they attain good size and still hard. Kiwifruit should also be harvested when the surface hairs/ hairy bristles on the fruit skin go off easily when rubbed lightly with fingers. On an average, Kiwifruit yield varies from 50 to 100 kg fruits/ vine. Vines on trellis produce about 25 tons/ ha after seven years.

CONCLUSION

In conclusion, undoubtedly kiwifruit has been assessed as one of the important future commercial fruit crop especially in mid and high hills of Arunachal Pradesh owing to its favourable agro climatic conditions and less chance of crop failure. Besides that, this fruit possess good nutritive and medicinal values recommended for patients suffering from diabetes and heart diseases. The added advantage in kiwifruit cultivation is that no serious pests and diseases have been recorded in the state thus giving a better scope for its commercial cultivation. Promoting kiwifruit cultivation with a

vision to cover more areas under its cultivation will not only generate sustainable economy of the rural masses, but also contribute to health, environmental and employment security. This is the future crop of the state which could provide sustenance to the economy of the rural masses and the state.

Fig.1: Pruned kiwifruit plants

Fig.2: Cuttings maintained in the nursery

Fig.4: Bearing stage

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Heart worm Diseases in Dogs:

an Enigma to Pet owners and Vets

P K Rath*[1], B P Mishra[2] and J Mishra[3]

[1]Assistant Professor, Department of Veterinary Pathology,
[2]Assistant Professor, Department of Livestock Products Technology,
College of Veterinary Science & Animal Husbandry, OUAT, Bhubaneswar-751003, Odisha,
[3]Scientist (Animal Science), KVK, Sambalpur, OUAT, Odisha
*corresponding author:drpkrath78@gmail.com

Abstract

Heartworm disease in dog not only a veterinary problem but also a zoonoses affecting human being all over the world. It is considered as an enigma because when owners diagnose the disease, the case is at the last stage and the treatment is often expensive, complex and life threatening. Most of the owners not having the adequate knowledge regarding the disease and it's pathogenesis. Veterinarians also always pose a great difficulty in treating the dog affected with Heartworm at the time the pet owners present their dogs. Most of the pet owners present their dogs to a vet when the situation of the pet get worsened and after handled by the so many inexperienced quacks. In recent years the mortality of dogs due to heartworm disease is rampantly increasing in India. Due to it's tropical climate, India favors the propagation and considered as an endemic zone for this disease. The present objective of this article is to educate the pet owners as well as field veterinarians about the etiology, life cycle of the causative agent, typical clinical signs, related pathology, importance of early diagnosis and preventive measures to be taken so that the disease not only be controlled but also saves the owners from vague spent.

INTRODUCTION

Heartworm infection in dogs has been recognized for over 300 years. Canine dirofilariasis popularly known as "Heartworm disease" caused by *Dirofilaria immitis, Dirofilaria ripens, Dipetalonema reconditum.* Important killer species among them is *Dirofilaria immitis*, commonly called as 'heart worm' of dogs (Genchi et al., 2001). Diagnosis of canine dirofilariasis is based on history of occurrence of the disease in the area and clinical signs and their development. Auscultation of chest can be of great help in evaluating the cardio- pulmonary state of dogs suffering with dirofilariasis. Microfilariae in the peripheral blood can be demonstrated by wet blood smear, thick blood smear, and also with various concentration techniques or with stained blood smear examinations.

Besides this radiography, echocardiography, electrocardiography, angiography, C-arm examination, detection of dirofilarial antigen and other molecular or serological technique also being employed in arriving a diagnosis of dirofilariasis. Pathological findings i.e. both gross and microscopic changes of different organs along with presence of adult parasites in the right ventricle or in other places helps a lot in arriving the diagnosis in dirofilariasis during necropsy examinations (Pachuri, 1999). Dog is considered as a definitive host. Human is the "Dead end host" of *D.immitis* since worms can not reach maturity and in majority of cases produce solitary granulomatous nodules in lungs parenchyma with symptoms of chronic coughing and fever.

Life cycle of the parasite

The heart worm lives mainly in the right ventricle, in the pulmonary artery but also found in posterior venacava less often in the right auricle, anterior chamber of eye, inter digital cysts and other parts of body. The males and females copulate in these sites*. Dirofilaria immitis* has an indirect life cycle. Females are viviparous (producing living young instead of eggs), producing motile unsheathed microfilaria which circulating in the peripheral blood at any time but there is a tendency towards nocturnal periodicity. The vectors of *Dirofilaria immitis* larvae are many mosquito species. Approximately in toto,70 species of mosquitoes shown to be capable of supporting larval development of *Dirofilaria immitis* to the 3rd (infective) larval stage. Mostly *culex, Aedes, Anopehles, Mansonia* etc. are incrimanted as intermediate host of the parasite (Arellano *et al.*, 2002). The motile microfilaria taken up from the peripheral circulation by the mosquito vector from infected dogs during their blood meal. Within the mosquito vector it molts twice i.e. (L1 microfilariae) will progressively mature to second stage larvae (L2) and then to the infective third stage larvae (L3) in the malpighian tubules and then migrates to the proboscis through the body cavity for sub subsequent infection to dogs. Development to the L3 stage is directly dependent on temperature. For maturing larvae to L3 stage within 10-14 days, it is necessary to have the temperature consistently above 80^0F. If at any time the temperature falls below 57^0 F, larval development will be retarded. The infected mosquito again during their blood meal leaves the infected L3 larvae to the new vertebrate host which molts to L4 larvae within 3 days. After two months the L4 larvae molt to L5 larvae and relocate from the subcutaneous tissue to the pulmonary arteries. The parasite remains dormant in the vertebrate hosts muscle tissue for 85 to 120 days. After this time period, the parasite enters the host's blood stream, where they carried to the heart. Completion of the life cycle in the heart requires 7 to 9 months. Microfilariae can be seen in the blood approximately 6-7 months after exposure to the infective L3 larvae. Adult parasite remains for 5-7 years in the dog. The circulating microfilariae may persist for about two years in dog. With a single patent infection with L3 larvae, the infected dogs may develop the disease or serve as reservoir capable of

infecting to other non infected dogs. Therefore, a dog may remain positive for microfilaria up to 7 years after a single infection with L3 larvae (Pachauri, 1999). The adult worms are thin, almost thread like with males 12-30 cm long and females 25-31cm long. Microfilariae are approximately 300 µm and 7µm wide.

Clinical Signs

Early symptoms like increased late night coughing and inappetance are generally mistaken or overlooked by the owners and also by the physicians by treating the dogs symptomatically with antibiotics which subsides the early symptoms for some time but it will gradually worsen the animal condition. Typical clinical signs like coughing, slight pyrexia, exercise intolerance, inappetance, haemoptysis, soiling of anus, dull and pale mucosa are observed during the course of this disease (Eslami *et al*. 2005). On a long run, when the asymptomatic dogs more particularly, those engaged in Police departments when subjected for a routine exercise, then produce a typical growling sound with panting for a long time and reluctance to move further.

Canine diorofilariasis categorized clinically as of three types such as Class I, Class II, and Class III. Dogs with class I heartworm disease are often remain asymptotic or may exhibit occasional cough. Class II category dogs show the signs like coughing and exercise intolerance. Dogs with Class III category show symptoms like anemia, fainting spells, right sided heart failure, hypertension, and labored breathing with tachycardia (Niwetpathomwat *et al*. 2007).

Screening of Dogs

Those dogs suspected for canine dirofilariasis basing on the presence of typical clinical signs should be subjected for blood examination prior to any medicaments by the physicians.

Blood samples (5ml from each animal) were collected from all the dogs for screening.

(a) Wet blood smear examination (Direct mount method) - One drop of blood from each sample was taken on a grease free glass slide and a cover slip was put on the drop of blood. It was then immediately examined under low power objective of microscope for the presence of microfilariae. Five wet films were similarly prepared and examined to have a better efficacy. The microfilariae identified through the wet blood smear technique as per their motility pattern. The *D.immitis* had slow wriggling movement i.e. undulate at one place and *D. reconditum* had quick progressive movement across the field.

(b) Modified Knott's method- One ml blood from each sample was taken in a sterilized centrifuged test tube and 9 ml of 2% formalin solution was added to it. Then it was centrifuged in an electrically operated centrifuged machine at 1000 rpm for 5 minutes. The supernatant fluid was poured off and 2 drops of 1: 1000 aqueous methylene blues was mixed to the sediments and shaken well and examined under low power objective of microscope for the presence of microfilariae. Modified knot test as the preferred method for observing morphology and to differentiate *D.immitis* from *D.reconditum*. The *D. immitis* showed longer length, long width and presence of straight tail with tapering

anterior extremity while *D. reconditum* was of short length, short width and presence of bottom hook tail with blunt anterior extremity (Mc Call *et al*. 2004).

Anaemia with decreased hemoglobin, total erythrocytes, neutrophillia and eosinophillia are the constant findings of Heartworm affected dogs through routine hematology. Movement of parasites and/or microfilariae will cause mechanical damage to the erythrocytes which mainly a contributing factor for anaemia.

Thoracic Radiography

Dogs screened on the basis of presence of typical clinical signs after due wet blood smear and modified Knott's tests if found of having a high load of microfilariae further subjected to thoracic radiography for studying the patho-morphological evaluation of heart and lungs. Cardiomegaly, round heart appearance suggestive of right ventricular hypertrophy, tortousity of the pulmonary artery, darkening of lungs, increased prominence of the main pulmonary artery segments, increased size and density of the pulmonary arteries, arterial tortuosity, and pruning are the important findings of thoracic radiography (samanta *et al*. 2007).

Pathology

The pathology of heartworm disease mainly attributed to the mechanical damage inflicted due to migration of the microfilariae and adult parasites in various vital organs such as heart, lungs, kidney and liver during different stages of life cycle. Presence of parasites add stress in affected animals which further compromise the immunity status of body and invite many opportunistic infections subsequently. Presence of adult parasite impedes the free flow of blood through heart to lungs and cause lesions of heart failure in affected dogs. Reduced blood supply to various important organs of the body then produce typical pathology in heartworm affected dogs. Heartworms release vasoactive substances that result in vasoconstriction and hypoxia, which lead to pulmonary hypertension and compromised cardiac output. Pulmonary hypertension causes pressure overload of the right ventricle, resulting in compensatory, concentric ventricular hypertrophy (thickening of the ventricular walls). In high worm burdens, chronic pulmonary hypertension with tricuspid insufficiency results in elevated cardiac filling pressures and congestive heart failure. Thromboembolism may cause acute decompensation by producing or aggravating pulmonary hypertension, right heart failure, or pulmonary infarction Heartworm infection may also lead to glomerulonephritis and proteinuria secondary to antigen–antibody complex formation.

Importance of early diagnosis

1. The wet blood smear examination at an early stage giving an idea about presence of microfilaria definitely gives right direction to the physicians for choosing the proper medicaments in treating the dogs.
2. Early wet blood examination helps in knowing about the microfilaria load in dogs.
3. Veterinarians are thus able to plan for future treatment schedule or postponement of any earlier therapy.

4. Pet owners will be saved from unnecessary expenditures for treatment as well as valuable time and reducing their hospital visits with animals.
5. Early detection will control the disease from further worsening the conditions in affected thus prolonging the longevity of dogs.
6. Diagnosis of disease early checks the further spread of disease to any susceptible.

PREVENTIVE PROCEDURES

There is a say that "Prevention is better than cure". Treatment in heartworm is always complicated and time consuming. Also it is a complicated and expensive process, taking months for infected animals to recover and there is often permanent damage to the heart.

Following preventive procedures should be adopted to prevent this disease:

1. Regular and routine blood examinations for dogs.
2. Use of suitable Preventive medications after due consultation of Vets.
3. Minimizing pet's exposure to mosquitoes
4. Use of mosquito repellants regularly
5. Action taken for making pet's environment less hospitable to mosquitoes.

CONCLUSION

Heartworm disease in dogs is now considered to be an important killer disease in India which needs to be properly addressed from every quarter through wide awareness. The veterinarians as well as the pet owners should be infused with adequate knowledge regarding it's etiology, pathogenesis, screening, control and possible preventive procedures. There should be a routine procedure for Wet blood smear examination of dogs presented for any treatment to the hospitals which not only a cheapest but also easy to do without requiring any state of art laboratory facility. Treating a heartworm affected dogs is really pose a puzzle to the veterinarians as it involves life complication of the patient as well as time consuming and expensive if not detected early.

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"Ethostasis" and Behavioral Anomalies in Dairy Animals

T. K. S. Rao, S. Chaurasia, K. K. Verma, A. Singh* and Krishna Gamit C.*

**M. V. Sc. Scholar, Vanbandhu College of Veterinary Science & Animal Husbandry*
Navsari Agricultural University, Navsari 396 450 Gujarat India
**Corresponding Author: tksrao.vet@gmail.com*

Abstract:

Problems occurring at farm require modern approach like behavior study of animals. Relationship between husbandry system, diseases and behavioral factors are interrelated. It is hypothesized that intensive system increases behavioral abnormalities; phenomenon has been referred as "ethostasis". Dairy animals are handled frequently in order to manage according to production and therefore further increasing behavioral problems due to stress related to management, space and restrain. Crowding, hypostimulation and hypokinesis commonly observed in continuous restriction system. Behavioral abnormality like buller steer, tongue rolling feed tossing, dropping feeds are common in animals due to boredom and other problems. Behavioral abnormalities should be controlled to manage the farm in scientific way. Features of animals are also important with respect to behavior for either selection or culling of animals at the farm.

INTRODUCTION:

Problems occurring at farm require modern approach like behavior study of cattles. Behavior can be monitored and quantified especially in intensive production system so that change in behavior can be traced and alteration can be included in existing problem prevention protocol. Intuition, empathy and sensitivity are essentially required for Animal husbandry to move in positive direction. As economic approach and reduced values with farm animals will limit our compassion and good animal husbandry practices.

Relationship between existing husbandry system, disease problems and behavioral factors are interrelated and dependent on each other. It is hypothesized that restrictive husbandry practice leads to behavioral abnormalities; this phenomenon has been referred to as "ethostasis". Animals in captivity affect its ability to express natural behavior. Restrictions affect the psychology and welfare and comfort of animals in negative direction

towards frustration. Monotonous condition affects welfare stimulating animals to seek behavior to avoid boredom. Behavior restriction implies not only the animal is prohibited from performing activities but also adverse effect arises as a result of ceiling. It is therefore need of the time is to investigate the problems that have been created by modern intensive system of production.

Husbandry practices:

Intensive housing and management adds behavioural problems that may not be seen with animal in natural pasture. Dairy animals are handled frequently in order to manage according to production and therefore further increasing behavioral problems. In order to reduce anomalies, livestock producer must be innovative to shift towards managemental interventions that will improve and not compromise animal well being. Understanding behavioral clue is the best way to know discomfort or stress in animals (Albright, 1990).

Variation in behavior:

Individual variation with respect to behavior is common therefore generalization about particular behavior is not always appropriate.

Categories of behavioral anomalies:

1. **Idiosyncratic behavior:** Individual specific abnormal behavior with no clinical significance. This behavior is shown in animals without any purpose. E.g. tongue rolling in cattle.
2. **Clinical and subclinical behaviors:** Behavioral alteration in animals due to diseases. Behavioral changes common in both clinical and subclinical diseases.
3. **Anomalous behavior:** Medical irregularities are termed anomalies. Uneven form of behavior therefore called anomalous behavior. Behavioral problem is common in animals kept in controlled condition. It is irregular form of behavior common in clinically not sick animals.

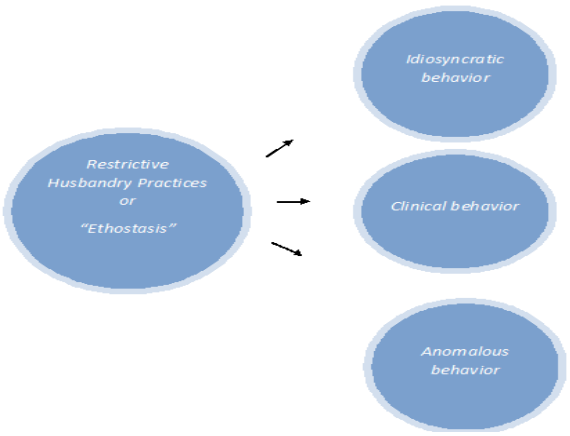


Figure 1 Stress in animals: (Fraser and Fox, 1983)

S. No.	Stress type	Common stress
1.	Management	Compromised welfare Nutritional deficiencies Husbandry problems Environmental variables Hygienic sub standards Noise level Management policies
2.	Space	Social density Peck order status Group size Permitted Movement Area per head Isolation
3.	Restraint	Use of control device like stall tether, crush Suppressive device Restrictive housing

Modern animal husbandry system:
Cattles are kept in group while feeding and density of cattle is further increasing in same space. Many dairy farms are using indoor system of management with set daily routine movement of cattle from holding section to milking section and vice versa. These ethostatic situations may not be always harmful events but frequent repetition over time creates stressful condition.

Crowding: When population of animal is increasing, which may ultimately leads to anomalous behavior. Aggression is commonly seen in animals maintained at high densities. Establishment of stable peck order is essential for less fighting in group animal under intensive system otherwise aggression may change into agonistic behavior. Injuries are common in subordinate animals commonly.

Hypostimulation and hypokinesis (diminished body movement): Commonly observed in continuous restriction and intensive management system due to lack of variable stimuli.

Behavioral abnormalities in cattle: Cause and its control:

Nymphomania: This behavior is common in multiparous cow and is characterized by bull like behavior in cow especially frequent mounting. Common cause is follicular cyst and behavior can be controlled with Luteinizing Hormone injection.

Silent heat: Inability of a animal to show sign of estrus even though the reproductive tract, ovary and follicle are close to normal. Animals placed on surface with unsure footing are reluctant to show estrus behavior. During heavy rain or snow fall and during high temperature or cold including problem of sore feet in cow increases the incidence of silent heat. Submissive nature of cow is also contributes to this problems. Improving estrus detection technique is best way to overcome problem.

Buller steer: Root cause is overcrowding and hormonal imbalance. It is typical dominant recessive interaction behavior. Dominant one having tendency of mounting is known as buller and who stands to be mounted is steer. The behavior can be restricted by removal of buller from group, aiding hiding place in loafing areas, placing overhead electric wire and painting odoriferous material on rump of buller.

Aggressive behavior: This behavior might be occurring due to fear, inadequate socialization, mimicking and hormonal state. Animals with aggressive behavior should be culled from the herd.

Kicking: Animals suffering from the behavior should be handled carefully. They may be mildly sedated before handling to avoid severe injury. Food rewards can be provided for soothing effect. Fig-1 Showing blind area and Fig-2 Showing Kicking pattern in cow i.e., Side kick and back kick.

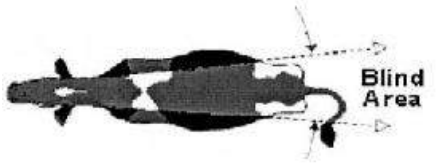


Figure 1

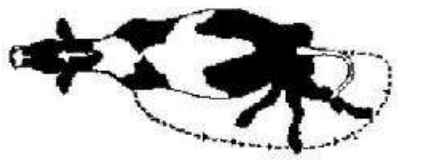


Figure 2

Cross-fostering: Post-parturient bonding between cow and calf is based on fetal fluid and visual cues. Using amniotic fluid, skin of cow's own calf or blind folding the cow can help in accepting introduced calf. Providing food reward to cow can help in acceptance.

Reluctant to enter the parlor: Earlier negative experiences in parlor may create reluctance. Concentrate feeding while milking, keeping animals in quite, cool and calm environment and preferred cow mates at the time of milking may solve the problems.

Orthostasis in calf: Calf prefer spent more time in static standing position and significantly reducing lying time due to isolation and confinement. It leads to fatigue and diarrhea in calf.

STEREOTYPIES:

Stereotypies are repetitive series of a behavior that have no apparent purpose of benefits. This includes tongue rolling, bar biting, prepuce or scrotum sucking, biting or licking body parts and urine drinking.

Tongue rolling: This behavior is categorized under orosthenia. This behaviour is common in animals kept in confinement. It is also established that tongue rolling reduces the stress in

animals. Few authors also suggested deterioration in physical condition of animals due to this habit. Incidence can be reduced by provision of dry teats to calf.

Excessive grooming and licking: This behavior categorized under oro-sthenia. Common in calf kept in confinement. Excessive grooming results in hair ball formation in alimentary tract which ultimately leads to obstruction and ulceration.

Inter-suckling: This behavior is categorized under orosthenia. Poor nutrition especially deficiency of roughage in diet may influence the development of behavior. It causes hair ball in alimentary tract. Problems are common in calf due to suppression of suckling instinct due to early weaning practice. Dry teats, serrated nose ring, repellent material and muzzle can be utilized for controlling the anomalies (Kiley-Worthington, 1977).

FEED RELATED VICES (Albright and Arave, 1997):

Feed tossing or Food throwing on back: Commonly seen in fly infested barn during summer and total mixed ration type of feeds. Feeding animals at ground level in place of elevated bunk diminishes the behavior.

Dropping feed: This behavior is again common in elevated feed bunk. Cows drop the food intentionally to fulfill natural grazing instinct i.e., placing the feed where it can be more comfortably eaten. Dropping of feed from mouth of aged cattle indicates need of filing on molar teeth to make it flat for crushing. Slanted feeding stall will solve this type of problems.

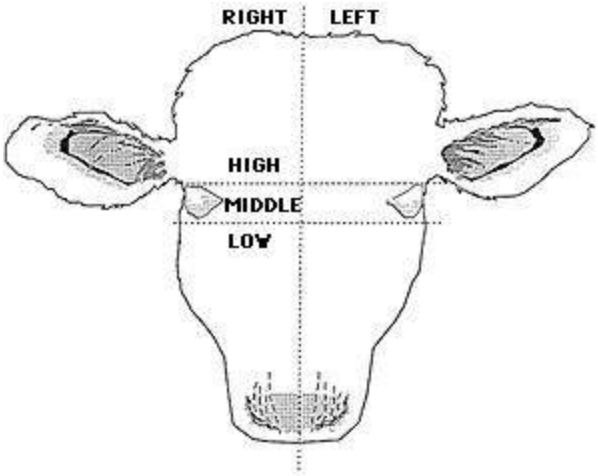
Water lapping: Cows licking at water surface with their tongue instead of drinking by vacuum mechanism. This behavior might be due to boredom from suppressed grazing behavior or be deficient in exercise.

Basic points related to behavior anomalies:

1. Stress creates anomalies with specific sign and symptoms if it increases above critical limits.
2. Etho-anomalies are persistent however its expression depends on increase and reduction of causal factors.
3. Anomalies are enzootic in nature and transmitted mainly by imitation.
4. Said behavior in animals affects health, welfare and production negatively.
5. Etho-anomalies are basic evidence of animal suffering from stress.

Understanding unique features affecting behavior:

- Fine cannon boned cattle were more panic and flighty (Lanier et al., 2000). Foreleg was wider in calmer animals. Cattles that remain calm during handling have better reproductive performance as compared to aggressive (Kasimanickam, et al, 2014).
- Hair whorls present high i.e., above eye level on forehead show bad temperament (Grandin et al., 1995; Lanier et al., 1999).
- Hair whorl present low i.e., below eye level on fore head explains a calm temperament.
- Height of hair whorl on forehead related to calf vigilance (Floreke et al., 2012).



Hair whorl position

CONCLUSIONS:

Artificial and restricted environmental conditions imposed on cattles create condition i.e., "ethostasis" which leads to increase in behavioral problems at farm. Restricted suckling to calf stimulates inter-suckling and licking behaviors which may persist for long time. Frustrated and boring behavior leads some cows to engage in streotypies which is due to reduced activity in intensively managed cows. Reproductive problems like nymphomania and silent heat are specifically increasing in intensive system. Decreasing fear of human being i.e., decreasing flight zone to animals stimulates, mounting by cattle on caretakers is common in this system. Feeding anomalies also attributed to boredom following a too rapid ingestion of rations and restricting animals from grazing and other natural behavior.

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Nutritional interventions for functional food production

N. Sahoo, K. Sethy*, S.K. Mishra, S. S. Parhi and M.R. Mohapatra and S. Khadenga

Department of Animal Nutrition
College of veterinary science and Animal Husbandry
Orissa University of Agriculture and Technology, Bhubaneswar, Odisha, 751003
**Corresponding Author: babuivri@gmail.com*

A food can be regarded as 'functional' if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutrition, in a way that improves health and well-being or reduces the risk of disease. The use of nutritional strategies to improve quality of food products from livestock is a new approach that emerges at the interface of food science and animal science. These strategies have emphasized in the alteration of nutritional profile, for example increasing the content of polyunsaturated fatty acid (PUFA), and in the improvement of the oxidative stability, such as supplementation of animal with natural antioxidants to minimize pigment and lipid oxidation in meat, production of Vitamin E enrichment egg *etc.* Most people have a concern for their diet from a health aspect. Dietary food guides, such as the United State Drug Administration (USDA), food guide pyramid are tools to inform the public about diet, nutrition and health (Lachance and Fisher, 2005).

Consumer demand for food products of superior health quality has generated interest in modifying the lipid composition and enriching egg and meat with beneficial nutrients. Meeting consumer demands is a constant challenge for the animal food industry. Many consumers desire somewhat distinct products with respect to safety, healthfulness, freshness, taste, color *etc*. To tap into this market, companies have developed several designer and speciality eggs which have appeared on store shelves.

NUTRITIONAL MANIPULATIONS FOR P RODUCING DESIGNER EGG

Modified or enriched eggs or super eggs are those in which the content has been modified from the standard eggs. These eggs may be classified as nutritionally enhanced eggs, value added eggs, processed eggs. Designer eggs are those specially produced eggs which are rich in additional nutrients and health promoting components like carotenoids, chelated minerals, Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) like omega 3 fatty acids, selenium, vitamin E and other immune-modulating factors. The generic egg has only 60mg omega-3 fatty acids as compared to omega-3 enriched egg which may have level as high as 350 mg (Scheiders and

Lewis,2002).In India ,Narahari et al.(2004) has build up a herbal enriched designer eggs(HEDE) which was not only rich in n-3 PUFA but also had vit-E, Se, Carotenoids, certain B-complex vitamin & trace minerals.

MANIPULATION OF FATTY ACID PROFILE IN EGGS

Eggs have gained attention as an alternative to fish and oilseeds as a source of Omega -3 fatty acids. The total fat content in the egg yolk cannot be altered; but its fatty acid composition can be altered, by changing the type of oil used in the hen's diet. The omega-3 fatty acids, also called as n-3 fatty acids are a family of polyunsaturated fatty acids which have the first C-C double bond at the third carbon position counting from the omega end of the carbon chain. Important omega-3 fatty acids are derived largely as DHA and EPA from fish oils and as α-linolenic acid (LNA) from plant oil. Omega-3 fatty acids are usually obtained from two sources which can be classified as:

The marine type ω-3 PUFA, DHA and EPA which are more commonly found in deep sea cold water fish (such as salmon, mackerel, herring, tuna, bluefish and anchovies) and marine algae (Barclay *et al.,* 1998).

The terrestrial type ω-3 PUFA, LNA found in canola oil, soybean oil, flaxseed, walnuts, and spinach and mustard greens. Flaxseed has been a popular choice as a terrestrial source of n−3 PUFA for animals but there have been reports that eggs from hens offered flaxseed also have a fishy odour or taste, similar to that found in eggs from hens offered fish oil.In general, taints arising from flaxseed or fish oil feeding were reported as a problem only when the oil sources were included above certain levels in the hens' diet (N5% for flaxseed or N1.5% for fish oil) (Surai and Sparks, 2001). Long chain omega-3 (LC n-3) PUFA have been implicated in the prevention of cardio vascular disease (Harris, 2007), chronic inflammatory disorders (Calder, 2006) and mental health conditions (Assisi et al., 2006).

CONJUGATE LINOLEIC ACID ENRICHMENT IN EGG

Conjugated (CLA) is a group of positional and geometrical isomers of 18-carbon unsaturated fatty acids with two conjugated double bonds (unlike linoleic acid, which has a nonconjugated diene). The most commonly occurring CLA isomers is *cis*-9, *trans*-11-CLA. CLAs have been shown to have anticarcinogenic, antiadipogenic, antidiabetic and anti-inflammatory properties (Bhattacharya *et al.,* 2006). Eggs produced by hens when fed with 5.0% CLA will contain 310 to 1000 mg of CLA per egg (Suksombat *et al.,* 2006) which could provide a substantial amount of CLA in human foods to meet the proposed CLA requirement.

VITAMIN E ENRICHMENT IN EGGS

Vitamin E enriched can be produced with a higher amount of vitamin-E as compared to normal eggs by feeding hens on a diet high in vitamin-E (Shahriar *et al*., 2008). As ω-3 fatty acid enriched eggs are more susceptible to lipid oxidation, Supplementation with vitamin E is generally recommended to stabilize egg lipids against rancidity and extend the shelf life of the product (Galobart *et al.*, 2001). Leeson *et al.* (1998) recommended that the level of dietary vitamin E in feed should be 100 IU/kg for commercial n-3 fatty acid rich egg production. Inclusion of

vitamin E in the hen's diet at 200 mg/kg of feed has been found to be an effective antioxidant (Galobart *et al.,* 2001).

SELENIUM ENRICHMENT IN EGGS

Selenium is an important constituent of a number of functional selenoprotein which is mandatory for normal health that may come from different sources like that cereals, fish, poultry and meat (Hattingh *et al.,* 2008). Now a days, Selenium enriched eggs are available in many countries. Russia is the most advanced country for the production of Selenium enriched eggs. Selenium enriched eggs were first time developed in the Scottish agriculture college in 1998 (Surai, 2000) by the use of supplementation of organic Se in the form of Se enriched yeast into hen diet. Inorganic sources (selenate and selenite) and organic sources of selenium supplements (selenium yeast) are used in typical corn soybean meal based layer diets to develop the Se enriched egg. Inorganic Se has lower transfer efficiency to eggs than the organic Se. The use of Sel-Plex, organic Se in the layer diet @ 0.3 mg/ kg resulted in significantly higher albumen values (Haugh Units) after seven days of storage. Se has a sparing effect on vitamin E, such that selenium supplementation can increase the vitamin E content of egg yolk (Surai *et al.,* 2006). The maximum allowable level (0.3 ppm) used in commercial poultry diets is well below toxic levels.

NUTRITIONAL MANIPULATIONS FOR D ESIGNER MEAT PRODUCTION

Meat is the animal flesh that is used as food. Most often, this means the skeletal muscle and associated fat, but it may also describe other edible tissues such as livers, brains, bone marrow, kidneys and lungs. The word *meat* comes from the Old English word *mete*, which referred to food in general (Sharma, 1999). Meat is a highly nutritious food with a high degree of bioavailabilty and consumers have a high degree of preference for its taste and flavor. According to Decker and Park (2010) such ingredients credited as being "functional" have to be considered for their intake level, their efficiency in providing physiological benefits, stability and technological performance (like storage stability and effect on sensory characters).

MANIPULATION OF FATTY ACID PROFILE IN MEAT

It is well established that the fatty acid composition of muscle lipid has an important impact on ruminant and nonruminant meat quality. This was comprehensively reviewed by Wood et al. (2003) who reported that meat fatty acids affect fat tissue hardness, shelf life and flavour. The long-chain polyunsaturated fatty acid eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA) offer a wide range of potential health benefits and are recognised as essential nutrients in the human diet (Simopoulos 1991). Nuijten *et al.*(2011) reported that the greatest concentration of n-3 fatty acid is observed in the fish oil groups and the lowest level in the tallow groups , the soybean/linseed oil groups being intermediate. Enrichment of pork with n−3 LCPUFA may reduce the shelf life of the product, with off-odours and flavours and impaired meat colour resulting from oxidation of the PUFA (Wood et al., 2003). Zuidhof *et al.* (2009) have suggested that feeding flaxseed for 24 days before processing gave optimal breast meat ω-3

enrichment, carcass weight and meat yield. Lopez-Ferrer *et al*. (2001) showed that all forms of ù3 PUFA content significantly increased by feeding diets supplemented with fish oil for 38 days in broiler chickens. Rymer *et al.* (2010) have reported that algal biomass is as effective as fish oil for enhancing oxidative stability of the meat.

VITAMIN E ENRICHMENT IN MEAT

Vitamin E is recognised as a radical chain-breaking antioxidant although it has limitations as it requires another antioxidant to recycle it from the oxidised form and it can act as a pro-oxidant when high doses are ingested (Rietjens *et al.,* 2002). Faustman *et al.* (1989) recommended an optimum level of 3–3.5 µg of α-tocopherol/g muscle to inhibit metmyoglobin formation during 7 days ageing of beef. Rosenvold and Andersen (2003) concluded that vitamin E inclusion at levels above the dietary requirement (for example 200 mg/kg feed) protected fresh pork and pork products against lipid oxidation. They also noted that although vitamin E supplementation has been used successfully to improve both colour and lipid stability in beef, the results reported for colour stability of pork was inconclusive. Niu *et al.* (2009) observed that heat stress severely reduced growth performance, feed intake, feed conversion and immune response of broilers, while dietary vitamin E supplementation improved the immune response of broilers under heat stress. Vitamin E was also reported to reduce the lipid oxidation (Malondialdehyde concentration) in breast and thigh meats during refrigerated storage (Goni *et al.,* 2007). Dietary supplementation of vitamin E inhibited the development of PSE conditions in pork resulting in improved meat quality (Olivo *et al*., 2001).

SELENIUM ENRICHMENT IN MEAT

Selenium is an essential trace mineral for human and animal because it is involved in regulating various physiological functions as an integral part of seleno-proteins. Se supplementation showed a positive effect on weight gain and FCR compared to controls in broiler birds (Spring, 2008). Kim and Mahan (2001) reported that dietary supplementation of 5% or less organic and inorganic selenium did not influence body weight, daily weight gain and feed intake in growing–finishing pigs. However, it significantly increased selenium levels in blood and tissues including kidney, liver, pancreas, spleen, heart and muscle .Organic Se (Selplex) at 0.1-0.3ppm can be added as antioxidants to the poultry diet (Surai *et al.*, 2010). Skrivan *et al*. (2008) reported that 24 weeks of feeding selenium-enriched yeast and selenium-enriched alga chlorella increased the selenium and átocopherol content in laying hens. In Korea, "Selen Chicken" and "Selen Pork" was produced by feeding yeast bound selenium and sold as a designer food that can improve human health and nutrition.

ENRICHMENT OF MEAT WITH CONJUGATED LINOLEIC ACID

CLA is a collective term describing a mixture of positional and geometric isomers of linoleic acid, which are involved with double bonds at positions 7 and 9, 8 and 10, 9 and 11, 10 and 12, and 11 and 13 in the fatty acid chain (Eulitz *et al*., 1999). Among these isomers, the most studied two isomers are cis 9, trans 11-

CLA and trans 10, cis 12-CLA due to their biological effects. Du and Ahn (2002) reported that feeding 2% and 3% CLA for 5 weeks decreased the body fat by 16% and 14% respectively in broilers. Dietary addition of CLA for 12 weeks in 27 week-old White Leghorn hens caused decreased lipid oxidation in raw chicken meat and decreased content of haxanal and pentanal in cooked chicken meat, which are responsible for bad flavour in meat.

Park *et al.* (1999a) stated that the t10c12 isomer appeared to be metabolised more rapidly than the c9t11 isomer, especially in skeletal muscle, leading to the higher deposition of the c9t11 isomer. Gläser et al. (2000) fed hydrogenated fat, rich in tC18:1 isomers (1.79 g t6-9 C18:1/kg feed and 1.39 g t10-11C18:1/kg feed), resulting in a higher c9t11CLA content in the adipose tissue of pigs compared to the control diets (0.44 and <0.01 g c9t11CLA/100 g of total fatty acids, respectively), but also resulting in a four to eight times higher deposition of tC18:1 isomers. Incorporating CLA into the pig diets resulted in increased deposition of SFA (C14:0, C16:0 and C18:0) and a decrease in MUFA (mainly C18:1). French *et al.* (2001) increased the CLA content ($P<0.05$) of the longissimus dorsi muscle in beef steers from 0.37 g/100 g total FA in concentrate-fed animals to 1.08 g/100 g total FA by feeding 22 kg DM fresh grass.

CONCLUSION

Now a day's consumer gives more attention towards their health and demand functional food than conventional food. Nutritional manipulations to alter composition of egg and meat for health aspects are of great importance in animal industry. Hance more emphasis should be given towards production of functional food.

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Effect of Climate Changes on Livestock Productivity

Balamurugan B, Gopalakrishnan A, Deepesh Gautam, Ravi Shankar kumar Mandal Deepa Singh, Nitish Kharayat, and Rahul Katiyar

PhD Scholars Indian Veterinary Research Institute –Izatnagar , Bareilly-243122.

Livestock play a vital role in the agricultural sector in developing nations, and the livestock sector contributes 40% to the agricultural GDP. Global demand for foods of animal origin is growing and it is apparent that the livestock sector will need to expand (FAO, 2009). Livestock are adversely affected by the detrimental effects of extreme weather. Climatic extremes and seasonal fluctuations in herbage quantity and quality will affect the well-being of livestock, and will lead to declines in production and reproduction efficiency. Climate change is a major hazard to the sustainability of livestock systems globally. therefore, adaptation to, and mitigation of the detrimental effects of extreme climates has played a major role in combating the climatic impact on livestock. There is little doubt that climate change will have an impact on livestock performance in many regions and as per most predictive models the impact will be harmful. Climate change may manifest itself as rapid changes in climate in the short term a couple of years) or more subtle changes over decades. Generally it is associated with an increasing global temperature. Various climate model projections suggest that by the year 2100, mean global temperature may be 1.1–6.4 °C warmer than in 2010. The difficulty facing livestock is weather extremes, e.g. intense heat waves, floods and droughts. In addition to production losses, extreme events also result in livestock death. Animals can adapt to hot climates, however the response mechanisms that are helpful for survival may be detrimental to performance.

Effect of climate change on livestock production

Animals exposed to heat stress reduce feed intake and increase water intake, and there are changes in the endocrine status which in turn increase the maintenance requirements leading to reduced performanc. Environmental stressors reduce body weight, average daily gain and body condition of livestock. Declines in the milk yield are pronounced and milk quality is affected. Generally the higher production animals are the most affected. Adaptation to prolonged stressors may be accompanied by production losses. Increasing or maintaining current production levels in an increasingly hostile environment is not a sustainable option. It

may make better sense to look at using adapted animals, albeit with lower production levels (and also lower input costs) rather than try to infuse 'stress tolerance' genes into non-adapted breeds.

Effect of climate change on livestock Reproduction

Reproductive processes are affected by thermal stress. Conception rates of dairy cows may drop 20–27% in summer, and heat stressed cows often have poor expression of oestrus due to reduced oestradiol secretion from the dominant follicle developed in a low LH environment. Reproductive inefficiency due to heat stress involves changes in ovarian function and embryonic development by reducing the competence of oocyte to be fertilized and the resulting embryo. Heat stress compromises oocyte growth in cows by altering progesterone secretion, the secretion of FSH, LH and ovarian dynamics during the oestrus cycle. Heat stress has also been associated with impairment of embryo development and increase in embryonic mortality in cattle. Heat stress during pregnancy causes slows growth of the foetus and can increase foetal loss. Secretion of the hormones and enzymes regulating reproductive tract function may also be altered by heat stress. In males, heat stress adversely affects spermatogenesis maybe by inhibiting the proliferation of spermatocytes.

Effect of climate change on livestock dieases

Variations in temperature and rainfall are the most significant climatic variables affecting livestock disease outbreak. Warmer and warmer winters will increase the risk and occurrence of animal diseases, because certain species that serve as disease vectors, such as ticks and biting flies, are more likely to survive year-round. The movement of disease vectors into new areas e.g. malaria and livestock tick borne diseases (babesiosis, theileriosis, anaplasmosis), Rift Valley fever and bluetongue disease in Europe has been documented. Certain existing parasitic diseases may also become more prevalent, or their geographical range may spread, if rainfall increases. This may contribute to an increase in disease spread for livestock such as ovine chlamydiosis, caprine arthritis, equine infectious anemia, equine influenza, Marek's disease and bovine viral diarrhea. There are many rapidly emerging diseases that continue to spread over large areas. Outbreaks of diseases such as FMD or avian influenza affect very large numbers of animals and contribute to further degradation of the environment and surrounding communities' health and livelihood.

Effect of climate change on livestock adaptation

In order to maintain body temperature within physiological limits, heat stressed animals initiate compensatory and adaptive mechanisms to re-establish homeothermy and homeostasis, which are important for survival, but may result reduction in productive potential. The virtual changes in the various physiological responses i.e. respiration rate, pulse rate and rectal temperature give an indication of stress imposed on livestock. The thermal stress affects the hypothalamic–pituitary–adrenal axis. Corticotropin releasing

hormone stimulates somatostatin, possibly a key mechanism by which heat-stressed animals have reduced growth hormone and thyroxin levels. The animals thriving in the hot climate have acquired some genes that protect cells from the increased environmental temperatures. Using functional genomics to identify genes that are up- or downregulated during a stressful event can lead to the identification of animals that are genetically superior for coping with stress and to the creation of therapeutic drugs and treatments that target affected genes. Studies evaluating genes identified as participating in the cellular acclimation response from microarray analyses or genome-wide association studies have indicated that heat shock proteins are playing a major role in adaptation to thermal stress.

CONCLUSION

Climate change is a global reality. Contributing factors are Temperature, Rainfall, Radiation, Wind velocity, Relative humidity and Snow fall. Industrialization & anthrop activities increase the GHG that contribute to climate change. Developing countries tend more vulnerable to climatic change. Heat stress adversely affects productive and reproductive performance. Mitigation strategies includes Cooling of animal shed, proper ventilation, Nutritional management, hormonal alterations, Genetic Selection, Diseases resistant and proliferation of thermo tolerant animals.

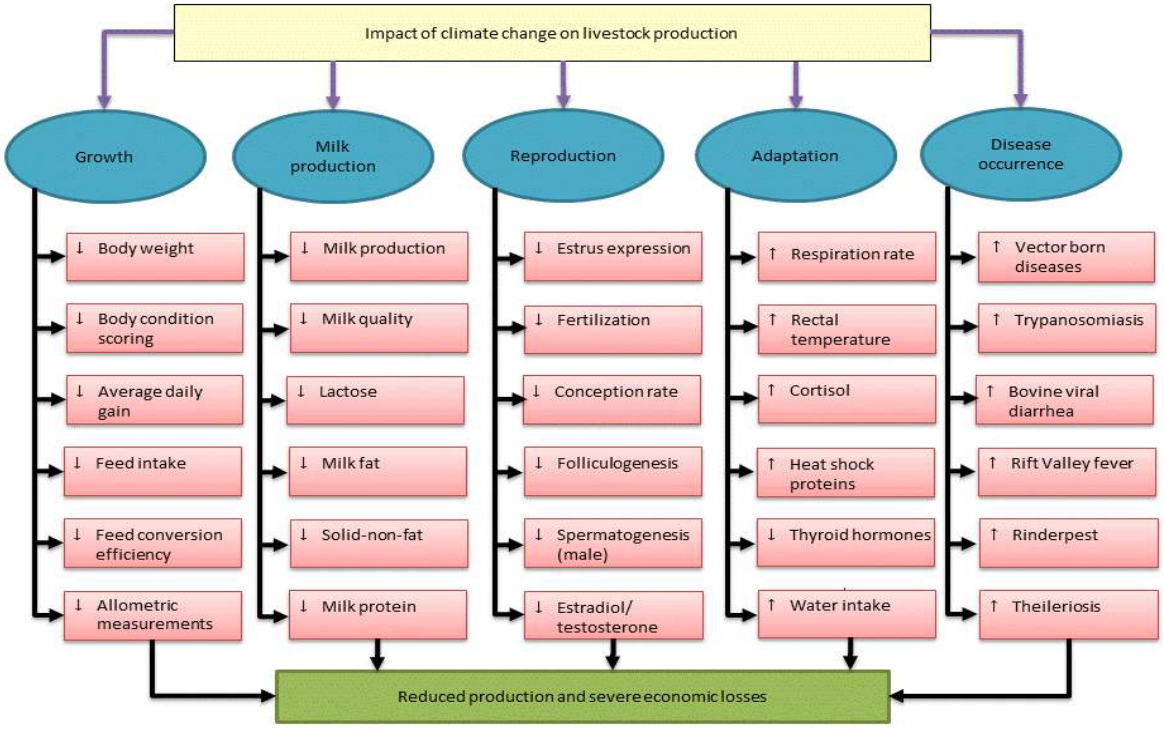


Fig. 1. Impact of climate change on livestock production

Foremost Insect pests of Sugarcane in Indian subtropics and their Management

Arti Katiyar[1] and Shiva Kant Singh[2]

[1]*Senior Research Fellow Entomology,*
[2]*Principal Scientist Entomology, Division of Crop Protection,*
ICAR-Indian Institute of Pulses Research, Kanpur- 208024, U.P.
Email- *artikatiyar25@gmail.com*

Abstract

Sugarcane Saccharum officinarum Linnaeus is a long duration crop of 10-12 months and therefore is liable to be attacked by a number of insect-pests and diseases. It is considered as one of the most efficient photo-synthesizer in the plant kingdom, classified as a C4 plant it converts 2% of incident solar energy into biomass. According to an estimate, sugarcane production declines by 20.0% by insect-pests and more than 50 diseases are reported in sugarcane. As many as 288 insect pests and 76 non-insect pests are reported to harass this crop after sowing to till harvest. Sugarcane pests based on feeding habit may be grouped as subterranean pests-termites, white grubs, root aphid and mealy bugs, borers, sucking types-pyrilla, white flies, scale insects and mealy bugs, defoliators-army worm, leaf rollers, skippers and gross hopper etc. To increase the crop productivity, management of insect-pests and diseases are of great significance. Due to diversity in agro-ecological conditions the importance of insect pests varies and therefore, management strategy should be adopted accordingly.

INTRODUCTION

Sugarcane is a perennial grass in the family *Poaceae* grown for its stem (cane) which is primarily used to produce sucrose. A mature stalk is typically composed of 11–16% fiber, 12–16% soluble sugars, 2–3% non-sugars, and 63–73% water. It is grown on about 5.3 million hectares, average yield 360 million tones and sugar production is about 252 million tones. It is one of the second largest major Industrial crops of India. The crop needs plenty of sun and water (min. 600mm of rain per annum, 1200 to 1800mm without irrigation, though water logging is not tolerated), pH of 6 – 7.5 is deemed as suitable soil. A sugarcane crop is sensitive to the climate, soil type, irrigation, fertilizers, insect pests and diseases. It is attacked by a number of insect pests and diseases. Below herein is given a brief account of symptoms of important pests occurring in several parts of the Indian subtropics.

Sugarcane is infested by about 288 insects of which nearly two dozen causes heavy losses to the quality as well as quantity of the crop, as detail given below in (Table 1). The scenario of insect pests

and diseases varies in sub-tropical and tropical belt of sugarcane. Top borer and stalk borer are found pre-dominantly in sub-tropical areas whereas internodes borer and early shoot borer and among disease rust & eye spot are prevalent in tropical region

Table-1 showing major insect pests of sugarcane

Name of the pest	Scientific Name	Plant parts infested	Peak period of activity
Termites	*Odentotermes obesus* Ramb	Cane setts, shoots and canes.	Active in all seasons severe under drought conditions.
Shoot borer	*Chilo infuscatellus* Snellen.	Young Shoots and during drough the internodes.	March-June
Top borer	*Scirpophaga excerptalis* Wlk.	Shoot and grown up canes	June - December
Root borer	*Emmalocera depressella* Swinhoe	Young plants	April - June
Leaf hopper	*Pyrilla perpusilla* Wlk	Leaf and leaf sheath	Summers with moderate to high humidity low rainfall or March-October
Lygaeid bug or black bug	*Cavelerius excavatus* Dist.	Leaf whorl mostly ratoons	Pre mansoon period
Scale insect	*Melanaspis glomerata* (Green)	Internodes	May - December
Mealy bug	*Saccharioccus sacchari* Cockerell.	Nodal region	Throughout the year but severe under drought
White fly	*Saccharioccus sacchari* Cockerell.	Leaf	Well-manured and heavy crops or August-October
White grub	*Hilotrichia consanguinea* Blanch	Roots, lower portion of stem covered by the soil	March to October (Mass emergence immediately after first heavy rain)

1. Early Shoot Borer (Chilo infescatellus)

- Attacks the crop during the early part of cane growth, before internode formation. It also attacks the cane stalks in the years of scanty rainfall.
- Larvae enter the cane laterally through one or more holes in the stalks (shoot) and bores downwards as well as upwards killing the growing point. Thus it cuts of the central leaf spindle, which eventually dries forming a dead heart. The dead heart can be easily pulled out. It emits an offensive odour.

- Borer infestation during the germination phase kills the mother shoots resulting in the drying up of the entire clump. This leads to gaps in the field (Fig 1).
- Causes heavy yield losses as it affects the plant stand/unit area. It also leads to canes of different age, which will be poor in juice quality, with less cane weight. When borer infects cane stalks, both yield and quality are reduced (Khanzada 1993).

Adult of Early shoot borer

Early Shoot Borerlarvae

Dead Heart

Early Shoot borer affected field

Fig -1 Showing different stages of Early Shoot Borer in sugarcane

Management strategies:

Following control measure should be adopted-

(i) Light earthing up of the tillers at the early stages of the crop (month old) during May and June reduces the incidence. A second earthing a month later reduces the borer attack considerably.

(ii) Mulching with cane trash at the early stages also has been reported to reduce the incidence and help in conserving moisture.

(iii) Cutting the affected tillers as close to the ground as possible and destroying them.

(iv) Soil application of granules of cartap hydrochloride at 1 kg a.i./ha at planting followed by another application on 45th day for late planted crop.

(v) Cartap hydrochloride 4G, sevidol 8G and chlorpyriphos 10G at 1 kg a.i./ha as whorl application at 35th and 65th day are also found effective.

(vi) Inundative releases of the egg parasitoid *Trichogramma chilonis* @ 50,000/ha from first month of planting at 7 - 10 days interval till one month prior to harvest.

(vii) At 30th, 45th and 60th day of crop growth spray granulosis virus of *Chilo infuscatellus* (10^{-7} – 10^{-8} inclusion bodies/ml) at 500 l/ha.

(viii) Release of 125 gravid females of *Sturmiopsis inferens* (Tachinidae) per ha at 45th day of crop growth.

2. Internode Borer (Chilo Saccharifagus Indicus)

- Damages the crop soon after internode formation and its activity continues till hatvest. Lodging, high dosage of nitrogen,

waterlogged condition and presence of water shoots favour buildup of pest.

- Fresh borer attack is mostly found in the top five immature internodes (Fig 2).
- Caterpillars bore at the nodal region and enter the stem and tunnel up-wards in a characteristic spiral fashion. Entrance hole is usually plugged with excreta.
- Larvae feed and multiply in water shoots. One larvae found in a single cane damages 1-3 internodes. The length and girth of the infected internodes get reduced.

Adult Larva Infested sugarcane

Fig -2 Showing different stages of Internode Borer in sugarcane

Management strategies:

Subsequent control measure should be adopted-

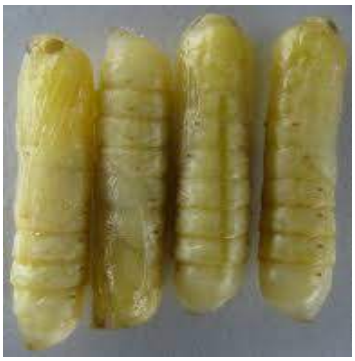
(i) Inundative release of the egg parasitoid *Trichogramma chilonis* @ 50,000 parasitoid/ha/week from the 4th up to 11th month after planting affords protection.

(ii) Use of resistant varieties are CO 285, 453, 513, 617, 853, 915, 1007, 1287, 6806 and COJ 46.

3. *Top Borer (Scirpophaga Excerptalis)*

- Water logging favours moth attack.
- Larva first tunnels into the midrib of the leaves and causes a white streak which later turns reddish brown usually in the second to fifth leaf from the top. As a result of biting across the spindle, a number of shot holes are formed in the leaf. As larva nibbles into the central core of the cane a portion of the internal tissue is eaten resulting in dead heart formation (Conlong 1994a, Chaudhry and Ansari 1988).
- Dead heart when formed is reddish brown, appears charred, and cannot be easily pulled out. In tillering phase of the crop, the attacked shoots die, side shoots (tillers) develop producing a bunchy top appearance. In the grand growth period, the crop growth is arrested, and the crown with dead heart dries and may be blown off leaving the stump (Fig 3).
- Severe yield loss and quality deterioration occurs due to top borer. Depending upon the incidence level yield loss may be up to 20-30%.





Adult Moth on sugarcane Pupa

Fig -3 Showing different stages of Top Borer in sugarcane

Management strategies:

Following control measure should be adopted-

(i) The egg masses and also the infested portions of plants may be collected and destroyed during the brood emergence period.

(ii) Release of the ichneumonid parasitoid *Gambroides javensis* Rohw. has been found to be promising in Tamil Nadu.

(iii) Variety Co 419 is comparatively resistant to this borer. Other resistant varieties are CoS 767, CoJ 67 and Co 1158.

(iv) Soil application of carbofuran at 2 kg a.i. /ha or phorate at 1 kg a.i./ha for the third brood during first week of July is recommended.

4. *Scale Insect (Melanaspis Glomerata)*

- Water logging, high temperature and humidity favour buildup of scale insect population. Rainwater and high wind velocity facilitate dispersal of the pest. It spreads to new areas through seed material. Men and animals passing through the infested fields also lead to spread of the pest to the adjoining areas.
- Scales usually establish on internodes covered with leaf sheath. The leaves of infested canes show signs of tip drying and unhealthy pale green colour and with continued infestation turn yellow. Desapping leads to non-opening of leaves also, which also turn yellow and finally dry out. Nodal region is more infested than internodal region (Fig 4).

Infested sugarcane from scale insect

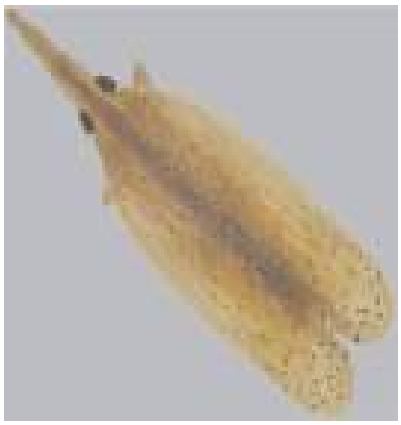
Adults become black or brown circular scales and cover the nodal region forming a thick encrustation

Fig -4 showing infested stages of sugarcane from Scale Insect

- Infested crop losses its vigour, canes shrivel, growth is stunted and the internodal length is reduced drastically. Ultimately cane dries up. Such canes when slit open appear brownish red. Thus yield and quality suffer. The yield loss could range from negligible to total crop failure.

Management strategies:

Subsequent control measure should be adopted-



Adult of pyrilla Larva Pyrilla on sugarcane

Fig -5 Showing different stages of Leaf hopper

(i) Selection of pests free setts.
(ii) Sett treatment with acephate 75 SP @ 1g/lt, Chlorpyriphos 50SC in 100 lit of water.
(iii) Remove lower most 2-3 dry leaves and spray crop with Chlorpyriphos 20 EC @ 5 lit in 1000 lit water/ ha.

5. Leaf hopper *(Pyrilla purpusilla Walker)*

- Pyrilla is the most destructive foliage-sucking pest of sugarcane. The loss in cane yield due to pyrilla have been estimated to be around 28% with about 1.6% unit loss in sugar
- Heavy rainfall followed by 75-80% humidity, intermittent drought periods, high temperature (26-30°c) and wind movement favour rapid buildup of pyrilla. Other factors favouring pyrilla buildup are dense and luxuriant crop, excess nitrogen application, water logging, lodging of cane and varieties with broad and succulent leaves (Fig 5).
- Adults and the nymps suck leaf sap from the under surface of the lower leaves. When the infestation is heavy, leaves turn yellowish white and wither away. Due to continuous desapping by large number of hoppers top leaves in the affected canes dry up and lateral buds germinate.
- The hoppers exude a sweet sticky fluid known as honeydew, which promotes quick and luxuriant growth of the fungus, capanodium species and as a result the leaves are completely covered by the sooty mould. This affects photosynthesis.

Management strategies:

Successive control measure should be adopted-

(i) Release of the lepidopteran ectoparasitoid *Epiricania melanoleuca* @ 4000 - 5000 cocoons or @ 4 - 6 lakh eggs/ha checks its multiplication.
(ii) In case of severe infestation without the occurrence of the ectoparasitoid, spraying of endosulfan 0.07 % is quite effective.

6. Termite (Odentomes obesus)

- Termites attack causes severe damage to sugarcane crop.
- It is polyphagous and found throughout the world. More serious under

prolonged drought conditions and in light textured soils viz., sandy and sandy loam soils.

- The termites attack setts, shoots, canes and also stubbles (Fig 6).
- The termites gain entry through the cut ends or through buds of the setts and feed on the soft tissue. The tunnel excavated is filled with the soil. This affects germination and thus the initial crop stand and ultimately the cane yield. The germination failure could be up to 60%.
- In the stalks the termites feed on the inner tissues leaving the rind intact. The cavity formed is filled up with moist soil, having galleries, in which, they move about. The affected canes die.

Termite in sugarcane field

The trunk of the sugarcane turns red in the initial stages of the termite attack

Fig -6 Showing infested sugarcane from termite attack

Management strategies:

Termites attack the planted sugarcane setts, usually from cut ends or eye buds but in severe cases internode as well. After germination, roots are attacked, eating all their contents and filling galleries with soil, finally leaves dry up and plants die. The damage can be contained by treating the setts with Markar or Fax Gras under-

(i)At the time of sowing:- Mix 10 kg of "Fax GR" in 15-20 kg of dry sand and broadcast uniformly in one acre over cane setts in furrows. After this, cover the sugarcane setts with soil and given light irrigation.

(ii) **In standing crop:-** Mix 8 kg Fax-GR in the 15-20 kg dry sand or in manure and broadcast it in one acre area uniformly and then apply light irrigation.

Sugarcane woolly aphid, *Ceratovacuna lanigera* Zehntner

Nymphs and adults are found on the lower surface of the sugarcane leaves and suck the cell sap and excrete 'honey dew' which is dropped on the upper surface of the lower leaves.

Honey dew encourages the growth of the fungus *Capnodium* spp. which results in black coating called 'sooty mould' on the upper surface of leaves affecting photosynthesis (Fig -7).

Due to sap sucking, yellowish white spots develop on the leaves leading to drying of leaf edges and complete drying of leaves. Severe infestation causes mottling of leaves, stunted growth, and loss in sugarcane yield and sugar recovery. Losses up to 26% in sugarcane yield and 24% in sugar content have been reported (Gupta and Goswami 1995, Mote et. *al.,* 2003).

Nymphs and adult of woolly aphid

Infested sugarcane from woolly aphid

3rd and ivth instar nymphs are covered with white woolly secretion

Fig -7 Showing infested sugarcane from woolly aphid

Management strategies:

Subsequent control measure should be adopted-

(i)Paired or wider row planting of sugarcane.

(ii) Release of the natural enemies *Dipha aphidivora* Meyr. or *Micromus igorotus* in shade net cages (5m x 5m) @ 50/cage and allow them to develop and disperse by removing the cages.

(iii) Release of *D. aphidivora* larvae @ 1000/ha and *M. igorotus* larvae @ 2500/ha.

(iv) Need based application of metasystox 0.0375% or endosulfan 0.05% or dimethoate 0.045% in case of severe infestation without the presence of natural enemies.

8. Whitefly *(Aleurolobus Barodensis Mask)*

- Water logging and nitrogen starvation cause severe out break of whiteflies. Summer droughts and dry spells during monsoon season also favour buildup of this pest.
- Varieties with broad and long leaves are more susceptible to this pest.
- The nymphs of white flies suck the sap from the under surface of leaves which turn yellow and pinkish in severe cases and gradually dry up.
- Heavy infested leaves are covered by the sooty mould caused by the fungus, which adversely affects photosynthesis. The whitefly infestation retards cane growth and reduces sugar content.

Adult of whitefly

Symptom of Whitefly

Fig -8 Showing infested sugarcane from whitefly

Management strategies:

Following control measure should be adopted-

(i) Discourage ratooning in low lying areas and avoid water logging. Remove lower leaves containing pupae periodically.

(ii) Spray imidacloprid 0.01% or acetamiprid @ 0.01% after removing infested lower leaves. At least two or more sprays will be required at fortnightly intervals.

CONCLUSION

Due to long duration of sugarcane, crop attracts number of insect-pests from planting till harvest. Damage caused by insects during germination and tillering caused yield reduction. Whereas pest attack during grand growth and ripening mars juice quality and sugar yield. In order to save the crop from insect pests' diverse integrated pest management strategy should be adopted including predators, resistant genotypes, culture practices and finally insecticides.

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Rice Functional Genomics

Ashok Kumar Malav, Indu, Deshraj Gurjar and Kuldeep Singh Chandrawat

Department of Plant Breeding and Genetics, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur-313001, Rajasthan (India)
Corresponding Author: ashok3251@gmail.com

Plant functional genomics is now a major driving force in research and a great challenge to the scientific community. Genome wide research tools such as data mining for structural similarities, expression profiling at the RNA level with expressed sequence tags (ESTs), oligonucleotide or cDNA chips, expression profiling at the protein level (proteomics), gene knockouts or loss of function studies with naturally occurring alleles, induced deletion and insertional mutants and gene expression knock down studies with RNAi have become integral to plant functional genomics. Rice has been chosen as the model cereal for functional genomics by international scientific community not only because it is a major food crop of the world but also because of its small genome (430 Mb which is the smallest among cereal genomes), the ease with which it can be transformed, and its well-studied genetics together with the availability of detailed physical maps and large number of molecular markers. Because of the similarities in gene sequence, gene structure, gene order and gene functionally the cereals and grasses, genes identified in rice as being important agronomical may be important in other cereals. With the availability of near complete genome sequence data for both *japonica* and *India* rice, the most straightforward way of predicting a likely function of a rice ORF sequence is by comparison with sequence database.

Rice Genome Sequence: Technology & Achievements

Construction of the sequence ready physical map "Clone by clone methodology"- large genomics DNA digested into intermediate sized fragments (40-150kb), and these fragments are cloned into *E.coli* to make genomic libraries.

Two Sep Strategy for Completion of Rice Genome Sequencing

The IRGSP (International Rice Genome Sequence Project) took clone by clone method to obtain an accurate rice sequence and followed a two-step sequence publication in the public database.

Rice Genome Annotation

Large scale computation to find genes and gene functions become essential process for a genome wide sequencing. For this purpose two step are required: prediction of exons, and inference of functions by comparison with other known sequence. *Ab initio* gene finding

methods or cDNA mapping is used for rice genome annotation.

Automated annotation system

An automated annotation system is that which facilitates analysis of hundreds of Mb of DNA sequences and produce reliable and comprehensive results. Rice genome automated annotation system (RiceGAAS) was developed to execute genome wide annotation of rice (Sakata *et al*.2002)

Genome -Wide RNA Expression Profiling in Rice

The first transcriptome approaches is usually to collect a large number of ESTs from many cDNA libraries. RGP (The Japanese Rice Genome Research Program) contributed a large number of, pre genome sequencing phase (60,000EST) sequences from Nipponbare. Presently 6,713 unique EST sequences are mapped to 4,387 yeast artificial chromosome (YAC) clones from rice genomic DNA, generating 6,591 mapped sites on the rice genome (Wu *et al*.2002).

- Deep Transcriptome Analysis of the Rice Genome using RL-SAGE (Robust long serial analysis of gene expression)
- Transcriptional Analysis Using Genome Tiling Microarray

Wu *et al.* (2002), studied large scale cDNA analysis in rice, Gowda *et al.* (2006), described general diagram of RL-SAGE library construction, Yuling *et al*. (2005), reported, A Tiling Microarray Expression Analysis of Rice Chromosome 4 reported tiling Microarray of rice chromosome 10.

Rice Proteomics

Once the rice genome is completely sequenced; the challenge before the monocot plant research community is to identify the function, regulation, protein interactions and type of post translation modification of each encoded protein. One of the most commonly used methods for quantitative proteomics is 2D-PAGE coupled to either MS or protein sequencing. In the 2D-PAGE based approaches, intact proteins are separated by 2D-PAGE, and the abundance of a protein is determined based on the stain intensity of the protein spot on the gel. The identity of the protein is generally confirmed by image analysis software.

Komatsu *et al*. (2003), reported Identification of a calcium-binding protein, calreticulin, and effects of sense overexpression and antisense suppression of calreticulin on the growth of rice plant.

Rice T-DNA insertion Mutantagenesis

- Agrobacterium mediated transformation of rice
- T-DNA insertional mutagen
- Gene and enhancer trapping with T-DNA in Rice
- Forward genetics screen and gene isolation using T-DNA insertion lines

Kim and Lee (2000) studied T-DNA insertional mutagenesis for functional genomics in rice. Dong (2002) reported T-DNA Insertional Mutagenesis for Activation Tagging in Rice, Yue-Ie Hsing *et al*. (2007) studied Establishment of Rice Mutant Library Functional Genomics

Gene Targeting By Homologous Recombination in Rice

Gene targeting refers to the alternation of a specific DNA sequence in an endogenous gene at its original locus in the genome and, often, involve the

conversion of endogenous gene into a designed sequence.

Integration of transgene associated with homologous recombination dependent gene targeting

- Targeted gene replacement
- Targeted base changes
- Targeted gene replacement with positive and negative selection

Informatics Resources for Rice Functional Genomics

Various bioinformatics tools and resources developed by the major players in rice functional genomics are:

1. **NIAS (National Institute of Agrobiological Science)** Informatics Resources, includes various projects on structural and functional characterization of the genome and analysis of agronomically important genes (**www.nias.com**)
2. **Rice PIPLINE** is unification tools for rice functional genomics, generates three types of information, namely, structural, gene expression and genome information (www.affrcg.org)
3. **TIGR (The Institute for Genomic Research)** is to generate high quality, uniform structural and functional annotation of the rice genome and make it available to public (http://rice.tigr.org)
4. **Oryzabase (*Oryza* genetics database)** is a comprehensive rice database integrating biological data derived from various studies on morphology, physiology and ecology with molecular genetic information. (www.Orybase.com)
5. **Gramene** is a comparative mapping database and resource for cereals with an emphasis on rice (www.gramene.org)

Other informatics resources for rice are CIRAD Informatics Resources includes **orygenesDB** (Rice Flanking Sequence Tags), **Oryza Tag Line** (Rice Phenotypic and Reporter Gene Expression Database), **Greenphyl** (Molecular Genetic Analysis in Rice), Insertional Mutant Databases are ***Tos17***, **Rice Mutant Database**, **Rice *Ds* Tagging Lines**, **Rice GE** (Rice Functional Genomics Browser), **Rice T-DNA Insertional Sequence Database**.

CONCLUSION

- The rice genome sequence is the key to understanding the science of rice
- Automated computation focusing on the frame work of the annotation
- Rice is regarded as a “reference" crop that should be sequenced with as high a quality as possible
- Metabolomics is poised to contribute substantially to the rice functional genomics
- Function of proteins aids in molecular cloning, facilitates the development of biomarkers, and contributes to the development of transgenic rice

FUTURE THRUST

- Genome wide expression profiling of rice genes should be facilitated by high throughput techniques
- Mutational approaches should be further used to unravel the genetic and molecular basis of traits
- T-DNA insertional mutagenesis provides a more rapid and direct way to gene function
- Activation tagging is that which increase the level of gene expression

can create mutation for identification of gene function

- Genome sequencing and annotation and the various tools and resources have been developed world wide which should be thoroughly used
- The large amount of information that has emerged from genome sequencing as well as the post sequencing era has posed a new challenge to rice bioinformatics which need to be tackled boldly

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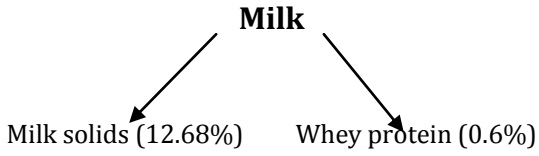
Factors Influencing Quality and Composition of Milk: An Economic Concern to the Indian Farmer

[1]Jyotiprabha Mishra*, [2]Nihar Ranjan Sarangi, [3]Rashmi Prabha Mishra, [4]Navin Kumar, [5]Bidyut Prava Mishra and [6]Prasana Kumar Rath

[1]Ph.D. Scholar, Department of Livestock Products Technology, W.B.U.A.F.S, Kolkata, India.
[2]Ph.D. Scholar, Department of Livestock Production and Management, NDRI, Karnal, Haryana, India.
[3]Programme Assistant (Fishery Science). Krishi Vigyan Kendra, Angul, Odisha, India.
[4]Fisheries Extension Officer, Muzaffarpur, Bihar, India.
[5]Assistant Professor, Dept of LPT, [6]Assistant Professor, Dept of Pathology, C.V.Sc. & A.H, O.U.A.T, BBSR, 751003.
Corresponding Author Address: mishrajyotiprabha@gmail.com

Milk is a white liquid emulsion of fat globules and a suspension of casein micelles (casein, calcium and phosphorous) produced by the mammary glands of mammals. It is the primary source of nutrition for young mammals and it provides immunity, many other nutrients and the carbohydrate lactose (which is only found in milk) to the young one. Several factors held responsible for the variation observed in the composition of milk and the major components of which are i.e. water, fat, protein, lactose and minerals. In cattle, fat is the most variable component while minerals and lactose are the least variable. Fat concentration can change according to dietary changes and it can vary over a range of nearly 3.0 percentage units whereas milk protein concentration changes approximately 0.60 percentage units. The concentrations of lactose and minerals, the other solids constituents of milk, do not change as per adjustments in diet. It is considered that the variation in milk composition is generally more in small dairy farms as compared to large ones. Here the factors contributing to variations in milk composition are discussed.

Gross composition of milk



Species

Milk composition differs according to the different species of animal concern. When considering camel milk, it is lower in lactose but higher in protein and fat content than cow's milk. However, content of minerals like potassium, magnesium, iron, copper, manganese,

sodium and zinc are found higher than in cow's milk. As compared to cow, buffalo and ewe milk fat, camel milk fat contains less number of short-chained fatty acids. Cholesterol content in camel milk is very less as compared to cow or goat milk. The fat content of the milk produced by cows can also be modified by adopting selective breeding method and genetic modification. Skimmed milk (less than 1% fat content) has been produced by the scientists of New Zealand by process of selective breeding. Donkey and horse milk have the lowest fat content, while the milk of seals and whales may contain more than 50% fat. Milk composition analysis, per 100 grams is given in table no 1.

Table 1- Milk composition analysis, per 100 grams

Constituents	Unit	Cow	Goat	Sheep	Water buffalo
Water	g	87.8	88.9	83.0	81.1
Protein	g	3.2	3.1	5.4	4.5
Fat	g	3.9	3.5	6.0	8.0
Saturated fatty acids	g	2.4	2.3	3.8	4.2
Monounsaturated fatty acids	g	1.1	0.8	1.5	1.7
Polyunsaturated fatty acids	g	0.1	0.1	0.3	0.2
Carbohydrate (i.e the sugar form of lactose)	g	4.8	4.4	5.1	4.9
Cholesterol	mg	14	10	11	8
Calcium	mg	120	100	170	195
Energy	kcal	66	60	95	110
	kJ	275	253	396	463

Genetic

Breed and individual cow

Milk composition varies according to breeds of dairy cattle: Jersey and Guernsey breeds provide milk of higher fat and protein content than Shorthorns and Friesians. Zebu cows can give milk with fat percentage of 7%. The composition of camel milk depends on its feed and species: Bactrian milk has a higher fat content than dromedary milk. Milk protein to milk fat ratio ranges from 0.78 to 0.85 depending on breed type. The protein range for these four breeds is 3.3% to 3.9%, while the lactose range is 4.7% to 4.9% in the following table no 2.

Table -2 Variation in milk composition with relation to breed of cow

Milk fat percentages	
Cow breed	**Approximate percentage**
Jersey	5.2
Zebu	4.7
Brown Swiss	4.0
Holstein-Friesian	3.6

Variability among cows within a breed

The potential fat content of milk from an individual cow is determined genetically, as that of protein and lactose levels. Thus, selective breeding can be used to improve milk quality. Heredity also stands as strong component behind the potential milk production of the animal. Besides this, environment and various physiological factors strongly influence the amount and composition of milk.

Environmental

Interval between successive milking

It has been reported that three times milking per day increases milk production up to 10 to 25 % whereas, milking four times a day results in another 5 to 15% increase in production. The fat content of milk varies between the morning and evening milking. If cows were milked at 12-hour intervals the variation in fat content between milking would be negligible, but this is not practicable on most of the farms. Normally, SNF content varies little with the changing pattern of milking.

Stage of lactation

The amount of fat, lactose and protein contents of milk varies according to the stage of lactation. Solids-not-fat content (SNF) is usually highest during the first 2 to 3 weeks and then it shows a decreasing trend. Fat content is high immediately after calving after which it begins to fall for next 10 to 12 weeks and further it tends to rise again until the end of the lactation. The variation in milk constituents throughout lactation is shown in the below figure no 1.

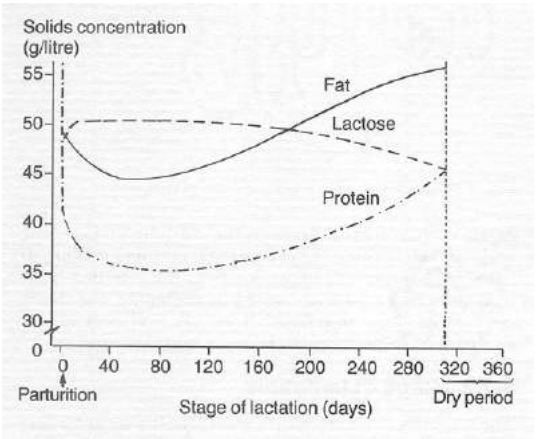


Figure no 1- Changes in the amount of fat, protein and lactose during a lactation period of a cow

Age

There is an inverse relationship observed between the age and milk composition with regards to fat content. With the increase in age of animal, fat content of their milk decreases by about 0.02 percentage units per lactation and the fall in SNF content is very high. Some reporters also stated that milk protein content decreases 0.10 to 0.15 unit over a period of five or more lactations or approximately 0.02 to 0.05 unit per lactation. There is some variation among breeds. After attaining 8 to 9 years of age, a reduction in the level of milk production observed in the cows generally.

Disease

Both fat and SNF contents can be reduced due to different disease, particularly mastitis. Clinical mastitis causes reductions in yield in both high and low-yielding herds. Infectious mastitis results in changes in milk composition like, fat content is reduced to below 3%, chloride is increased 1.5-fold, and lactose decreases (often by 5-fold or more), because the pathogen uses this substrate for their growth. Total protein content may not shows significant changes, but the amount of casein may be reduced at the expense of protein from antibodies, somatic cells, and bacterial cells and shows a reduced lactose and increased chloride content in milk. Milk from cows with high somatic cell counts (greater than 500,000 somatic cells /ml) has longer coagulation time and forms

weaker curds than milk from cows with lower somatic cell counts.

Feeding regime

Heat stress resulted in decreased feed intakes, 10 to 25% lower milk production, decreased milk fat percentage total protein, Lactose and increase pH of milk. Underfeeding tends to decrease both the fat and the SNF content of milk. Fat content and fat composition are showing more variation due to feeding of roughage (fibre) intake. The SNF content can also decrease if the cow is fed a low-energy diet. The various types of diet, which can cause a decrease in milk fat percentage, are as follows:

- High concentrate rations
- Low roughage rations
- Grass from lush spring pastures
- Finely ground hay
- Heat treated feeds
- Feeds in pelleted form

Feeding finely chopped forages has a negative influence on milk fat % and may become the reason for milk fat depression syndrome (drop of milk fat % below 3%). Cows fed finely chopped forages give less time in chewing and this will cause less saliva production. Ruminal pH will decrease as less saliva is produced to buffer the acid production in the rumen. As the ruminal pH comes down to below 6, the activity of the cellulolytic bacteria is also reduced and the same trend in decrease is observed in production of acetic and butyric acids (precursors of short chain fatty acid synthesis in the mammary gland. Monounsaturated fatty acid (C18:1) content can be increased up to 50 to 80 percent by feeding lipids rich in 18-carbon fatty acids. Due to ruminal hydrogenation process and intestinal and mammary desaturase activity, degree of unsaturation of dietary 18-carbon fatty acids is not very important in influencing milk fat C18:1. Feeding of low roughage containing diets increases the \amount of C18:1 in milk fat. Milk fat alteration is dependent on the level of lipid supplementation. Limited reports indicates frequency of lipid feeding and physical form of oil (free oil vs. oilseed), and heat treatment of oilseeds has relatively less impact on modification of milk fat. Significant changes in milk fat composition can be achieved on farm through nutritional modifications.

Completeness of milking

The first milk obtained from the udder is comparatively low in fat while the last milk (or strippings) is always high in fat content. Thus it is essential to mix thoroughly all the milk removed, before taking a sample for analysis.

Solutions against these variations:

- Provision of frequent feeding of low fiber, high grain diets increases milk fat levels. The greatest increase occurs in diets of less than 45 percent forage and when grain is fed separately as in parlor feeding.
- When diets are fed as a total mixed ration, feeding frequency is not important if the feed remains palatable to the animal.
- During summer season, frequent feeding helps to keep the feed fresh and palatable.
- High producing cows should given 3.5 to 4.0 percent of their body weight as dry matter regularly.

- Feed containers should be kept clean and few amount of feed should be there for the animal most of the time in a day.
- Feeding frequency should be taken care.
- Moisture level of feed should be in between 25 and 50 percent (to optimize dry matter intake).On a dry matter (DM) basis, the minimum ratio of forage to concentrate required to maintain normal milk fat percentage is approximately 40 to 60.
- Animals should be taken care for their health and from mastitis.

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Performance of Murrah buffaloes at hot and humid Cauvery delta region in Tamil Nadu

B. Balasundaram[1], V. Jeichitra[1], P. Devendran[1] and V. Boopathi[2]

[1]*Department of Animal Genetics and Breeding,*
[2]*Department of Livestock Production Management,*
Veterinary College and Research Institute,
Tamil Nadu Veterinary and Animal Sciences University,
Orathanadu-614 625 Tamil Nadu
Corresponding Author: b.balasundaram@tanuvas.org.in

India, the biggest global producer of milk, attained the level of milk production 132.4 million tonnes during the year 2013-14. Buffaloes contributed more than half of the total milk production in the country. The improvement in production performance and the population growth of buffaloes made them as the major contributor to the total milk production. Despite the increasing growth of buffalo population in India by 3.19 per cent, the Tamil Nadu state showed decline by 61.15 per cent for the period from 2007 to 2012 (19th Livestock Census, 2012). India's Murrah buffalo is the most popular buffalo breed in the world. It is considered to be the finest genetic material for the highest milk production among all the breeds of buffaloes. The environmental factors are also important as genetic factors for the performance of buffaloes. Production and reproduction performance of Murrah buffaloes varies among different environmental conditions. The reported average lactation milk yield was ranging from 1618 kg to 2014.00 (Buffalopedia, CIRB) in different locations of the country. The buffalo breeding policy of Tamil Nadu provides that the Murrah buffalo is the breed of choice for the improvement of non-descript buffaloes in different regions of the state including the Cauvery delta region. Climatic condition of the Cauvery delta region is hot and humid. The information about production performance and reproductive problems of the Murrah buffaloes in this region is scarce. Hence, the Murrah buffaloes at an organised farm in hot and humid Cauvery delta region of Tamil Nadu were studied for performance traits and reproduction problems.

Murrah buffalo farm and management

Murrah buffalo farm at Veterinary College and Research Institute, Orathanadu in the hot and humid Cauvery delta region of Tamil Nadu was utilized for the evaluation. Thirty five purbred Murrah buffaloes were maintained in the buffalo farm. A balanced ration of green, dry fodder and concentrates was provided to meet the nutritional requirement of Murrah buffaloes in the farm. All the buffaloes were stall fed. Adult buffaloes were provided with ad-libitum quantity of green fodder and extra allowance of concentrate ration was provided for

pregnant and lactating buffaloes. Buffaloes were maintained in high level of sanitary condition and with adequate veterinary care. Artificial insemination is practiced to impregnate the buffaloes maintained in the farm. Buffaloes were milked two times in a day and proper record was maintained.

Production performance of Murrah buffaloes

Data recorded in the daily milk yield register was utilized to assess the production performance of Murrah buffaloes in hot and humid Cauvery delta region. The production traits considered for the evaluation of Murrah Buffaloes are lactation length, lactation milk yield, 305 days milk yield, average daily milk yield and peak yield.

Table 1. Averages of the production traits in Murrah buffaloes

Trait	Average of the performance	Best animal's performance
Lactation Length (days)	344.35	423
Lactation Milk Yield (kg.)	2312.76	3684.6
305 Days Milk Yield (kg.)	2149.64	3107.8
Average Daily Milk Yield (kg.)	7.04	10.18
Peak yield (kg.)	11.90	16.4

As per the Buffalopedia of Central Institute for Research on Buffaloes (CIRB), Harryana, the average lacatation milk yield of Murrah buffaloes was 1800 kg. The Murrah buffaloes at the hot humid region of Tamil Nadu were recorded with high milk yield than the average of the breed. Lactation length of the buffaloes was higher than the earlier reports (Gajbhiye and Tripathi,1999; and Sethi and Khatkar, 1997). Purebred Murrah buffaloes in the Cauvery delta region showed 7.04 kg as average daily milk yield. The average peak yield of the buffaloes was 11.90 kg and the maximum was 16.400 kg. It was in agreement with the report in Buffalopedia of Central Institute for Research on Buffaloes as minimum peak yield of Murrah buffalo herds is more than 7 kg.

Table 2. Averages of the production traits in Murrah buffaloes - Parity wise

Trait	Fist lactation	Second lactation	Third lactation
Lactation Length (days)	335	338.7	382
Lactation Milk Yield (kg.)	2345.82	2139.28	3147.1
305 Days Milk Yield (kg.)	2256.12	1999.91	2791.85
Average Daily Milk Yield (kg.)	7.39	6.55	9.15
Peak yield (kg.)	13.8	10.94	14.8

The performance of Murrah buffaloes among the first three lactations showed that the lactation length, lactation milk yield, 305 days milk yield, average daily milk yield and peak yield were higher in third lactation. The higher lactation length might be attributed to the cause, silent heat and its consequence as delay in conception. This report on production performance of Murrah buffaloes under hot and humid conditions may promote the farmers in the region to engage in Murrah buffalo farming or to upgrade their local buffaloes with Murrah.

Reproductive problems in Murrah buffaloes

Purebred Murrah buffalo farm in the institute was observed some reproductive problems viz., mastitis, utero-vaginal prolapse, endometritis, anoestrous and repeat breeding. Among the reproductive problems the major issues were silent heat and repeat breeding. Repeat breeding was higher in high yielders and elder animals. These reproductive problems lengthened the lactation period, service period, dry period and calving interval. The major causes of the repeat breeding problems are improper oestrous detection, inadequate semen quality, cow's prior exposure to reproductive problems, endocrine disorders, anatomical defects of the reproductive tract and early embryonic death. These causes of repeat breeding can be overcome by effective management except the early embryonic death due to genetic cause. Silent heat is one of the contributors for the reduction of breeding efficiency in buffaloes. During summer months, the hot and humid climate in the region makes the buffaloes as poor thermoregulators which leads to the animals under constant heat stress. Heat stress causes the suppression of behavioural signs of estrous. The dark skin and sparse hair coat of Murrah animals are considered as major reasons for their high sensitivity to heat stress. Heat stress also affects the production and reproduction performance of the animals. By increasing the frequency of water showering on buffaloes to alleviate the heat stress, the buffaloes may be improved to express estrous signs. The use of efficient heat detection methods and parading of teaser bull in morning and evening hours may ease the problem of silent heat.

CONCLUSION

Murrah buffaloes in hot and humid regions like Cauvery delta region showed the desirable level of performance in traits such as lactation length, lactation milk yield, 305 days milk yield, average daily milk yield and peak yield excluding the reproduction performance. The problems in buffalo farming like repeat breeding and silent heat may be eased by applying right technology and effective management strategies. Even though the population size was small, the results of the study may encourage the farmers in the Cauvery delta region and the other hot and humid regions of the state to involve in Murrah or upgraded Murrah buffalo farming. This may improve the population growth and milk production. The higher milk production of Murrah buffaloes may assist in the economic growth of the farmers in the region.

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