2021

TRAINING MANUAL

Scientific Management of Livestock Farm vis-à-vis Mithun husbandry

Organised By-

ICAR-National Research Centre on Mithun
Medziphema, Dimapur, Nagaland-797106

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Six days training programme for Veterinary Field Assistant

Training Compendium

- 6-Days Training Course on -

Scientific Management of Livestock Farm vis-à-vis Mithun husbandry

October 25th-30th 2021

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Foreword

Livestock-based livelihoods are of significant importance for the economic well-being and symbolic to the health and wealth of tribal people of the North-Eastern region of India. Livestock rearing forms an integral part and is pre-dominantly the endeavour of smallholders, as almost 90% of the rural household rear livestock of one species or the other and meat is a basic part of the daily food basket. Investment in infrastructure, support programs, and technical know-how including livestock breeding strategies for productivity improvement seems inadequate so far. Responding to the burgeoning demand for livestock products sustainably is a big challenge. Though there is vast potential for growth in this sector, the region has not achieved a self-sufficiency level in its production. There are hardly any commercial livestock farms in the rural areas. Focusing on the Mithun husbandry, the shrinking forest area and the declining Mithun population is exacting the need for the adoption of scientific Mithun husbandry along with sustainable resource management for feed and fodder supply. The need is to educate, build the capacity of local people and work with them, carefully integrating technical expertise for the most viable and appropriate solutions in livestock farming.

Our institute is regularly organizing training as well as awareness programs for the progressive farmers, educated unemployed youths, NGO' s, self-help groups (SHGs) for sustainable animal husbandry. In continuation, we are organizing this training program for veterinary field assistants on '***Scientific Management of Livestock Farm vis-à-vis Mithun Husbandry***' under under Tribal sub plan. The aim of this training is to establish a basis for making the management decisions called for in the development of livestock operations including Mithun husbandry. These are the skills that trainee will need if he or she is to work with small farmers. The compendium published by the institute will help the trainees to assist farmers to perform profitable livestock operations and guide farmers to adopt scientific Mithun husbandry for improving livelihood.

(M H Khan)

Preface

Being a unique and valuable bovine species of the North-Eastern Hill region of India, Mithun could be an essential component of the sustainable animal production system of the region. These animals can be exploited and developed as very good meat animals besides improvement of their milk production potentiality. However, there are many challenges for rearing this unique species in front of the Mithun rearing community. The challenges include the reduction in grazing areas and high mortality of animals due to diseases like Foot and Mouth Disease (FMD). As Mithun is reared traditionally under a free-range forest system in which the animals are let loose in the forest without any provision of shelter and supplementary feeding except salt. Due to exposure of the animal to harsh weather conditions and wild carnivores, a lot of mortality has been reported in Mithun due to diseases and particularly to newborn calves due to attacks of wild carnivores. Hence, proper knowledge of the scientific management of Mithun is very much important for exploiting the potential of this animal by incorporating and integrating scientific husbandry to the presently practised traditional rearing under a free-range system.

Every effort has been made to include various information related to the scientific management of livestock farms with special reference to Mithun animals. All our valuable contributors were encouraged to provide suitable and fundamental information to the trainees for imparting knowledge on scientific aspects of management of livestock and practical implementation of different technologies in their field conditions.

We acknowledge our contributors of this book who are working to impart knowledge on the scientific management of livestock farms for the ultimate benefit of the Mithun rearing community. We wish to extend our sincere thanks to Dr. Salam Temjen, Principal, Veterinary Field Assistant Training Institute, Medziphema. The organizing committee is highly thankful to the Director, ICAR NRC on Mithun, Medziphema Nagaland for his valuable advice and guidance.

Date: __/__/____

Editors

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Biosecurity: In farm management

Dr. H. Lalzampuia

Biosecurity

Biosecurity in simple language means taking any precautions and measures to reduce the chances of an infectious disease being introduced onto the farm animals. Diseases can be introduced into farm by people, animals, equipment, or vehicles. A good biosecurity measures reduces and mitigate the risk of introduction of diseases to the animals and workers.

Thus, to prevent introduction of the disease to the farm, strict measures need to be implemented. Movement of man and animals should be restricted to minimum; there should be no unauthorized entry at the farm. Farm duty personnel should follow good hygienic practices, sanitization and also farm tools and machinery should be routinely disinfected and cleaned.

In farm management, reduction of the chances of spread of diseases is one of the most important factor that is the ultimate need to have a good income and benefits. Occurrence of disease in the farm causes direct economic loss as well as it gives bad reputation that in the long run will again affect on the farm economy.

Biosecurity measures can be divided into distinct three levels based on the risk factor, management and the structures involves-

1. **Conceptual biosecurity**: It is the first and foremost biosecurity measures to be taken in considering the setting up of farm. The primary biosecurity mainly concern with the location and its component
    a. Farm should be located in an isolated area, far away from other farms, commercial places, slaughter houses etc
    b. Farm should be located away from public water sources and community plantation/agricultural lands.
    c. Maintain enough distance from public highways/roads
2. **Structural biosecurity**: The secondary level of biosecurity concerns with the physical factors, such as farm layout, perimeter fencing, drainage etc. Long-range planning and programming is important and should consider on-site movement of vehicles, equipment, and animals; traffic patterns; and feed delivery/storage.
    a. Proper fencing of the farm to prevent unwanted access
    b. Proper water storage and clean water supply
    c. There should be provision for storage of feed and fodders
    d. Clean and easily maintained feeding trough/manger
    e. Facilities for safe scientific disposal of dead animals
    f. Provision for storage of equipment and disposal of litter to prevent contamination
    g. Concrete floor and roads within the farm to ease cleaning and to prevent spreading of microbes by vehicles and foot wear.
    h. Safe housing, with suitable wild animals/birds and rodent proofing

i. Provision of quarantine and isolation of animals.

3. **Procedural biosecurity**: Procedural biosecurity is the last line of biosecurity which deals with routine procedures to prevent introduction (bioexclusion) and spread (biocontainment) of infection within a facility. A robust system and practices should be in place to maintain a disease free herd. All the workers and personnel involved in the farm activities should strictly adhere to such processes and activities. During emergencies and disease outbreak, systematic investigation and reviewing of the practices followed should be monitored and re-planned to prevent future problems.
    a. Standard operation manuals for day-to-day activities like feeding, cleaning, management etc should be incorporated and strictly followed.
    b. Decontamination and disinfection of farm equipment, houses and buildings etc., should be done regularly.
    c. All entry of visitors and vehicles should be monitored and register should be maintained.
    d. All visitors should follow the standard norms laid out in the farm.
    e. Routine health check up, preventive and prophylactic measures like deworming, vaccination etc should be done timely and regularly.
    f. Newly purchase animals should not be allowed to be in contact with the animals until they are confirmed free of any disease. For this, proper quarantine should be done for any newly introduced animals in the farm.
    g. Foot bath and disinfection chamber should be implemented.
    h. Effective pest control should be in place.
    i. Proper disease monitoring and surveillance system must be availed.
    j. Sharing of vehicles and equipment with other farms should be avoided.
    k. Sick and disease animals should be isolated from healthy animals.
    l. Farm workers who attended sick animals should not attend healthy animals until they decontaminate themselves.
    m. Proper litter management should be in place.
    n. Dead animal carcass should be disposed off carefully and scientifically.
    o. Regular culling of unhealthy and unproductive animals.

Cryopreservation of Mithun Semen

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Introduction

Mithun semen cryopreservation is of utmost necessity for the conservation and wider distribution of superior quality genetic material keeping in view the hilly terrain and inaccessible areas of Mithun habitat. In addition, the recent initiatives to popularize Mithun as an economic beef animal or component of an alternative animal production system by rearing under a semi-intensive system demand the adoption of the controlled breeding programme. In this context, it is necessary to standardize an effective semen cryopreservation protocol for Mithun to adopt artificial insemination (AI). The success of cryopreservation greatly depends on cryopreservation protocol. Freezing and thawing phases of the cryopreservation process change the physiology and deform the structure of spermatozoa due to changes in osmotic balance, generation of excessive reactive oxidants, and formation of intracellular ice crystals (Kumar et al., 2018; Ugur et al., 2019). Therefore, a thorough understanding is vital to improve cryopreservation and AI programme effectively. Sperm damages emanated during cryopreservation procedures could be mitigated to some extent through improvement in freezing strategies. The cooling rate before sperm cryopreservation seems to be an important step to minimize the deleterious effects of injury during the freezing process.

Cryopreservation basic facts and process

The process of cryopreservation involves sequential events of temperature reduction, cellular dehydration, freezing and thawing. Cooling of spermatozoa is the simplest method and the core principle behind the cryopreservation process that can successfully lower the sperm metabolic rate and prolong its survival. The freezing of semen at −196 °C is found to be the most desirable and commonly used method for preserving the fertilizing ability of spermatozoa (Kumar et al., 2019). Different diluent solutions are widely used for preserving the semen straws at −196 °C, such as glycerol–egg yolk–citrate, milk glycerol and glycerolated-egg yolk-TRIS. Different approaches for Mithun semen cryopreservation commonly used are conventional i.e., in different containers with liquid nitrogen maintaining temperature manually, and controlled method in which semen straws are maintained and cooled *via* an automatic process in bio-freezer. The controlled rate of the freezing method yields superior post-thaw sperm quality as compared to the conventional freezing method. Slow freezing is the most commonly used

technique which involves cooling spermatozoa at the rate of 1–2 °C/min in steps up to -196 °C.

The drawbacks associated with this traditional method of freezing are primarily due to heterogeneous ice nucleation or uncontrolled growth of ice crystals that disrupt sperm cells, and secondarily due to inadequate latent heat dissipation, that is repetitive freeze-thaw cycles that cause mechanical damage to cells (Kumar et al., 2019). Intracellular ice crystal disrupts the cytoskeleton, whereas the extracellular ice crystal increases solute concentration and increases osmolarity, triggering loss of water from cells (Holt et al., 2014; Morris et al., 2012). Cooling rates have a profound effect on various seminal attributes; a slow rate of cooling followed by four hours of equilibration and freezing is a better protocol for cryopreservation of bovine semen. Thus, the equilibration time is important for spermatozoa to adapt to low temperatures and to enable the translocation of water, decreasing the damage by ice nucleation during freezing-thawing (Fleisch et al., 2017; Leite et al., 2010).

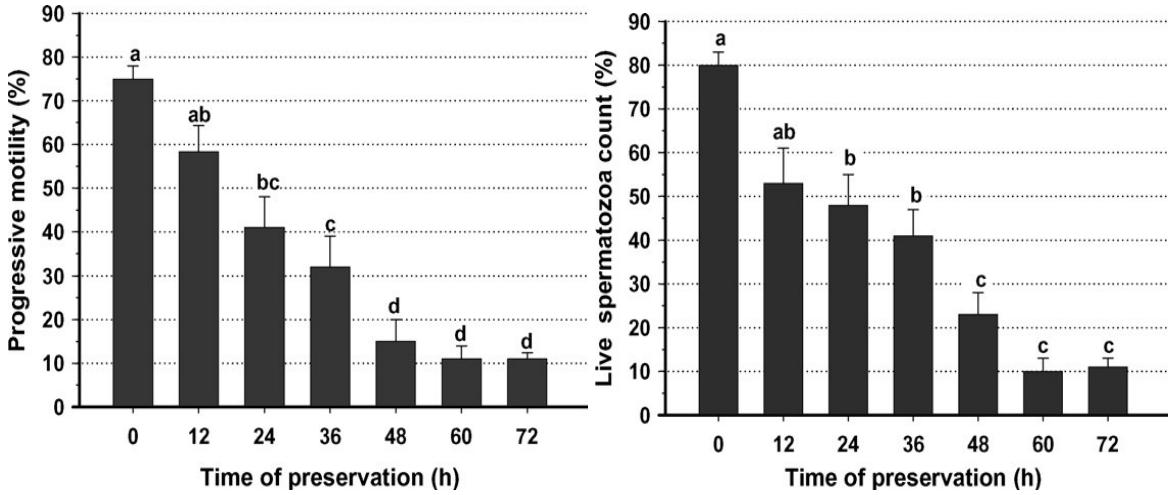
Effects of cryopreservation on structure and function of spermatozoa

Efficient cryopreservation depends upon numerous factors such as type of extenders, cryoprotectant, equilibration, cooling rate, packaging and thawing rate as well as the individual animals, breed, and species (Andrabi, 2007; Barbas and Mascarenhas, 2009). The stressors like ice formation, solution effects, and osmotic modifications during cooling and freezing cause structural changes in the organization, fluidity, permeability and lipid composition of the sperm membrane (Chatterjee et al., 2017). Cryopreservation induces ultra-structural damage to organelles predisposing the spermatozoa to gross morphologic defects, abnormal acrosomes, altered mitochondria, decreased ATP production, cellular integrity, viability, motility and fertilizing ability (Dziekońska et al., 2009; Gillan et al., 2005; Nishizono et al., 2004). The biophysical alterations turn the spermatozoa structure and function differently from spermatozoa before cryopreservation. During cooling, sperm cells are predisposed to numerous detrimental effects including ionic imbalance, metabolic decoupling, cellular acidosis, activation of proteases, membrane phase transition, deprivation of energy, destabilization of the cytoskeleton, and produce reactive oxygen species (ROS) and reactive nitrogen species (RNS). During freezing, harmful effects of ice crystal formation, hyper-osmolarity, alterations in the cell volume and protein denaturation are commonly perceived (Chatterjee et al., 2017; Srivastava & Pande, 2017). In addition to cooling and freezing stressors, thawing also affects semen quality (Bagchi et al., 2008). The researchers tried to find an optimum combination of time and

temperature for thawing and found thawing at 70 °C for 5 s is superior to thawing at 37 °C for 20 s; however, the latter procedure is usually implemented for practical reasons.

Preservation at refrigeration temperature

Immediately after semen collection, the samples are kept in a water bath at 37 °C and evaluated for volume, colour, consistency, mass activity and pH. Spermatozoa concentration is determined in fresh or partially diluted semen samples through the haemocytometer or photometer method. Following the determination of spermatozoa concentration, the final dilution of the semen samples is done with pre-warmed (37 °C) tris–egg yolk or commercial extender (OptiXcell or BullXcell) in such a way that after dilution a volume of 1 mL diluted semen contain 25 × 10^6 spermatozoa. Finally, the diluted samples are stored at 4 °C for 72 h. The progressive motility and live spermatozoa count will remain above 30 % and 40 %, respectively, until 36 h of storage. Simultaneously the percentage of morphologically abnormal spermatozoa will be significantly low until 36 h of storage. It is possible to preserve Mithun spermatozoa at refrigeration temperature in an extender, which can be further used for artificial insemination within 36 h of storage. The variations in progressive motility, live spermatozoa count and total morphological abnormalities at different h of storage are depicted in Figure 1. For the long-duration preservation of spermatozoa, an optimized cryopreservation process is essential.



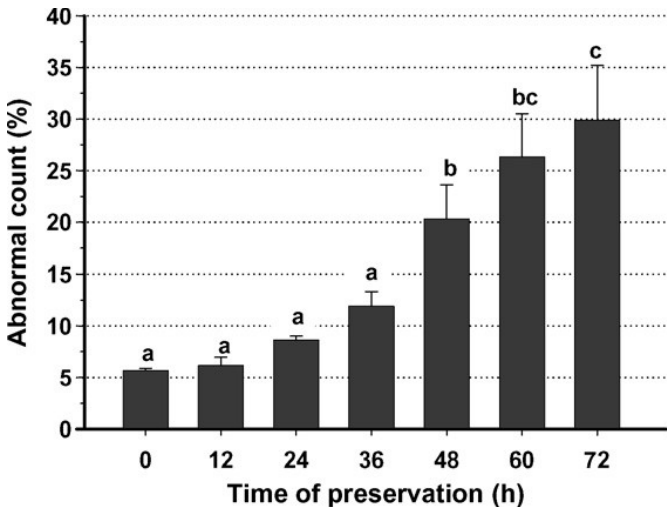


Fig. 1. Progressive motility, Live count and Total morphological abnormalities (mean±SE) of Mithun spermatozoa evaluated at 0, 12, 24, 36, 48, 60 and 72 h of *in vitro* storage at 4 ◦C; 0 h indicates the evaluation just before storage; a-c or a-d on error bar indicates a significant variation at P < 0.01 (Source: Karunakaran et al., 2007).

Cryopreservation by conventional or controlled freezing

After semen collection and evaluation, it is diluted with tris egg yolk citrate glycerol (TEYG) or a commercial extender. Before freezing, the fresh semen samples are analysed for initial progressive motility, live sperm count, acrosomal integrity and hypo-osmotic sperm swelling test (HOST). The ejaculates with ≥ 70 % progressive motility, ≥ 2.5 mass activity and ≥ 500 millions/mL concentration are considered for freezing. Tris-egg yolk extender is prepared by dissolving 3.025 g tris buffer, 1.67 g citric acid and 1.25 g fructose in 50 mL of distilled water by stirring and the volume is adjusted to 73 mL with distilled water. To this, the sterilized mixture of egg-yolk and glycerol is added @ 20 % and 7 %, respectively. If a commercial extender is employed, it is diluted according to the manufacturer's instructions. The freshly collected semen is diluted with an extender to make the final sperm concentration of 80 million/mL.

Conventional freezing

The extended semen is packed and sealed into a 0.5 mL straw and cooled up to 5 °C by keeping them in a cold handling cabinet for 60 min. Once the temperature reached 5 °C, the semen straws are equilibrated for 4 h. Conventional freezing is performed using an isothermal box filled with liquid nitrogen (LN_2). Semen straws are placed horizontally 4 cm above the LN_2 levels to expose LN_2 vapours for 10-12 min. After initial freezing on LN_2 vapours, the straws are immersed into liquid nitrogen for storage.

Controlled freezing

In the control freezing system, the straws are placed evenly on racks inside the bio-freezer. The bio-freezer equipment is programmed with the following rate: 5 °C/ min from 5 to -10 °C, 20 °C/min from -10 to -100 °C and 40 °C/min from -100 to -140 °C. After initial freezing in the bio-freezer, the straws are immersed into liquid nitrogen for storage.

Steps involved in cryopreservation of Mithun semen

4. The tube containing the freshly collected semen is recorded for volume, initially diluted in a 1:1 ratio with an extender placed in the thermos (37 °C) before transferring to the laboratory in a thermos. The collection tube remains capped until processed.
5. The 1:1 diluted semen is kept in a thermally controlled water bath at 35 °C under Laminar Air Flow Unit.
6. After examination of sperm concentration and initial motility, the semen is diluted further (final sperm concentration of 80 million/mL) after 7 minutes of cooling at 20 °C with extender maintained at the lab temperature.
7. Filling and sealing of semen into sterile straws is done under Laminar Air Flow Unit. The filling nozzles and rubber tubing used are always fresh.
8. The freezing is carried out as per the above-described protocols using a biological freezer or conventional freezer. Figure 2 represents the processing and cryopreservation of Mithun semen

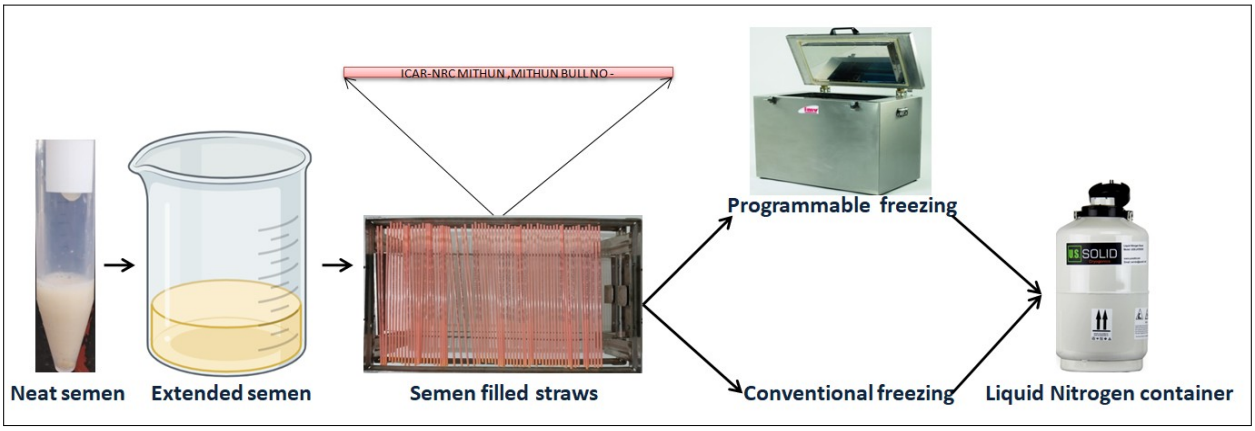


Fig. 2. Processing and cryopreservation of Mithun semen

Fresh semen attributes

The ejaculates obtained from the Artificial Vagina (AV) or Electro-ejaculation (EE) is most often used for cryopreservation. The fresh semen attributes & sperm motility and velocity parameters following semen collection with the AV and EE are presented in Tables 1 & 2. Semen collected with the EE had significantly (P<0.05) lower semen volume (mL), mass activity, progressive sperm motility (%), live sperm count (%), plasma membrane integrity (%), and significantly (P<0.05) higher total sperm abnormality (%) than AV technique (Table 1). The sperm concentration (x 10^6/mL) was significantly (P<0.05) higher in the EE_2 group. The motility and velocity parameters measured using a computer-assisted semen analyser (CASA) revealed that total motility (%), forward progressive motility (%), VAP, VSL, VCL, ALH, straightness, and linearity differed significantly (P<0.05) between different groups of two collection techniques (Table 2).

Table 1. Comparison of semen quality parameters in Mithun ejaculates collected by artificial vagina (AV) and electro-ejaculation (EE) method (mean±SEM). AV_1 and EE_1 – young bulls (*n*=4; 4-5 years of age, body weight 389 ± 15 kg) and AV_2 and EE_2 - older bulls (*n*=4; 8-10 years of age, weighing 476 ± 17 kg).

	G-I		G-II	
	n=16	n=36	n=16	n=36
Semen attributes	**AV_1**	**EE_1**	**AV_2**	**EE_2**
Colour	Milky white to creamy	Milky white to Light creamy	Milky white to creamy	Milky white to Light creamy
Consistency	Thick creamy	Watery to	Thick creamy	Watery to
Volume (mL)	5.31±0.51[a]	4.17±0.29[b]	5.58±0.21[a]	4.67±0.24[b]
pH	6.68±0.10	6.82±0.12	6.74±0.08	6.73±0.15
Mass Activity (0-5)	4.06±0.26[a]	1.97±0.09[b]	4.10±0.12[a]	2.24±0.13[b]
Sperm Concentration (x	607.37±21.01[a]	634.74±23.27	642.28±15.47[a]	729.90±13.72[b]
Progressive sperm motility	82.26±0.56[a]	70.10±1.37[b]	80.33±1.16[a]	71.01±2.57[b]
Live sperm count (%)	84.73±1.30[a]	74.29±2.19[b]	82.66±1.40[a]	75.30±3.28[b]
Acrosomal integrity (%)	82.81±0.50	81.18±1.25	83.73±0.53	80.15±1.05
Plasma membrane integrity	83.25±0.69[a]	59.07±1.88[b]	83.53±0.53[a]	64.26±1.29[b]
Total sperm abnormality (%)	8.20±0.55[a]	14.18±1.16[b]	7.66±0.34[a]	11.14±0.21[bc]

[a, b, c] Indicate significant differences within rows (P<0.05), n=number of ejaculates.

Table 2. Comparison of sperm motility and velocity parameters measured by computer-assisted sperm analyser (CASA) in Mithun ejaculates collected by artificial vagina (AV) and electro-ejaculation (EE) method (mean±SEM). AV_1 and EE_1 – young bulls (*n*=4; 4-5 years of age, body weight 389 ± 15 kg) and AV_2 and EE_2 – older bulls (*n*=4; 8-10 years of age, weighing 476 ± 17 kg).

	G-I		G-II	
	n=16	n=36	n=16	n=36
CASA Parameters	**AV_1**	**EE_1**	**AV_2**	**EE_2**
Total motility (%)	78.66±0.74 [a]	66.71±2.46 [b]	77.86±0.86 [a]	69.71±2.68 [b]
Forward progressive motility	71.86±0.60[a]	48.37±2.56[b]	71.33±1.16[a]	47.33±3.31[b]
VAP (µm/s)	147.44±6.63[a]	115.42±4.16[b]	135.58±5.66	99.91±4.45[b]
VSL (µm/s)	89.09±1.41[a]	82.60±2.65 [ab]	71.05±3.56[b]	75.30±3.68[b]
VCL (µm/s)	244.36±12.88	230.93±8.11[a]	229.69±10.0	190.98±9.17[b]
ALH (µm)	8.16±0.28 [ab]	9.09±0.21[b]	7.81±0.46 [a]	10.22±0.19[c]
BCF (Hz)	25.33±0.93	24.87±0.82	24.86±1.07	20.41±0.53
Straightness (%)	69.53±1.88[a]	73.54±1.10 [ab]	72.93±2.41 [ab]	77.50±0.74[c]
Linearity (%)	41.93±1.09 [a]	37.71±0.60 [bc]	36.40±1.21[c]	40.87±0.77 [ab]
Rapid velocity (%)	79.53±0.81	76.75±1.79	78.06±1.12	76.09±2.20
Static velocity (%)	20.66±1.28	16.89±2.30	17.01±1.46	22.04±3.47

[a, b, c] Indicate significant differences within rows (P<0.05), n=number of ejaculates.

Thawing of frozen semen

Thawing is done by placing the straw vertically in 37 °C water for a minute to convert frozen semen into liquid. The random samples from the lot are evaluated for motility, liveability, acrosomal integrity and HOST test and abnormalities before employing it for artificial insemination. Care should be taken to prevent the cold shock by adjusting the proper temperature before thawing or sudden decrease in semen temperature after thawing. The temperature of the thawing water must be checked immediately before removing the straw from the LN_2 tank using an accurate easy-to-read thermometer. The length of thaw should be at least 40 seconds to obtain better viability post-thawing.

Fresh semen attributes

The frozen-thawed semen attributes & sperm motility and velocity parameters of AV and EE are presented in Tables 3 & 4. The frozen-thawed EE semen had significantly (P<0.05) lower progressive sperm motility (%), live sperm count (%), acrosome integrity (%), plasma membrane integrity (%), and significantly (P<0.05) higher total sperm abnormality (%) than AV technique (Table 3). The total motility (%), forward progressive motility (%), VAP, VCL, rapid velocity were significantly (P<0.05) lower, and static velocity was significantly (P< 0.05) higher in EE as measured by CASA (Table 4).

Table 3. Comparison of frozen-thawed semen quality parameters in Mithun ejaculates collected by artificial vagina (AV) and electro-ejaculation (EE) method (mean±SEM).

	G-I		G-II	
	n=11	n=18	n=12	n=20
Semen attributes	**AV_1**	**EE_1**	**AV_2**	**EE_2**
Progressive sperm motility	53.25±2.45[a]	32.14±2.32[b]	51.45±2.14[a]	34.28±2.57[b]
Live sperm count (%)	60.20±2.85[a]	50.44±2.50[c]	57.24±3.25[ab]	54.02±2.56[b]
Acrosomal integrity (%)	62.45±3.84[a]	40.64±1.64[b]	60.23±2.57[a]	45.92±2.21[b]
Plasma membrane integrity	75.27±1.17[a]	50.89±1.58[b]	72.33±2.31[a]	53.77±4.22[b]
Total sperm abnormality (%)	9.6±2.26[a]	21.09±2.37[b]	10.11±2.15[a]	20.13±1.75[b]

[a, b, c] Indicate significant differences within rows (P<0.05), n=number of ejaculates.

Table 4. Comparison of frozen-thawed sperm motility and velocity parameters measured by computer-assisted sperm analyser (CASA) in Mithun ejaculates collected by artificial vagina (AV) and electro-ejaculation (EE) method (mean±SEM).

	G-I		G-II	
	n=11	n=18	n=12	n=20
CASA Parameters	**AV_1**	**EE_1**	**AV_2**	**EE_2**
Total motility (%)	65.82±2.99[a]	40.36±0.04[b]	67.11±3.12[a]	41.48±2.12[b]
Forward progressive motility	47.22±4.89[a]	33.36±2.08[b]	49.45±3.88[a]	36.48±2.12[b]
VAP (µm/s)	109.53±2.36[a]	100.34±1.07[b]	110.67±2.85	99.00±3.08[b]
VSL (µm/s)	75.12±2.63	72.96±3.7	69.51±3.11	74.89±3.45
VCL (µm/s)	230.24±7.55[a]	213.28±8.48[b]	224.37±8.62	215.03±7.56[b]
ALH (µm)	8.25±0.27	8.4±0.20	8.16±0.22	7.88±0.30
BCF (Hz)	24.39±1.25	22.10±0.76	24.61±0.98	24.59±0.93
Straightness (%)	71.24±1.58[a]	72.46±1.11[a]	71.34±1.26[a]	76.39±1.04[b]
Linearity (%)	38.11±0.84	35.41±0.35	36.28±0.41	37.55±0.99
Rapid velocity (%)	40.5±2.37[a]	27.90±2.63[b]	42.87±2.69[a]	30.53±2.89[b]
Static velocity (%)	46.38±4.66[a]	60.52±3.71[b]	45.17±3.67[a]	57.60±2.30[b]

[a, b, c] Indicate significant differences within rows (P<0.05), n=number of ejaculates.

Conclusion

The results obtained from the collection and cryopreservation of semen from Mithun bull are comparable with cattle and buffalo with post-thaw motility of ≥ 50 % and ≥ 30 % in AV and EE methods, respectively. The post-thaw quality of cryopreserved Mithun sperm in terms of motility, morphology, and acrosome & membrane integrities are sufficient for genetic improvement of this rare species through AI and conservation of the valuable germplasm for the future.

Foot and mouth disease: Control and Prevention

Dr. H. Lalzampuia

Introduction

Foot and mouth disease (FMD) is a severe, highly contagious viral disease of livestock that has a significant economic impact. The disease affects cloven-hoofed animals including Mithun. The disease is usually not fatal in adult animals, but there is often high mortality in young animals due to myocarditis. The organism which causes FMD belongs to aphthovirus genus of the family Picornaviridae. There are seven strains (A, O, C, SAT1, SAT2, SAT3, and Asia1) worldwide. Out of these, three serotypes *viz.* O, A and Asia1 are prevalent in India.

Mode of Transmission

The FMD virus (FMDV) is shed in all secretions and excretion from infected animals. Transmission can be either direct or indirect contacts between susceptible and infected animals. The FMDV can be introduced to healthy animals through any of the following points-

- Through contact with clinically affected animals.
- Through contaminated inanimate vectors such as vehicles, fodders, utensils, equipments etc.,
- Through air. Infected animals can secrete large amount of aerosol virus through exhaled air, which can infect other animals via the respiratory or oral routes. The virus can travel up to 60 km overland and 300 km by sea.
- All secretions and excretions from the infected animal such as saliva, faeces and urine.
- The virus may be present in milk and semen for up to 4 days before clinical signs appear.
- The disease has been transmitted to calves via infected milk.
- Through animal handlers, visitors and physicians.
- Recovered animals can remain as a carrier following infection. Carrier may transfer the virus from one animal to another. Carrier cattle may harbor the virus in the esophageal-pharyngeal fluid for 6-24 months.

Clinical Signs

The severity of clinical signs will depend on the strain of virus, the exposure dose, the age and species of animal and the host immunity. Morbidity can reach 100% in susceptible populations. Mortality is generally low in adult animals (1–5%), but higher in young calves, lambs and piglets (20% or higher). The incubation period is 2–14 days.

Clinical signs can range from mild or in-apparent to severe: they are more severe in cattle and intensively reared pigs than in sheep and goats. Common signs observed in acute infection are

1. 1. High fever up to 104-106˚F (41˚C) and anorexia.
2. Profuse salivation (saliva hanging in long ropy strings up to the ground).
3. Vesicles in feet and wounds in the interdigital space of legs followed by lameness.
4. Oral ulcers and lesions.
5. Smacking of lips.
6. Vesicles in the mammary gland

As the disease advances, rupturing of blisters can result in extreme lameness and reluctance to move or eat. Usually, blisters heal within 7 days (sometimes longer), but complications, such as secondary bacterial infection of open blisters can occur if proper care is not taken. In young animals, death can occur before development of blisters due to a multifocal myocarditis. Recovered animals may have complications like weight loss, growth retardation and a drop in milk production.

Preventive measures

In FMD endemic countries like India, vaccination is the foremost action to prevent the occurrence of FMD. Bi-annual vaccination with inactivated trivalent vaccine is being followed. Routine vaccination of animals with proper dose is important to maintain herd immunity. Young animals should be vaccinated at 3 months followed by booster dose at 30 days after first vaccination. Then it should be repeated every 6 months interval. Following points must be followed for effective control of FMD-

- Vaccination of the entire animal in farm/village.

- Routine health check up and veterinary care should be followed.
- In case of FMD outbreak, ring vaccination may be followed to prevent further spread of the disease in and around the area.
- Only vaccinated animals should be brought into the village from outside sources that too only 15-21 days following vaccination.
- Avoid purchase of animals from disease prevailing areas.
- New animals should not be purchased until six months following outbreak.
- Strict quarantine measures for newly purchased animals.
- A foot bath or truck bath may be made at the entrance of the village/farm.
- Avoid community grazing during outbreak.

Control measures

- Proper biosecurity measures should be in place at farm level-
    - Control of people's movement in and around livestock and equipment
    - Controlled introduction of new animals into existing herds
    - Proper cleaning and disinfection of livestock pens, buildings, vehicles and equipment
    - Appropriate disposal of manure and dead carcasses
    - Foot bath should be made at the entrance of the farm.
- Isolation and confinement of affected animals immediately after detection of clinical symptoms and restriction of animal movements.
    - Infected animals should not be allowed to graze in common grazing pasture.
    - Affected animals should not be allowed to drink water from ponds/streams/ rivers etc.
    - Diseased animals should not be allowed to roam about with other animals of the village.
- Movement of animal handlers and attendants who attended diseased animals should be restricted to the other animal population / farms. If it is not practicable, people should scrub themselves and their belongings with soap and caustic soda.
- In case of outbreaks, healthy animals should be attended first and then the affected ones. After attending the sick animals, persons should wash himself and his clothes with

4% sodium carbonate solution. Utensils used for collecting milk should be cleaned with 4% sodium carbonate solution.

- Calves should not be allowed to suckle affected mothers and they should not be fed with milk from affected animals.
- Mouth of the affected animals may be washed with antiseptic mouth wash. 1% potassium permanganate solution may be applied 3-4 times a day.
- Feet of the affected animals may be washed with 2% copper sulphate solution. Antiseptic lotion and fly repellents are to be used to avoid infection and maggot formation on the wound.
- Thorough disinfection of floors, premises and all infected materials by using Sodium hydroxide (2%), sodium carbonate (4%) and citric acid (0.2%) is advisable.
- Lime powder should be sprinkled around the animal houses.
- Surveillance and monitoring in compliance with the State/National norms.
- Reporting of any suspected disease to the local authority/veterinary department.

IMPORTANT DISEASES OF PIGS AND THEIR MANAGEMENT

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COLIBACILLOSIS

Escherichia coli (E. coli) infections are common in the first week after farrowing, and again in the first week after weaning. Infection in neonatal piglets is common due to sudden exposure to the bacteria on the skin of the mother and in the farrowing hut environment. Diarrhoea will appear within the first 2-3 hours, in individual piglets or whole litters. Faeces may be clear or white/brown. Severe cases result in dehydration, and mortality of up to 70%.

Diagnosis

Based on clinical signs, isolation and identification of the organism.

Treatment

E. coli infections can be treated effectively with antibiotics but prior to treatment antibiogram should be determined. Antibiotics such as amikacin, enrofloxacin and ciprofloxacin are found to be effective against colibacilosis in piglets although the most effective antibiotic against such infection was amikacin. Dehydration can be treated with orally administered glucose fluids. Probiotics can also be used to check diarrhoea in piglets.

Prevention and Control

The following measures can be adopted:

- Managing suckling and fostering in order to ensure that all piglets consume colostrum.
- Reduction in feed intake of sows and weaned piglets through supplementation of high protein and fibre diets.
- The new stock should be introduced carefully particularly the new gilts, in order to enable all animals to adjust to new strains of the organism.
- Keeping sufficient levels of clean and dry straw in farrowing pen.
- Farrowing pen should be disinfected and moved between litters.
- Bedding should be either removed or burned properly
- Piglets should be weaned onto clean ground (i.e. no pigs in the previous 12 months).

OEDEMA DISEASE

Oedema disease is one of the important bacterial diseases of pig which is caused by pathogenic strains of *Escherichia coli* known as Shigatoxin producing *E. coli* (STEC) and this disease mostly affects the healthiest piglet of the litter. The disease occurs within 10 days of weaning and outbreaks commence with one or more pigs being found dead and others developing varying degrees of nervous disturbance. Affected pigs appear dull may appear blind and may show head pressing. Lateral recumbency with paddling movements leading to coma and death normally follow within 4-36 hours or the onset of clinical signs.

Diagnosis

Based on clinical signs and detection of genes for VT2e through PCR.

Treatment and Control

Antimicrobial injection is rarely of value to individuals but therapy may be of value to the group. The antimicrobials used for injection or in water are ampicillin, amoxicillin, neomycin, tetracyclines, trimethoprim: sulphonamide, gentamicin and cephalothin or ceftiofur. Prevention is possible only through adoption of strict hygienic measures.

CLOSTRIDIAL INFECTION

Clostridial infection in pig is mostly caused by *Clostridium perfringens* types A and C which cause diarrhoea, dysentery and sudden death in piglets. Piglets affected by *C. perfringens* type C are normal at birth, sicken on the first or second day of life and usually die within 12-24 hours of the onset of clinical signs. A dramatic, profuse diarrhoea occurs and rapidly become claret-coloured. Affected piglets become weak, collapse and die. Some may be found dead.

Diagnosis

Fatal bloodstained diarrhoea in piglets of 36-48 hours of age strongly suggests *C. perfringens* type C infection. In some cases animals may die before the diarrhoea is obvious. The small intestine is red in colour and the contents are blood stained. The organism may be isolated in anaerobic culture and the toxin gene can be demonstrated through use of PCR.

Treatment and Control

Oral ampicillin can be used to treat the survivors of an affected litter and if it is administered soon after birth may prevent the occurrence of the disease completely.

SALMONELLOSIS

Pigs are affected by invasive serovars of *S. enterica* (such as Choleraesuis) between weaning and 3 or 4 months of age and affected animals often bury themselves in straw and show mauve-red cyanosis of the ears, limbs, the centre of the back, high rise of temperature and die within 24-48 hours. In the acute enteric form in younger pigs, animals pass a thin watery yellowish diarrhoea. Pneumonia, weakness and nervous signs such as paralysis and tremor may occur. In severely affected cases, skin discolouration is present.

Diagnosis

Based on clinical signs and isolation and identification of the organism.

Treatment and control

Affected animals may be treated with antibiotics but prior to treatment it is always better to obtain the antibiogram of the organism. Disinfection should accompany courses of treatment. Adoption of strict hygienic measures in the farm, provision of clean water, rodent and fly control and netting against birds will all help in preventing the introduction of salmonellosis to a farm. Control on infected farms will require medication when disease is expected and should be accompanied by disinfection. All-in, all-out housing, couple with isolation of batches by disinfectant barriers and thorough cleaning and disinfection between batches will definitely reduce the spread.

PASTEURELLOSIS

This disease of swine is usually seen in association with other infectious diseases or environmental factors that impair pulmonary function. There are both primary and secondary forms of the disease. The etiologic agent is *Pasteurella multocida* and there are five capsular serotypes (A, B, D, E, and F) and 16 somatic serotypes. Type A causes bronchopneumonia, type D is associated with atrophic rhinitis whereas type B is responsible for pneumonic pasteurellosis in pigs. The main clinical signs of the disease are coughing, dyspnoea, fever and

prostration. Chronic cases tend to have less fever, a persistent cough and a more marked dyspnoea. Swine with well-developed pneumonia or extensive adhesions between lungs and rib cage often have a marked expiratory lift ("thump").

Diagnosis

History, clinical signs and the remarkable pulmonary lesions are suggestive of pneumonic pasteurellosis but culture of lung lesions from a nonmedicated pig is required for confirmation.

Treatment and Control

The effective treatment of pasteurellosis in pigs depends on the selection of right antimicrobials, appropriate dose with sufficient duration of therapy and obtaining antibiogram of isolated organism. Antimicrobials such as long acting oxytetracycline, chlortetracycline, ceftriaxone and ciprofloxacin are found to be effective against pneumonic pasteurellosis in swine. Control methods include all the measures that might prevent introduction of a new strain of ***P. multocida*** into a herd. Herd additions should be quarantined for at least a few weeks. Mixing and sorting of pigs should be minimized. Implementing control of other respiratory pathogens or any other disease, environmental or stress factor that might lower resistance should be addressed.

SWINE ERYSIPELAS

Swine erysipelas is caused by the bacterium *Erysipelothrix rhusiopathiae* and the affected pigs die suddenly or collapse with a high temperature and a scarlet flush on the skin. In gilts, fattening pigs and young boars there may be flushing or blotching of the skin and ears. Diamond skin lesions occur within 48 hours of the onset of clinical signs and can be felt as raised patches along the back or neck but rapidly become purplish-red.

Diagnosis

The development of the characteristic skin lesions in one of a group of affected animals confirms the diagnosis. The organisms can be cultured from the blood and from most parts of the carcass in acute disease. In chronic disease they may only be recoverable from the joints or skin lesions.

Treatment and control

Penicillin injection can be used for the treatment of erysipelas and the response is normally rapid.

GREASY PIG DISEASE

Greasy pig disease also known as exudative epidermitis (EE) is an acute generalized disease of pigs caused by *Staphylococcus hyicus*. This is particularly a disease of young piglets and the clinical picture of greasy pig disease is characterized by exfoliation of the skin, excessive sebaceous secretion and the formation of a brownish coat of exudates that may cover the entire body. Morbidity can be up to 90% in infected herds. Unlike mange mite infection there is absence of itching in this disease.

Diagnosis

Diagnosis is based on clinical signs as well as isolation and identification of *Staphylococcus hyicus* from clinically affected animals. In very young piglets (1-2 days old) when it is very difficult to collect samples from skin, the oraganism can be effectively isolated from heart blood. The causative organism can be specifically detected through use of species specific PCR.

Treatment and control

The disease can be effectively treated with antimicrobials. Antimicrobials such as ampicillin, penicillin, oxytetracycline, gentamicin, chloramphenicol, enrofloxacin, norfloxacin, ciprofloxacin, cephalexin , sulphadiazine and co-trimaxazole were found to be effective against greasy pig disease. Prevention is possible only through adoption of strict hygienic measures such as regular disinfection and cleaning of pig shed.

Streptococcus suis INFECTION

Streptococcus suis (*S. suis*) is an important pathogen of pig responsible for a wide range of diseases such as meningitis, arthritis, septicaemia, endocarditis, encephalitis, abortions, polyserositis and bronchopneumonia. This is primarily a disease of young piglets and disease has been observed most commonly during the first week of their life. The first sign noticed in young piglet is the swelling of the joints (both hock and knee joints are involved) and later on

septicaemia and meningitis (when CNS is involved) develops. If treatment is not initiated in the early stage of the disease, treatment in later stage (when meningitis develops) is not fruitful.

Diagnosis

Diagnosis is based on clinical signs as well as isolation and identification of the organism from clinically affected piglets.

Treatment and control

The disease can be effectively treated with antimicrobials but all antimicrobials are not equally effective. The most effective antibiotic against this infection was found to be penicillin and other antibiotics which can also be used in pigs are amikacin, enrofloxacin and gentamicin.

Strategy for prevention of S. suis infection in piglets

- Injection of piglets on the day of birth with long acting penicillin @70 IU per piglet (150 IU per ml).
- Adoption of strict hygienic measures in the farrowing pen.

BRUCELLOSIS

Brucellosis in pigs is caused by a bacterium called *Brucella suis*. This disease has zoonotic significance and if the organism gets into the pig herd, it is difficult to eliminate. It causes long term reproductive losses in pig. Common manifestations are abortion, temporary or permanent sterility, orchitis, lameness, posterior paralysis, spondylitis, and occasionally metritis and abscess formation. The incidence of abortion may be 0-80%. Abortions may also occur early in gestation and be undetected. Usually, sows or gilts that abort early in gestation return to estrus soon and are rebred. Sterility in sows, gilts, and boars is common and may be the only manifestation.

Diagnosis

Diagnosis is based on clinical signs as well as isolation and identification of the organism from affected animals. Sero-diagnosis can be made through use of serological tests like Rose Bengal plate test (RBPT) and Serum Agglutination test (SAT).

Treatment and control

- Treatment with antibiotics is not very effective and generally should not be attempted. Affected pigs should be destroyed.
- If the herd becomes infected the most reliable method of control is to slaughter the herd, clean up the premises and restock with brucella-free pigs. This is also the safest procedure from the pig attendants' and public's stand-point and in the long term is usually the least costly.
- Other approaches include repeated herd blood tests with removal of positive reactors. This may be effective if only a few pigs are infected but is likely to be unsuccessful if many pigs are positive.

BACTERIAL CONJUNCTIVITIS IN PIGS

Conjunctivitis is the inflammation of bulber or palpebral conjunctiva. Bacterial conjunctivitis is common in pigs and is mostly observed in Ghungroo breed of pig which could be due to their morphological predisposition.

Clinical signs

Common clinical signs observed are erythema, hyperaemia, blepharospasm in eyelid, photophobia, discharges from the eyes and sometimes discharge of mucopurulent materials from one or both the eyes. In most cases affected eyes remain closed because of excessive secretion of mucopurulent materials.

Diagnosis

Diagnosis of conjunctivitis can be made based on clinical signs and the involvement of bacteria (in case of bacterial conjunctivitis) can be confirmed through culture and isolation from conjunctival swabs using different culture media.

Treatment

Bacterial conjunctivitis can be treated effectively with a combination of steroid and antibiotics given as eye drop. Prior to application of eye drops the affected eyes should be cleaned properly through a swab ringed in normal saline/sterilized water. The effectiveness of the antimicrobials depends on the type of bacteria involved. It has been observed that gentamicin is the most effective antibiotic for the treatment of conjunctivitis in pigs.

Control measures

- Adoption of strict hygienic measures in the farm.
- Quick separation of in contact animals and prompt treatment of affected litters with suitable antimicrobials.
- Practice of keeping of different breeds of pigs in the same pen should be avoided.

CLASSICAL SWINE FEVER

Classical swine fever (CSF) or hog cholera, one of the most dreaded and devastating viral disease of swine, causes serious economic losses directly due to mortality, retardation of growth, reproductive problems of affected pigs and indirectly by bringing restrictions on exports of pork and pork products. It is caused by an RNA pesti virus. Acutely-affected animals are dull, lethargic, inappetent and fevered (105-107°F). These signs are followed by conjunctivitis and constipation then by diarrhoea with occasional vomiting. Pigs huddle in piles in the bedding, walk reluctantly with a swaying movement of the hindquarters and seek the support of walls or posts. Reddening and blotching of the skin and dyspnoea (difficulty in breathing) occur. Convulsions occur early in the disease and are followed by circling, incoordination and ataxia. Death normally occurs within 4-8 days of infection in hyperacute cases, 9-19 days in acute cases and between 30 and 95 days in chronic disease.

Diagnosis

Diagnosis is based on clinical signs and virus isolation. Antigen detection ELISA and RT-PCR can also be used. The ELISA is a simple and rapid method for screening sick or pyrexic pigs and has the advantage that it can be used on large numbers of blood samples.

Prevention and control

There is no treatment. Control is possible only through successful vaccination.

Swine fever vaccination schedule

Swine fever vaccine (lapinized swine fever vaccine)

Dose: 1ml, S/C or I/M

Primary vaccination: After weaning (weaning at 45 days)

First booster: 30 days after first vaccination.

Second booster: After 6 months of first booster.

Re-vaccinate at 6 months interval.

In case of tissue culture vaccine dose and route of administration is same as lapinised vaccine but it gives longer duration of immunity.

AFRICAN SWINE FEVER (ASF)

Clinical signs

- There are four forms of the disease: peracute, acute, subacute and chronic.
- Mortality varies from 0 to 100% depending on the virulence of the virus.
- Acute and peracute forms of the disease are characterized by a severe haemorrhagic disease with close to 100% mortality.
- Affected pigs develop high fever (up to 42ºC) followed rapidly by lack of appetite, in coordination and become extremely weak and may die at this stage without showing other clinical signs.
- Surviving pigs will then exhibit reddening or cyanosis of the ears and snout followed by more generalized reddening of the body and bleeding from the nose and anus.
- Affected pigs may also show difficulty in breathing, vomiting and abortion (if pregnant).
- Pigs that survive acute infection may appear healthy or chronically diseased.
- Pigs may also exhibit non-specific clinical signs and lesion often characterized by loss of body condition, swollen joints and respiratory problems if they are infected with low virulent form of the virus.
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Prevention and Control

As there is no vaccine available against this disease, prevention is possible only by adopting strict biosecurity measures.

PORCINE CIRCOVIRUS TYPE 2 (PCV2) INFECTION

Clinical signs

- Gradual wasting in weanling pigs
- Rough hair coat
- Difficulty in breathing
- Enlarged peripheral lymphnodes
- Diarrhoea
- Evidence of pneumonia
- Jaundice and paleness
- Abortion, mummification and stillbirth

Prevention and control

Can be controlled only by vaccination.

PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME (PRRS)

Clinical signs

In gilts, sows and boars

- Loss of appetite, fever and lethargy
- Respiratory distress or vomiting
- Cyanosis of the ears (common), vulva and abdomen
- Delayed or abnormal estrus cycle
- Increased premature farrowings, late term abortions, stillborn or weak piglets and mummified foetuses.

In young, growing and finishing pigs

- Primary clinical signs among young pigs are fever, depression, lethargy and pneumonia
- Sneezing, fever and lethargy are followed by difficulty in breathing and impaired growth
- Older piglets will have similar respiratory signs.

Treatment and control

- Adoption of strict biosecurity measures to prevent the entry of the disease to a clean farm
- Supportive care
- Regular disinfection of pig sheds with multi-constituent compound like Virkon.
- Use of antibiotics to control secondary bacterial infections
- Maintaining close herds
- Change of feeds if contaminated by mycotoxins

ROTAVIRUS INFECTION

Rotavirus (double stranded RNA virus) infection is an important viral infection particularly of young pigs which causes diarrhoea in piglets. Groups A, B, C and E have been found in pigs. Group A is usually the first to infect a piglet and is most common in pre-weaning diarrhoea. Diarrhoea is profuse and in milk-fed pigs, this is yellow with floccules floating in a whey-like fluid, while in others it may be yellow or dark grey. Vomiting may be seen. Clinical signs regress 4-6 days after infection but loose yellow faeces may persist for 7-14 days.

Diagnosis

Clinical signs may help in diagnosis but confirmatory diagnosis is based on polyacrilamide gel electrophoresis to detect the characteristic double-stranded RNA and use of RT-PCR.

Prevention and control

There is no specific treatment. Prevention depends on the adoption of strict hygienic measures in the farm which includes measures like regular cleaning and disinfection. Disinfection can be carried out using hypochlorite on clean surfaces and proprietary disinfectants such as a mixture of surfactant, organic acid, oxidising agents and buffers.

FOOT-AND-MOUTH DISEASE (FMD)

Foot-and-mouth disease is caused by the foot-and-mouth disease (FMD) virus. Seven distinct serotypes occur (A,O,C, S.A.T.1, S.A.T.2, S.A.T.3, Asia 1) each with several subtypes. The most obvious clinical sign is the sudden onset of severe lameness in a group of pigs which rapidly spreads to others in the same herd. The back may be arched, reluctance to move is common and movement may be accompanied by squealing. Vesicles are seen on the top of the tongue, on the snout and on the udder of the suckling sow and may rupture readily to leave small ulcers.

Diagnosis

Clinical signs of severe lameness spreading in a group or herd should lead to suspicion of foot-and-mouth disease (FMD) and inspection of the feet, snouts and tongues of lame pigs will confirm the presence of vesicles. Virus may be detected and identified by the complement fixation test using antibody to all 7 viral serotypes; a Polymerase Chain Reaction (RT-PCR) test for viral RNA; isolation in tissue culture and ELISA.

Prevention and control

Pigs are not readily immunised and require high concentrations of virus, although immunity has been demonstrated for up to 9 months using oil adjuvanted vaccines. These cause granulomatous reactions and should be given into the pinna of the ear or intraperitoneally.

FMD vaccination schedule for pig

Name of the vaccine: Foot and Mouth Disease Vaccine (Cell culture vaccine)

Age of vaccination:

First vaccination is done at 42 days of age. Booster vaccination is done after one month of the first vaccination. Subsequent vaccination is done at 6 months interval.

SWINE POX

Caused by the swine pox virus, a large DNA virus of the swine pox group. Disease is characterized by fever and appearance of lesions over the body which may persist for 1-3 weeks. In young piglets the bursting of the vesicle (blister) on the face may lead to wetting, scab formation and conjunctivitis.

Diagnosis

The size and colour and especially the uniformity and circular shape of the lesions is characteristic. Flank biting, "spirochaetal granuloma" and local infections with *Staphylococcus hyicus* may also resemble pig pox but the agents of these are usually demonstrable. Culture can confirm the presence of the virus and differentiates it from that of Orf.

Prevention and control

Treatment or control are rarely attempted because of the mildness of the disease, but the use of insecticide to eliminate lice and flies which transmit the disease on a farm and the thorough cleaning and disinfection of pens in which outbreaks of the disease have occurred will help in reducing the incidence.

PORCINE CIRCOVIRUS INFECTION

Porcine circovirus type 2 (PCV2) infections is one of the most economically important diseases of pigs and is caused by a DNA virus belonging to Circoviridae family. It is distributed worldwide and is considered to be an important emerging pathogen associated with several different syndromes and diseases in pigs, collectively grouped as porcine circovirus diseases (PCVD).

Clinical signs

PCV2- associated systemic infection is clinically characterized by wasting, dyspnea, and lymphadenopathy and might be associated with diarrhea, pallor, and jaundice.

Diagnosis

Based on clinical signs, virus isolation/PCR-based detection of viral DNA as well as detection of viral antibody/antigen by ELISA.

Prevention and control

Can be controlled only by vaccination.

Health care practices for the control of important parasitic diseases of pigs

Pigs heavily parasitized are more susceptible to diseases such as scours and pneumonia. The resulting diseases and unthriftiness are a major cause of economic loss. Swine producers should be aware of the common parasites of swine and methods of prevention and control. The common parasites of pigs are:

Coccidia

Neonatal (baby pigs) coccidiosis caused by **Isospora suis** is found wherever pigs are raised in confinement. Clinical signs of yellowish or gray pasty to liquid diarrhoea appear at 1 to 2 weeks of age with dehydration evident even though nursing continues. The other coccidia, **Eimeria,** which are found in weanling and older pigs, apparently cause little or no damage. None of the anticoccidial drugs is effective against **Isospora,** but sanitation of farrowing crates by thorough cleaning can be successful in its control. Control is best achieved by:

- Thorough cleaning and sanitation between each farrowing
- Monitoring of movement of personnel and supplies
- Control of pests and rodents to reduce mechanical transmission of the oocysts.

Roundworms (*Ascarids*)

Infective eggs of roundworms are abundant on pig sheds, pastures and other places contaminated by droppings of infected pigs. Migration of roundworm larvae through the lungs results in pneumonia and coughing. Roundworm infestation results in decreased feed efficiency, lowered growth rates and condemnation of livers.

Nodular worms (*Oesophagostomum*).

Nodular worms cause intestinal damage and unthriftiness in pigs. They burrow into the intestinal wall and develop nodules in the wall of the intestine.

Intestinal threadworms *(Strongyloides*)

This parasite can be transmitted from the sow to the piglets before birth (prenatal infection) and can also be transmitted through the colostrum and is capable of penetrating unbroken skin. As a result, mature threadworms have been detected in baby pigs as early as 4 days old. The parasites can result in yellowish diarrhoea and possible death in baby pigs.

Whipworms (*Trichuris*)

Whipworms are common internal parasites of swine which causes diarrhoea in pigs. Pigs infected with whipworms are also prone to other intestinal infection such as salmonellosis. Whipworm infestations can be particularly devastating in young pigs (3 months old or less).

Lungworms

The adult lungworm produces eggs in the lungs which are coughed up, swallowed and pass out in the faeces. Earth worms ingest the eggs and become infected. Pigs may root up and swallow earth worms containing the infective stage of the parasite. Lung infection then occurs and considerable lung damage and pneumonia can result.

Mange

Mange is a parasitic disease of the skin caused by mite *Sarcoptes scabiei* in pigs. Sarcoptic mange (sometimes called scabies) is by far the most common and important because it is irritant and uncomfortable for the pig, causing it to rub and damage the skin which becomes unsightly. It significantly depresses growth rate and feed efficiency of the affected pigs. The common signs are ear shaking and severe rubbing of the skin against the sides of the pen. The activity of the mites burrowing into the skin makes the pig scratch and the wounds caused can become infected with bacteria. Mange occurs around the head, ears, legs and tail but will spread over the body if not treated.

For control of parasitic infection the following anthelmintics can be used:

For Gastrointestinal parasites

Piperazine @ 250-300mg/ kg body weight in feed and water (single dose)

Fenbendazole @ 5 mg/kg body weight in feed (single dose)

Ivermectin @ 0.3mg/ kg body weight, S/C

For coccidiosis

Amprolium @ 25-65mg/kg of feed once or twice a day for 4-5 days

For mange mite infection

Deltamethrin @ 50-75 ppm (two applications at 10 days interval)

Ivermectin @ 0.3mg/kg body weight, S/C

PRACTICAL ASPECTS OF HEAT STRESS MANAGEMENT IN LIVESTOCK AND POULTRY

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Stress can be defined as the inability of an animal to cope up with its environment, a phenomenon which is often reflected in a failure to achieve genetic potential (Dobson and Smith, 2000). It is a cumulative detrimental effect of various factors on the health and performance of animals (Rosales, 1994), depending on the duration and intensity of the stressors, previous experience with stressors, physiological status, and the immediate environmental restraints. Stressors could be environmental (extreme heat and cold), nutritional (feed / water deprivation), social, and psychological (fear / restrain), internal (disease / pathogen / toxin) and physiological (pregnancy / lactation).

Among the stressors, heat stress is the major concern among livestock and poultry farmers in almost all the developed as well as developing countries in the changing climate scenario (Sejian et al. 2012). Animals and birds are 'heat stressed' if they have difficulty achieving a balance between body heat production and body heat loss. Increased ambient temperature is the major source of heat stress to animals and birds because it enhanced heat gain as compared to heat loss from the body (Kumar et al. 2011). The main weather parameters that influence heat stress are ambient temperature (AT), relative humidity (RH), wind velocity, and solar radiation while the level of heat stress is dependent on the animal's activity, body condition, coat cover, and colour, and disposition. Heat stress results in increased body temperature, increased water consumption, decreased feed consumption, reduced weight gain, poor breeding efficiency, lower milk production, decreased egg production, egg size, egg quality, and hatchability, increased disease susceptibility, behavioural changes, and in extreme cases it may lead to death (Shaji et al. 2015; Saeed et al. 2019). Since the metabolic energy is being diverted to ameliorate the stress, the production efficiency of the livestock and poultry are drastically reduced and thus leading to huge economic losses to livestock and poultry farmers

(Shaji et al. 2015). Hence, special emphasis should be given to cover the measurement of severity of heat stress, development of user-friendly and economically feasible ameliorating measures if farmers have to adopt those strategies to improve livestock and poultry production in the changing climatic scenario.

Thermogenesis and Thermal Comfort Zone

For a better understanding of the phenomenon of heat stress, it is essential to know about thermoregulation and the different thresholds of thermo-neutrality and comfort zone of the livestock and poultry. In Figure 1 an overall scheme is presented about the relationship of thermal zones and temperature. The thermoneutral zone, or zone of thermal comfort, is the range of temperatures under which the livestock and poultry feel mental and physical wellbeing. Thermoneutral zone depends on the age, breeds, species, feed intake, diet composition, the previous state of temperature acclimatization, housing and stall conditions, tissue (fat/ skin), insulation, and external (coat) insulation, and the behaviors of the livestock and poultry. For example, the thermo-neutral zone /comfort zone for Holstein Friesian (HF) is 5-21°C (Worstels and Brody, 1953), Jersey and Brown Swiss is 5-24°C (Johnson, 1965), crossbred cow of India is 15-25°C and India buffaloes are 13-24°C (Goswami and Narain, 1962). Likewise, the ideal AT is between 18-24 °C for chickens and 18 to 25°C pigs respectively. The thermoneutral zone is bounded by the Upper critical temperature (UCT) and lower critical temperature (LCT). Beyond the ULT and LCT, metabolism is must adapted to either get rid of body heat or acquire body heat respectively. But at a certain moment, there is no further adaptation possible and the animal and bird enter a phase of hyperthermia or hypothermia respectively, which may end with death. Below the LCT, the animal and bird need to eat more feed in order to be able to increase body heat production, but this form of adaptation has its limits.

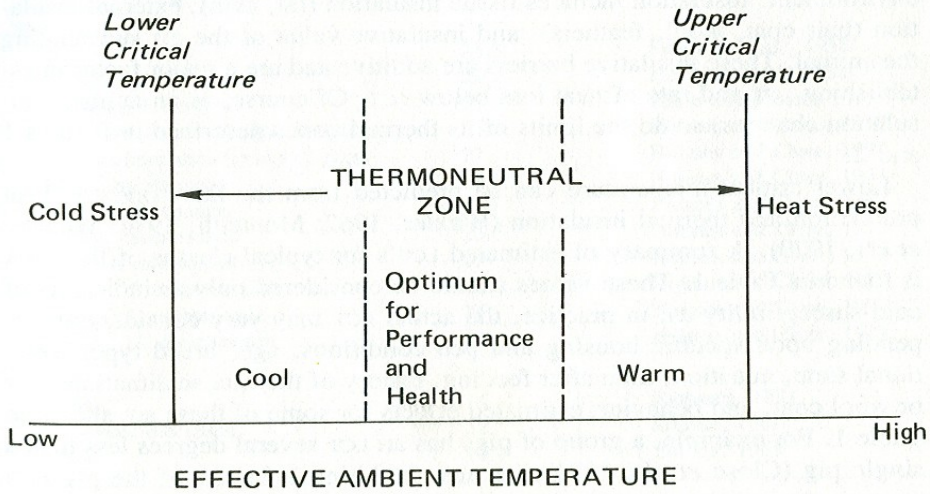

FIGURE 1. Schematic representation showing relationship of thermal zones and temperatures.

Signs of Heat Stress

Heat stress occurrence can be a phenomenon of one or a few days, but it may also be a phenomenon extending over a certain period. It is the joint results of multiple factors; of which AT and RH are the two most important ones. A number of physiological and behavioral responses to heat stress vary according to animal genetic make-up; intensity and duration of environmental factors (Altan et al. 2003). Many signs of heat stress can see in livestock and poultry. Some of the general signs include restlessness, crowding under shade or at water tanks, panting, salivation, increase respiration rate, an initial increase in heart rate, and later on reduce heart rate, lethargy, decreased activity, drop in milk yield, a drop in feed intake and a drop in energy and protein balance, decrease in reproductive performances in terms of decrease estrus period length, conception rate, growth, size and development of ovarian follicles, increase risk of early embryonic deaths, endometrium dysfunction; and reduced spermatogenesis, decrease fetal growth and size, etc. The most common signs of heat stress in poultry include laboured breathing and panting pale combs/wattles, lifting wings away from the body, seizures/convulsions, etc.

Measurement of Severity of Heat Stress

The severity of heat stress can be assessed by calculating the Temperature Humidity Index (THI) which is one of the most accepted indexes for assessing the impact of heat stress on livestock and poultry production. When the RT is measured in ^{0}F (LPHSI, 1990), the equation for calculation of THI and their interpretations are as follows,

THI=db^{0}F? {(0.55-0.55RH) (db^{0}F-580}

Where db= dry bulb temperature (^{0}F) and RH = relative humidity (%)/100.

Interpretation- If the calculated value is < 72= Indicates absence of heat stress, 72 to <74= moderate heat stress, 74 to < 78= sever heat stress, and 78 and more = very sever heat stress.

Different Approaches/ Strategies to Alleviate Heat Stress

Ameliorating heat stress on livestock and poultry is a multidisciplinary approach involving housing, nutrition, and recent advances in biotechnological interventions particularly in dairy cattle. Various approaches/ strategies to alleviate the adverse effect of heat stress are as follows.

1. Selection of heat tolerant livestock and poultry

Differences in heat tolerance exist between species, breeds, and within each breed. Thus, genetic selection of livestock and poultry based on specific molecular markers for heat tolerance will definitely be a boon to alleviate heat stress. Indigenous local livestock and poultry are relatively well adapted to their own ecological niche, grow faster, disease-resistant, and can be reared with minimal inputs with the locally available feed sources. Thus the effect of heat stress can be reduced by developing a suitable breeding program, and better utilization & improving the local genetic resources for the development of a region or agro-climatic zone-specific heat-tolerant breeds, and varieties (layer/ broiler) for poultry as per existing breeding policy.

2. Shelter Design for Alleviation of Heat Stress

Shelter management is one of the key techniques for reducing the impact of heat stress in livestock and poultry. Livestock and poultry need to be provided with shelter during extended periods of extreme temperatures. The best type of shelter during extreme heat should protect the livestock and birds from the extreme effects of heat without compromising their performance in terms of growth, health, and reproduction. Therefore, considerable efforts are needed in shelter design and management in the changing climatic scenario to improve the livestock and poultry production, thus farmer's profitability and economics. However, while doing so emphasis should be given to the use of economically viable, locally available materials to modify the shelters so that farmers can adopt those technologies easily. The following points are needed to keep in mind while constructing sheds.

- The livestock and poultry sheds should be located in a place where there is free air movement and good natural ventilation. It should be well away from the residential areas

to avoid creating a nuisance from odour and flies, away from the fire source, and garbage dumping grounds.

- The major shelter design parameters for permanent building structure include 1. Orientation, 2. Floor space, 3. Height, 4. Ventilation, 5. Roof construction, 6. Feeding and water facilities and 7. Wastewater management. The orientation of the sheds varies according to agro-climatic zones so as to prevent the direct penetration of solar radiation. Asbestos cement, Aluminium, or galvanized steel are ideal roofs for shelters, kennels, and chicken coops as these materials are very good at reflecting the radioactive rays of the sun. Also, to manage the drainage and disposal of effluent, the building should be on a slight slope.
- Space requirements inside the sheds should be doubled especially in hot and humid climates and provide an additional open area for improved air movement in order to avoid stress to the animals.
- Ventilation system is essential for heat stress relief. During extreme heat conditions, wind flow is important for keeping livestock and poultry cool, so this should be considered when deciding the type and location of the shelter. The distance between the sheds should be adjusted such that the flow of wind across the sheds is not interrupted and fresh air is available to the animals and birds. To achieve maximum airflow, the house should be open with internal recirculation fans positioned in a tunnel ventilation arrangement especially in the case of poultry sheds.
- Trees with large canopies can be planted individually in fields souring to the animal and birds shelters. Trees have a cooling effect due to the absorption of heat by the leaves.
- Evaporative cooling systems can be used with cooling pads inside the sheds, and sprinklers can be used in the poultry farms where environmental temperatures are high and humidity levels are low.

3. Nutritional and Feeding Management

Some nutritional and feeding management tips to manage heat stress are:-

- Provide high quality feeds like total mixed rations.
- Increase the frequency of feedings.
- Restricted feeding and/or intermittent feeding programmes for broiler framings in high-temperature regions.
- Feed during cooler times of the day.
- Keep feed fresh as much as possible.

- Provide high-quality forage. Feeding high quality forages and balanced rations will decrease some of the effects of heat stress and will boost the performance of the animals.
- Provide adequate fats in rations. Increasing the metabolizable energy content in the diet by adding fat is a common practice during the summer. Fat feeding apart from lowering heat production also helps to improve the dietary energy density which produces less metabolic heat.
- Use of bypass proteins can enhance the milk yield and protein content in case of dairy cows.
- Providing sufficient cool water is probably the most important strategy for animals to undertake during heat stress.
- Use of feed additives such as betain, prebiotics, and probiotics.
- Supplementation of vitamins C, E, A are very effective in ameliorating the adverse effect of heat stress.
- Supplementation of trace minerals such as selenium, chromium, zinc, etc.
- Supplementation of electrolytes

5. **The information on weather events and extremes, remote sensing.**

6. Application of geographic information system (GIS) and modeling in prediction of climate change associated livestock diseases

7. **Applications of assisted reproductive techniques–** The use of all emerging technologies, especially the rapidly developing/ developed modern reproductive the following techniques will be helpful in dealing with heat stress in the changing climatic scenario.

a. **Artificial Insemination (AI)–**This technology has played a valuable role in facilitating appropriate genetic changes in animal and poultry populations. AI technology allows widespread use of outstanding males and dissemination of superior genetics material, progeny testing under environmental and managerial conditions to improve the rate and efficiency of genetic selection.

b. **Embryo Transfer Technology (ETT) -** One way to avoid the consequences of heat stress on the oocyte, fertilization, and the early embryo is to bypass its effects through implementation of an embryo transfer program. Embryos are typically transferred into females at day 7 after estrus. By that time, embryos have gained resistance to the effects of heat stress. Embryo transfer can be coupled with ovulation synchronization programs to allow timed embryo transfer and avoid the need for estrus detection.

c. **Transgenesis-** Since the initial demonstration in 1980 that a transgenic animal can be generated harbouring a transgene from a different species, genetic engineering has revolutionized all aspects of fundamental biology and biomedical research. Transgenic approaches can alleviate the adverse effects of heat stress by improving heat tolerance. It involves the incorporation of genes of interest into the desired animals to improve animal tolerance to heat stress.

Conclusion

Heat stress has emerged as a major concern to livestock and poultry farmers because it adversely affects health, growth, and reproduction, which ultimately has great impacts on livestock and poultry well-being and farmer's profitability. Under this scenario, implementing approaches like the selection of the heat-tolerant livestock and poultry, shelter management, as well as nutritional and feeding strategies can have a significant impact in ameliorating the heat stress effect on livestock and poultry. In this connection, the veterinary (herd health) practitioner can provide added value to the farmer by advising and training on scientific heat stress mitigation strategies. This might pave way for developing agro-ecological zone-specific amelioration strategies to counter the impact of heat stress and farmers' economic in the changing climate scenario.

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Reproductive management of Mithun

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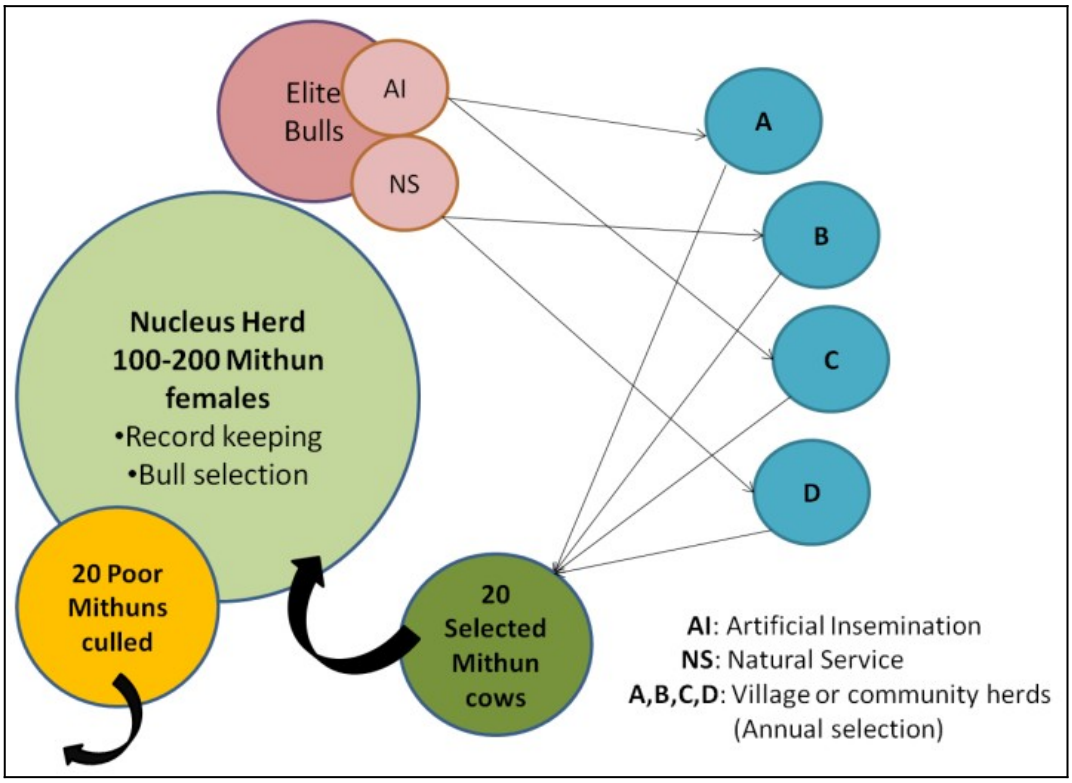
Semi-intensive system of Mithun rearing has several advantages such as control breeding, recording keeping, proper management of pregnant cows and calf, protection from wild predators, etc. Traditionally, Mithun has been reared for only meat, however, its value in terms of milk, hide, and draught power is recently explored. Herd management, especially breeding and reproductive management, is crucial for better performance of Mithuns reared scientifically under free range or semi-intensive conditions. The factors such as improper nutrition, endocrine imbalance, heredity, infectious diseases and reproductive abnormalities decrease performance of herd. In this chapter, some of the strategies that are required for scientific management of Mithun are discussed.

- **Genetic strategies to improve reproduction**

Breeding and genetic improvement of any livestock species are continuous process. The selection between breeds and within breed, and nominated mating practices are two major tools in the hands of a breeder which are widely used in farm livestock practice coupled with systematic record keeping and has led to dramatic improvement in the performance of dairy and beef cattle over the last 50 years. Initially, the emphasis was given to milk yield and body weight traits, however, nowadays selection for the traits including health, longevity, and reproduction is considered important for improved animal performance. With reference to Mithun, "*the in-discriminative slaughtering of the elite Mithun bulls has led to the loss of potential germplasm*". At present, the best Mithun bull in terms of its physical traits, health and body weight is selected for slaughtering at ceremonies and marriages. Keeping in view the overall genetic improvement of Mithun herd, the superior bulls with high genetic merit should not be slaughtered, rather these bulls need to be selected and maintained for further propagation. A proper breeding plan for genetic improvement of Mithun population is in the form of ONBS (Open nucleus breeding system) under participatory mode is presented during X Plan needs to be strengthened and should be established in the community herd or institute herd (Figure). At the same time, conservation and propagation of elite Mithun germplasm is important to continue genetic improvement of Mithun population.



Schematic representation of ONBS (Open Nucleus Breeding System) for Mithun under participatory mode with the local community.

- **Nutritional strategies to improve reproduction**

Mithun being reared in the free-range system, moves and browses around the forest and thrives on the forest forages, shrubs, herbs, and other natural vegetation. The Mithun is not fed with the additional feed except the salt which is offered from time to time by the farmers. Improper nutrition directly affects health and reproductive performance by lower expression of estrus or heat, increased incidence of embryonic or fetal death, and increased inter calving period. All the animals require a specific diet during the transition period to counteract negative energy balance. Forest grasses and mixed forages do not fully meet the nutrient requirements of Mithuns reared under captivity by scientific methods, however, in the free-range system Mithuns meet their requirements by consumption of the nutrient rich vegetation available in the forest. In addition, in the hilly regions of north-east India, leaching of minerals by excess rainfall is a common phenomenon, so the soil and vegetation are deficient in micro and macro minerals. To achieve maximum productivity in free range or semi-intensive system, during flush season, tree fodders, shrubs, herbs, salt and mineral mixture, or mineral blocks may be fed to fulfil the nutrient requirement and avoid mineral deficiency. During lean season when forest grasses or foliage are scarce, concentrate mixture (14-16% CP and 70% TDN) fortified with salt and mineral mixture may be supplemented at the rate of 1-2 kg to Mithun <2 years and 2-4 kg >2 years or

recently calved Mithun (per animal on daily basis). Supplementation of minerals is very essential as they play an important role in health and reproduction. The free-range Mithuns may be fed with minerals or concentrates in a particular location in the forests, while under semi-intensive system, minerals may be provided in the sheds during late evening or early morning.

- **Health management to improve reproductive performance**

In the present scenario, foot-and-mouth disease (FMD) is the most important and a very common viral disease of mithun mainly caused by serotype 'O' of FMD virus. It is a fatal disease with high mortality rate and post-convalescence complications such as lameness, reduced reproductive efficiency, etc. FMD is a highly contagious disease of Mithun which can only be prevented by practising routine vaccination. The primary vaccination is done at the age of 4 months and above followed by booster after 2-4 weeks and then, twice yearly. Other common health problems of Mithun include tick and leech infestation which if not routinely controlled, may lead to anaemia and loss of body condition. The routine application of ectoparasiticides (dip or spray) like amitraz, deltamethrin, etc. is important for their control. The other less frequently recorded diseases of mithun which may directly or indirectly affect health and reproduction include infectious bovine rhinotracheitis (IBR), malignant catarrhal fever (MCF), brucellosis, black quarter, anthrax, tuberculosis, and paratuberculosis. Likewise, mithun herd should be regularly dewormed to check various gastrointestinal nematodes, and coccidian parasites, so that the health and in turn reproductive performance of mithun herd is not deteriorated. The involvement of infectious agents and parasites in mithun health indicates that strict prevention and control measures are important in reducing their impact on health.

- **Estrus Behavior and Estrus Detection in Mithun**

Mithun cows generally do not exhibit behavioural signs of estrus although the physiological signs of heat are present, therefore it is termed as *silent estrus* animal. The general pattern of sexual behaviour is almost similar to cattle and buffaloes but the intensity of expression of behavioural signs of estrus in Mithun is markedly less pronounced. The behavioural sign of heat such as bellowing is absent and estrus is therefore silent. In addition to this, the other behavioural signs of estrus such as mounting to fellow animals and standing to be mounted, restlessness may also be expressed in much-diminished intensity. In Mithun, estrus can be accurately detected by parading a teaser bull and also by close observation by a trained person during early morning and evening hours. The incidence of silent heat is found to be more in those herds which are under stress and are kept on a low plane of nutrition. If a grouping of cows has been made without considering the ranks of cows in the herd, this will

results in a decrease in efficiency of heat detection as the submissive cows may avoid mounting to dominant cows.

Estrus cycle and Estrus duration

The length of the estrus cycle as indicated by behavioural estrus and by plasma progesterone profile is in the range of 18 to 27 days. The estrus cycle in mithun cows starts only when the animal attains sexual maturity at age of 24-32 months. The average duration of estrus and standing estrus is 67.2 h and 10.5 h, respectively.

Estrus Behaviour

The expression of behavioural estrus in Mithun is not associated with prominent visible signs. The behavioural sign of heat such as bellowing is completely absent and the estrus is therefore silent. Among all the behavioural signs of estrus, the cow to be mounted by Mithun bull is the accurate indicator of estrus followed by standing to be mounted by the bull. The mounting by herd-mates or homosexual behaviour is very rarely visualized in Mithun cows. Congestion of the vulval mucous membrane and swelling of the vulva are also important signs of estrus in Mithun cows. Other signs like mucous discharge, restlessness, and alertness, tail raising, frequent urination, and loss of appetite are found to be less prominent estrus signs in Mithun cows. The uterine horns of Mithun cows during estrus will be tonic, os cervix will be relaxed and the ovaries will have palpable follicles. The uterine tone is usually observed in all Mithun cows at estrus as revealed by per rectal examination.

Estrus detection

The estrus detection is accurate when animals are watched carefully for heat symptoms for half an hour at least in the morning (5-6 AM) and evening (5-6 PM).

Why detect estrus?

- Detection of heat is important to know whether the animal is returning to heat or not after calving.
- It is also important to determine the exact time of AI.
- It is also important to reduce inter-calving intervals and to have a better calf crop.

The following methods are used for estrus detection in Mithun

Visual signs of estrus

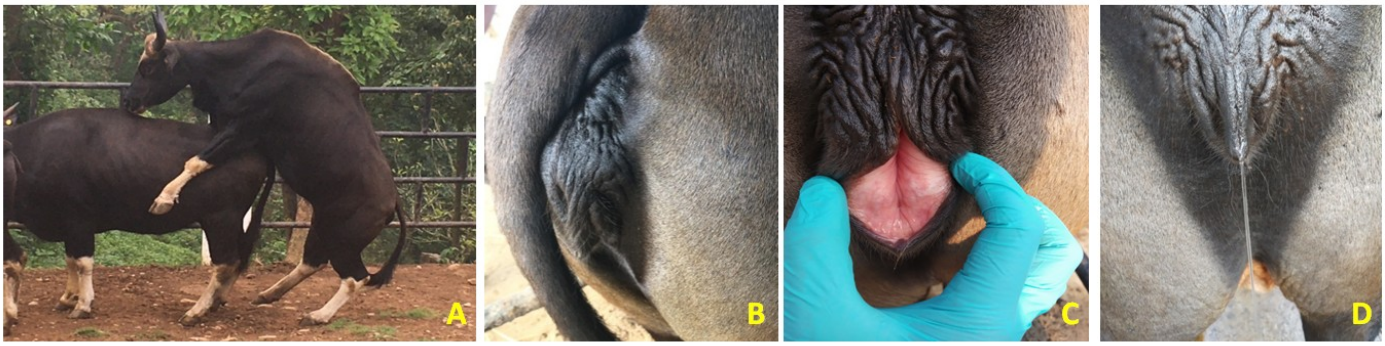
Primary estrus signs in Mithun cows

a. Mounting by Mithun bull or teaser bull: The cow to be mounted by Mithun bull or teaser bull is the best indicator of estrus.

b. Standing to be mounted: The cow in estrus will be standing to be mounted by a bull or teaser. The mounting by herd mates (homosexual) behaviour is very rarely visualized. After mounting she may have mud on her rump or sides due to mounting. Often bull calves in the herd attempt to mount cows.
c. Swollen vulva: Vulva will become slightly swollen, soft to touch, and glistening.
d. Vaginal congestion: The vaginal mucosa will be a bright pink colour with congestion and moist.
e. Mucous discharge from the vagina: The mucus discharge is seen in some Mithun hanging from the vulva which is thin, transparent, and elastic.
f. Tail raising: Observed during standing estrus.

Secondary estrus signs in Mithun cows

a. Mounting of herd mates: Mithun cows mount herd mates during the onset of estrus.
b. Watery mucous discharge: In early estrus occasionally the watery mucous drops from the vulva during defecation or when lying on the floor.
c. Frequent urination: It is not prominent in Mithun.
d. Restlessness and loss of appetite. The primary and secondary signs of estrus in Mithun cows are presented in Figure.



Primary and secondary signs of estrus (heat) in Mithun cows (A) Mounting by herd mate (cow), (B) Swollen vulva, (C) Congested vulval mucosa, (D) Transparent stringy mucus discharge.

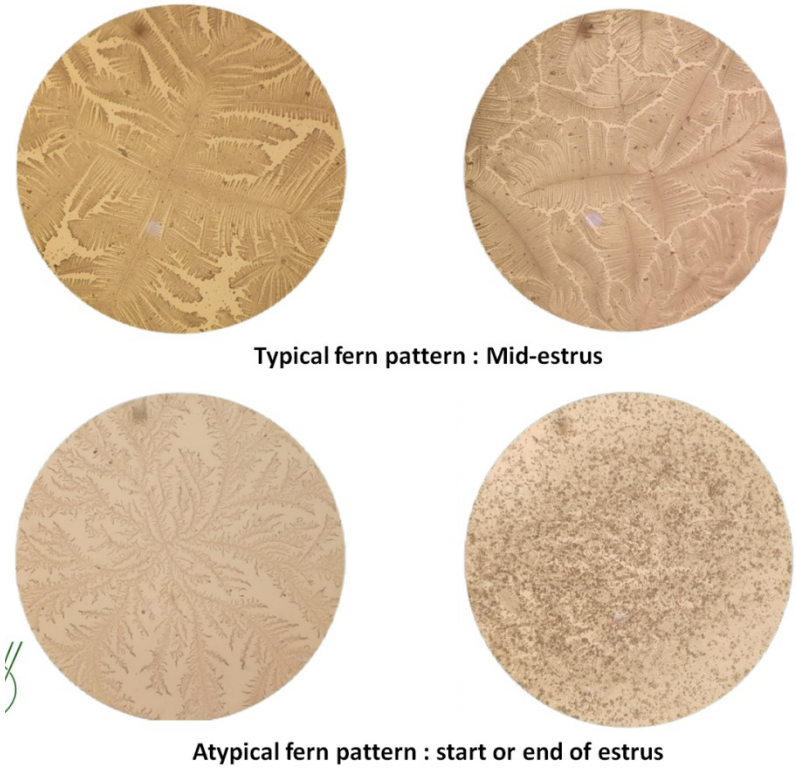
Teaser Mithun bull

Teaser Mithun bull parading in the morning and evening can accurately detect the estrus in Mithun cows. The efficiency of detection is higher when the teaser is left freely along with the cows in an open paddock (Figure).

Estrus detection by teaser bull (A) Flehman reaction and (B) Mounting estrus Mithun cow

Fern pattern of vaginal mucous

Take a drop of transparent, stingy, and elastic mucus and make a thin smear over a clean, dust-free glass slide and allow to dry the smear in the air. A characteristic fern-like pattern will be seen in the dried smear when observed under the magnifying lens (using crystoscope) or it may also be observed by naked eyes by seeing the slide against a black background (Fig. 3). The presence of a fern pattern in vaginal mucus is a sure sign of heat.



Fern pattern as visualized directly on the slide and (B) Fern pattern under microscope or crystoscope

- **Artificial Insemination (AI) in Mithun**

Artificial insemination (AI) is the technique in which semen is collected from the superior bulls and introduced into the female reproductive tract at the proper time with the help of instruments. Artificial insemination (AI) in Mithun is a high-potential assisted reproductive technology, which facilitates the propagation of elite germplasm. The major advantage of AI over natural service is that it facilitates rapid genetic improvement by allowing the use of elite bulls and control of venereal diseases. For AI, semen is most commonly collected using an artificial vagina from Mithun bulls. Electroejaculation is an alternative method used in bulls that fail to mount or are too fractious for easy handling.

Advantage of AI

1. Maximum utilization of superior males. Through natural mating, a bull can mate to 100 – 150 cows whereas, in AI, a bull can inseminate about 1500 – 2000 cows.
2. Genetic improvement of a herd by insemination using superior bulls.
3. Reduces the incidence of sexually transmitted diseases.
4. Overall growth rate and productivity of the herd will improve.

An ideal time for AI in Mithun

The estrus period in Mithun has a wide range of 36 h to 72 h, as a thumb rule, animals coming in heat in the morning should be inseminated in the next morning and those coming in heat in the evening should be inseminated in the next evening. Ideally, animals should be inseminated 24 hrs after the onset of heat symptoms at least two times at an interval of 12 hrs apart.

The procedure of AI in Mithun

In Mithun, the best method of insemination is the “Recto vaginal method of insemination”

- The Mithun in heat will be restrained in the Travis.
- The inseminator will get ready by wearing a plastic apron and gloves.
- The frozen semen straw after thawing (keeping the semen straw in 37 ^{0}C water for a minute to convert frozen semen into liquid) is loaded in a sterilized AI gun covered with a plastic sheath.
- The vulval region of the animal should be sterilized using the potassium permanganate disinfectant (1:1000) and wipe dry with a paper towel.
- The inseminator will insert the lubricated gloved hand into the rectum and back rack the animal to remove the dung, the hand will be further extended to catch hold the cervix through the rectal wall.
- The AI gun loaded with semen straw is passed through the vulva to ‘vagina and cervix and observed with the hand in the rectum that the AI gun reaches the cervix, then the

semen is deposited by injecting the gun, and after depositing the semen the gun is removed, the empty straw and sheath are discarded.

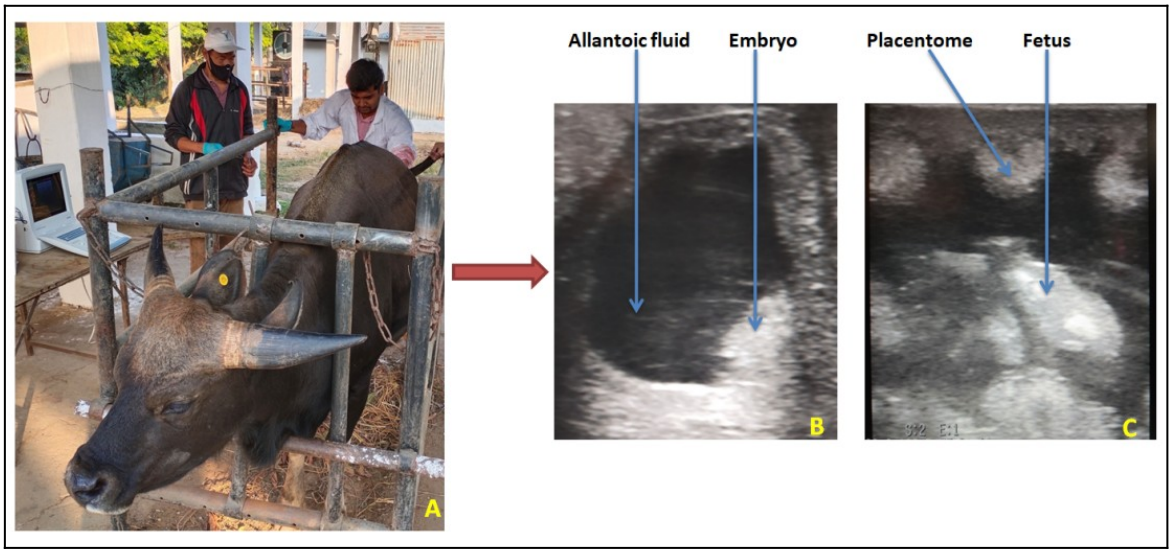
Estrous Synchronization and Fixed Time AI (FTAI) in Mithun

Synchronization of estrus has the potential to shorten the calving season, increase calf uniformity, and enhance the possibilities for using AI. The primary obstacle in synchronizing estrus and achieving optimum pregnancy rates in suckled Mithun cows is overcoming postpartum anestrus. Numerous estrous synchronization protocols using PGF2α, GnRH, and/or progestin have been developed that induce cyclicity and successfully synchronize estrus in cattle. To further enhance the use of estrous synchronization, the protocols need to limit time and labour, which can be achieved by using protocols that minimize or eliminate the detection of estrus by employing fixed-time AI (FTAI). The development of FTAI protocols that eliminates estrus detection is an attractive reproductive management tool. One of the limiting factors in the application of artificial insemination (AI) in Mithun is the difficulty in estrus detection. A small number of females exhibit estrus behaviour, the signs of estrus are discrete, and it occurs mainly at night. Therefore, the use of hormonal protocols associated with FTAI makes a reproduction in these animals more advantageous and practical, especially during seasonal anestrus. FTAI is also convenient from the farm management point as we can plan the calving according to the availability of green fodder and favourable season. Co-synch protocol is used for estrus synchronization of Mithun cows and heifers after at least 65 days of parturition in pluriparous animals and after attaining maturity (>24 to 30 months) in case of heifers. In the Co-synch protocol (PGF2α is administered 7 d after GnRH followed by a second GnRH injection and FTAI at 48 h).

Artificial Insemination (AI) in Mithun

- **Pregnancy diagnosis in Mithun**

Accurate pregnancy diagnosis is an important part of reproductive management. The early pregnancy diagnosis is a key to shorten the calving interval, so that the non-pregnant animals can be identified early and re-bred in next estrus. Various methods are available for pregnancy diagnosis in Mithun. The non return to estrus, rectal palpation of reproductive tract and ultrasound scanning (Figure) are the commonly used methods of PD in Mithun.



Pregnancy diagnosis is Mithun by ultrasound scanning (A) - Insertion of trans-rectal linear probe (7.5MHz), (B) - Day 35 of pregnancy, (C) - Day 110 of pregnancy.

- **Management of male fertility**

The role of the male should not be forgotten, as "*Bull supplies half of the genetics to all the cows he sire*". The well built Mithun bull with larger testes produces more volume of high quality semen. Furthermore, Mithun bulls with larger testes produce progenies which attain early puberty and are more fertile. In a free-range system, as natural service is followed, the male should be of high genetic merit. Any male Mithun which fails to impregnate females should be

culled immediately. In scientific Mithun rearing where the AI is followed, success depends on the deposition of appropriate number of sperm with good fertilizing capacity at the appropriate site in the reproductive tract at the appropriate time of ovulation. The fertility potential of an AI dose is a function of the quantity, quality, and health status of the semen present therein. In a nutshell, use of semen from Mithun males with proven fertility is the most important thing to be considered.

Semen Collection in Mithun

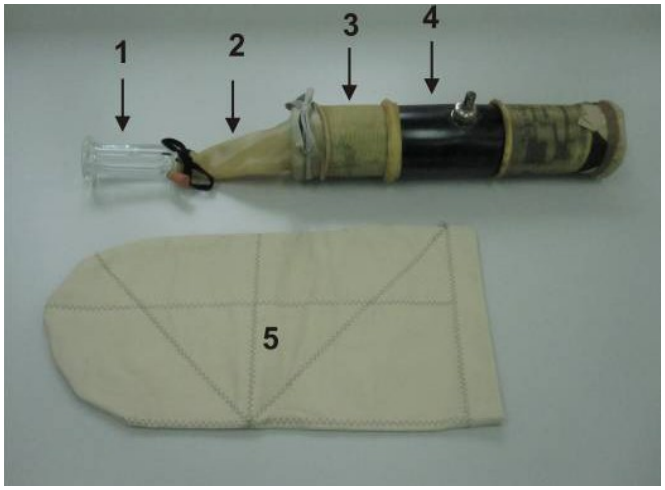
Mithun breeds naturally under the free-range system, very shy, and usually do not exhibit reproductive and mounting behaviour under the semi-intensive system. Similarly, Mithun cows also do not exhibit a prominent sign of standing estrus. Initially, Mithun semen was collected by rectal massage technique. In this method, seminal vesicles are massaged centrally and backwardly for 5 min followed by the gentle milking of ampullae one by one for 3-5 min, which results in erection and ejaculation. During collection, the initial transparent secretions are discarded and neat semen drops are collected in a graduated test tube with the help of a funnel. The massage method does not yield the optimum quality of semen in terms of volume, sperm concentration, motility, and freezability of semen. It consists of a large number of dead and damaged spermatozoa.

Mithun bulls can also be trained for mounting over the dummy (estrus Mithun cows or non-estrus cows with a sprinkling of estrus female urine). ICAR-National Research Centre on Mithun standardized the technique of bull training for the collection of semen and freezing. However, it is very difficult to train the bull for mounting over dummy and semen collection by the AV method. It is even more difficult for older bulls and bulls with poor libido. Therefore, for semen collection electro-ejaculation is the better alternative for germplasm conservation. Through electro-ejaculation, semen can be collected from older bulls, bulls with poor libido, and bulls reared under a free-range forest ecosystem. Electro ejaculation is particularly suited for captive species and an estrous female is not required to stimulate ejaculation. It is regularly used in bulls and rams without sedation or anaesthesia.

Electro ejaculation is of great value by providing a means of extending the use of valuable sires and also for routine estimation of the fertility of bulls. This technique also gives access to Mithun bulls reared under a free-range system. It saves the time and labour needed to train the bull to an artificial vagina and eliminates the risk to the operator and his assistants. These factors, coupled with advances in electronics, have enabled the development and wider usage

of the electro ejaculator, which is giving satisfactory and reliable results with no undesirable side effects.

The choice of collection method depends on the circumstances, bull response, bull behaviour, and technician confidence. Electroejaculation and Artificial Vagina are the methods most often used for semen collection in free-range or semi-intensive animals.



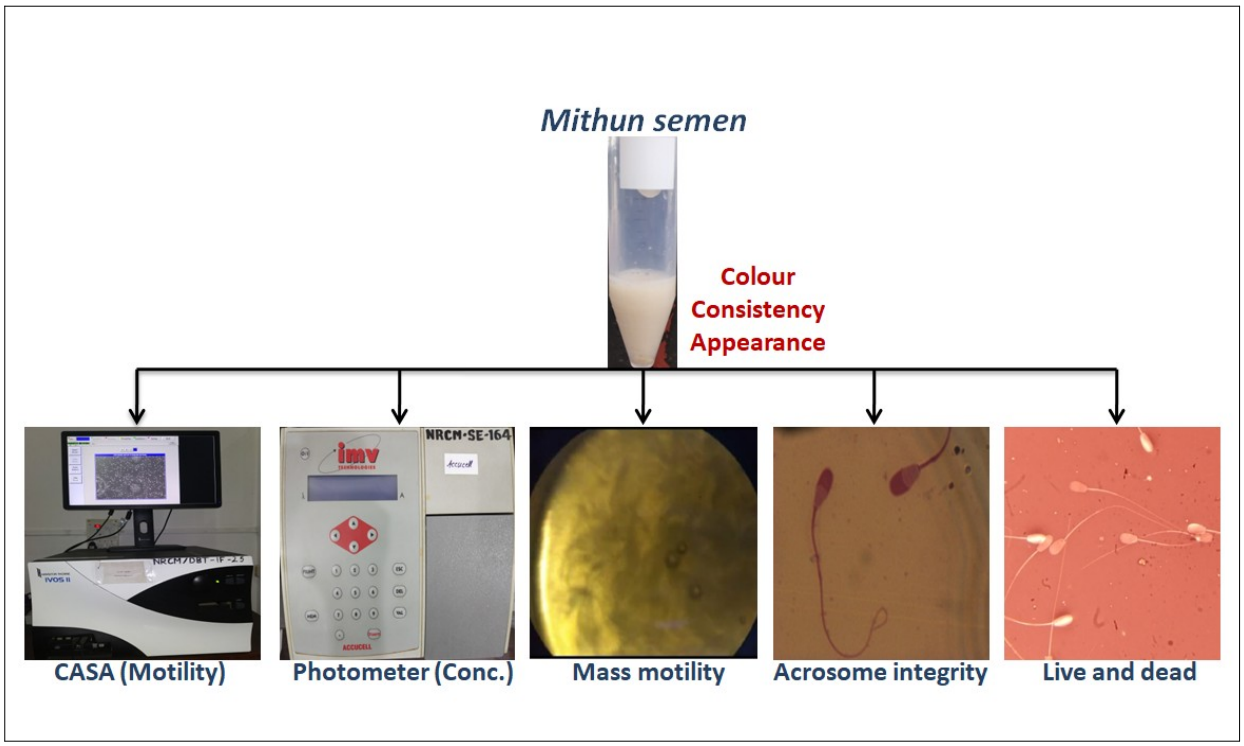
Parts of Artificial Vagina (AV), (B) Assembled AV – 1. Graduated semen collection vial inside the case, 2. Rubber cone, 3. Inner rubber liner, 4. Outer rubber cylinder, 5. Insulating bag

Collection of semen through massage and electro-ejaculation method in Mithun

Semen evaluation

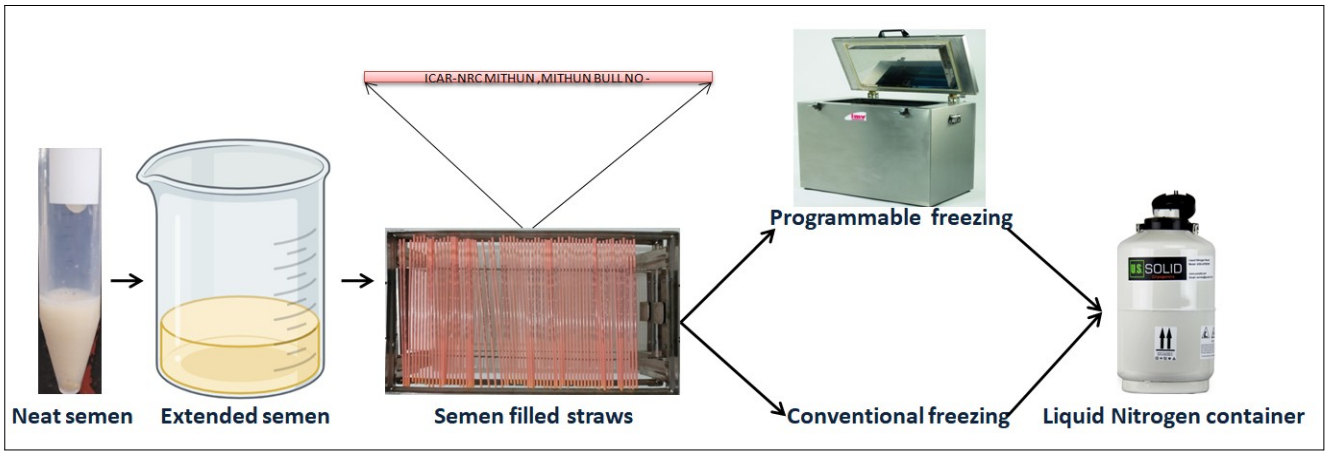
- Mithun semen is collected from the young, fertile bull by AV (Artificial Vagina) or electro-ejaculation method.
- Just after collection, semen is brought to the laboratory at 35 °C for evaluation (Fig. 8).
- Semen volume, pH, sperm concentration, mass motility, individual motility, live sperm count, abnormal sperm percentage are checked (Table 2).

- Semen samples that meet the standard criteria are frozen and can be kept for several years inside liquid nitrogen without any change in fertility and utilized for AI.



Cryopreservation of Mithun semen

- The tube containing the freshly collected semen is recorded for volume, initially diluted in a 1:1 ratio with an extender placed in the thermos (37 °C) before transferring to the laboratory in a thermos. The collection tube remains capped until processed.
- The 1:1 diluted semen is kept in a thermo-controlled water bath at 35 °C under Laminar Air Flow Unit.
- After examination of sperm concentration and initial motility, the semen is diluted further (final sperm concentration of 80 million/mL) after 7 minutes of cooling at 20 °C with extender maintained at the lab temperature.
- Filling and sealing of semen into sterile straws is done under Laminar Air Flow Unit. The filling nozzles and rubber tubing used are always fresh.
- The freezing is carried out as per the above-described protocols using a biological freezer or conventional freezer. Figure 2 represents the processing and cryopreservation of Mithun semen



- **Record Keeping**

One of the key components of any scientific management is proper record-keeping and analysis. Accurate record-keeping can guide the Mithun farmers, veterinarians, and consultants to make a better decision regarding the herd management. The records should be regularly analysed to know the herd performance in the past and what is needed in the future by using method of selection and culling animals. Furthermore, it helps to know the health, deworming and vaccination status, inter-calving intervals, non pregnant animals, reproductive problems, and male

- **Conclusion**

In their native hilly terrains, Mithuns roam freely in small groups; while individual bulls mostly remain solitary. However, in recent years a number of factors like deforestation, urbanization, and cross-breeding with cattle are supposed to have limiting factors towards Mithun population growth. The age-old tradition of sacrificing the best bull of the herd is another major hurdle for genetic improvement of Mithun population, breeding naturally in their remote locations. Further, various human activities like shifting cultivation, construction works, commercialized cropping are also largely responsible for the shrinking habitat of Mithun. The small and scattered population of Mithun herd is having the risk of increased rate of inbreeding within the populations and various reproductive problems in Mithun cows including infertility. The new developments in the form of semi-intensive Mithun rearing should be adopted which will promote improved breeding, feeding and reproductive performance of the Mithun herd in the future.

Restraining Techniques and Identification of Mithun

Dr Kobu Khate, Ph D (LPM)
Chief Technical Officer & Farm In-charge.

Mithun (Bos frontalis) is reared by the tribal people in the Northeast Hill Region of India since time immemorial under extensive farming system. Some people wrongly claimed that Mithun is not yet domesticated for a simple reason that they live all of their lives under wild habitat of forest ecosystem. As farmers continue to rear Mithun in natural dense forest, contact between farmers and Mithun is still very less resulted in restraining a major challenge. Restraint animals are relatively easy to handle for various examinations, treatment, vaccination and surgical intervention and over the time adapted to close human contact.

Purposes of handling the animals.

A person who is confident and willing to work with the animals can only do the best job in handling the animals for various purposes. Restraining of farm animals become urgently required for routine examination, administration of medicines and vaccines, carrying out of operations etc. The basic purpose of animal handling is to avoid getting animal overexcited and thus maintaining safety of the handler.

Three essential elements for approaching livestock.

Although the area of animal behaviour and control is quite vast, animal health worker must be well conversant with the following three essential elements of animal behaviour and control viz. flight zone, blind spot and point of balance.

Flight zone

All animals have a flight zone which is the animal's "personal space". It is the space in which the animal feels comfortable. It is the minimum distance the animal tries to maintain between itself and any perceived threat. The size of the flight zone varies depending on how calm or aggressive the animal is. Animals confined to a small space have a smaller flight zone than kept in a large area. The size of the flight zone slowly diminishes when animals receive frequent gentle handling. Mithun being kept under extensive farming system have bigger flight zone than cattle and buffalo. An understanding of the flight zone of the animal can help the handlers to reduce stress and prevent accidents.

Blind spot

It is necessary to remember that the area immediately behind the tail of the animals extending up to 15° on either side (i.e. total 30°) is treated as the "blind spot", where the animal cannot notice the handler. An efficient handler never approaches the animal in the area of blind spot as it may get frightened and cause injury to the handler.

Point of balance

This is another important concept of livestock handling. Far backwards. But if the handler stays in the rear portion, the animal moves in the forward direction.m animals have a wide angle of vision. Point of balance is the imaginary point located on the animal's shoulder which divides the animal's body into two portions, i.e. front portion and rear portion. If the handler crosses this hypothetical point in the direction of front portion, the animal generally moves backwards. But if the handler stays in the rear portion, the animal moves in the forward direction.

Restraining techniques

Halter

A rope halter is used to restrain the head of jugular venipuncture or other procedures of the head or neck. The halter of a moderately long rope with an eye slice on one end with a second eye splice located approximately ten inches from the same end. The opposite end of the rope is passed through the end splice first and then through the remaining eye splice.

Figure: Correct placement of a halter.

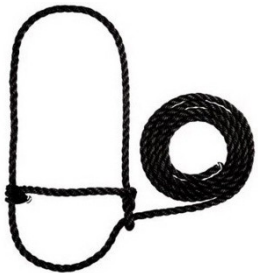


Figure: Rope slides through eye splices

Passing the free end of the rope through the eye splices results in a circle with a section of constant length bisecting the circle. The section of rope of a constant length should cross the bridge of the nose with the lead extending from under the left side of the chin.

Reuf Method

It is the most common and efficient method of casting the large animals. For this method, around 30 feet of rope is required to carry out the following steps for casting: Make a loop around the animal's neck using a bowline knot placed as indicated in the pictures. Throw the end of the rope over animal's back to the opposite side.

Figure: Reuf method

Pick the rope from under the animal, bring it around its body and near the bowline to form a half hitch just behind the shoulder. By tossing the end over the animal's back, make another half hitch just in front of the udder or scrotum in case of male cattle. Gently pull the rope to cast the animal. Practical demonstration will be shown to the trainees during the practical class at Mithun farm.

Burley method of casting (Running "W")

In this method, the rope is divided into two equal parts. The middle portion of the rope is placed on the upper side of the animal's neck and free ends of the rope are crossed under the neck. Then both the free ends of the rope pass between the front legs in backward direction on either side of the animal. Each free end of the rope then crosses over the back of the animal and subsequently passes through the area between the udder or scrotum (in case of males) and hind legs. When the rope is pulled in the backward direction, the animal is cast to the ground. Trainees will be shown with practical demonstration during the practical classes.

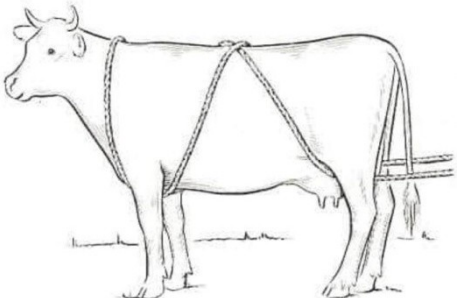


Figure: Burley method of casting

Tool for restraining of animals

Trevis:

Trevis is used for handling of animals for longer duration. It is a fixed structure constructed with steel pipes.

Methods of identification.

Body marking and identification of individual animal is important not only for identification but for maintaining of their performance record. Record keeping helps the farmers to take decision on each animal in the farm. Record in the farm includes health, reproduction and breeding, growth, feeding, treatment etc. Farmers especially those Mithun keepers often face ownership conflict due to improper and non maintenance of their animal's numbering. The followings are some of the major identification methods used in the organised farming.

- Ear tagging 2. Chips implantation 3. Ear notching 4. Hot and cold branding

Ear tagging

This method requires ear tag and applicator. Ears tags are available in various shapes, size and colour. Tags are Plastic or metal object used for identification of livestock and other animals. If the ear tag uses Radio Frequency Identification Device (RFID) technology, it is called Electronic ear tag.

Microchips

Microchips are implanted just under the skin, usually right side between the shoulder blades. This is done with a large-bore needle and doesn't require anaesthesia. Each microchip contains a unique identification number and there is a device or reader which can detect the chips' number when brought near to the designated area.

Figure: Microchip

Figure: Reader

Figure: Needle

Ear Notching.

Ear notching is a very old traditional method of identification in livestock in which animals are identified based on their notched marks in the ear.

Figure: Animal with ear notching marks

Figure: Ear notcher tool

VACCINATION OF IMPORTANT LIVESTOCK SPECIES

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Introduction

North-Eastern states are largely agrarian and raise normally small unit of animals at their backyard. Animal husbandry is an integral part of their livelihood and culture of this region. They rear several different kinds of livestock for their livelihood; to speak about few are cattle, buffalo, sheep goat, pigs, yak and Mithun. Highest consumption of meat especially pork is seen in NE India.

Animals, suffer from a range of infectious diseases causing serious loss if proper management, timely treatment and immunization are not followed. Prevention of such disease by creating immunity in the animal is usually achieved by vaccination. Young animals receive some immunity from their mothers both via the placenta and, principally, in the first milk (known as colostrum) from Maternally Derived Antibodies (MDA) which are highest in the colostrum for first three days of birth. Because this immunity is not actively produced by the young animal, it declines over time. Hence, regular vaccination schedule is to be carried out to prevent infectious diseases.

Vaccine &Vaccination

An antigen (a virus or a bacterium or its component), when injected or administered orally in an animal produces antibody and thereby makes the individual resistant or immune against particular disease. Vaccination is the administration of the vaccine to produce immunity to a disease. In other word it is the process of conferring increased resistance (or disease susceptibility) to infection.

Objective of Vaccination

Vaccination is done to generate herd resistance so that death and other risks due to viral or bacterial diseases can be minimized. Vaccination is considered to be one of the most effective methods of keeping several infectious and contagious diseases away.

Benefits of Vaccination

- Reduces susceptibility to infection.
- Decreases contamination of environment.
- Decreases risk of human infections.

- Strengthens immunity and protecting the body from fatal diseases.
- Best means of prevention of diseases
- Reduces expenditure on treatment.
- Maintains biosecurity in the premises.

Factors influencing Immune Response to Vaccination

1. **Age**- Presence of maternal antibodies can inhibit the immune process of vaccination in newborns. Weak immune system in adult animals.
2. **Immunodeficiency**- Animals become non-responsive.
3. **Genetic factors**- The immune response to the same antigen can be low or high depending upon the genetic makeup of animals.
4. **Nutritional status-** Malnutrition can be responsible for a relative deficiency of cellular immunity.
5. **Chronic illness**- May result in different immune response.
6. **Dose and administration route**- Specific administration route at a specific dose should be strictly followed.
7. **Maintenance of cold chain**- Vaccination failure is apparent if not maintained.

Guidelines for Vaccination

- Deworm animals prior to vaccination
- Healthy animals should be vaccinated
- Use of sterile syringes every time
- Administer after adopting usual aseptic precaution
- Vaccine should be stored at recommended temperature (Approx 4°C)
- A comfortable environment must be provided
- Vaccination within one month of anticipated breeding date may be avoided.
- New born or young pets should not be vaccinated since these animals usually carry passive antibody.
- Sick animal should not be vaccinated, but in some case attenuated vaccine can be used at the time of outbreak.
- Animals participating in show or fair must be vaccinated against the prevailing disease in the area at least 2-3 months prior to movement.

Vaccination schedule for Cattle and Buffaloes

Disease	Age	Dose	Booster	Interval	Season
Foot and Mouth disease	6 – 8 wks	10 ml S/c	6,9 or 12 months	Annual	Preferably November, December
Anthrax	All ages	1 ml S/c	6 months	Annual	Preferably on Feb/March/April/May
Black Quarter	All ages	5 ml S/c	6 months	Annual	All season in endemic areas.
Haemorrhagic Septicaemia.	All ages	3 ml I/m	6 months	Annual	Preferably in May/June.
Theileriosis	12 wks	3 ml	3 months	Annual	Tick endemic

		S/c			areas

Vaccination schedule for Mithun:

Disease	**Dose**	**Primary vaccination**	**Booster**	**revaccination**
Foot and Mouth disease	3ml s/c	4 months	2-4 weeks after first	Every 6 month
HS & BQ	3ml s/c	6 month and above		Annual

Vaccination schedule for Goats:

Disease	**Kids (above 6 months)**	**Adult Goat**	**Months**
Contagious Caprine Pleuropneumonia (C.C.P.P)	0.2 ml I/dermal	0.2 ml I/dermal	January
Haemorrhagic Septicaemia (H.S)	2.5 ml S/c	5 ml S/c	March
Goat pox	3 ml S/c	3 ml S/c	December/ March
Enterotoxaemia	Scratch method	Scratch method	April
F.M.D	2.5 ml S/c	5 ml S/c	May
Black Quarter	1 ml S/c	1 ml S/c	June
Enterotoxaemia	0.5 ml S/c	5 ml S/c	August
PPR	1 ml S/c	1 ml S/c	Before monsoon

Vaccination schedule for Sheep:

Disease	**Age/Dose**	**Booster**	**Interval**	**Season**
Foot and Mouth Disease	At 3 months (5 ml S/c)		Annual	Winter/Autumn
Black disease	Lamb (2 ml S/c)		Annual	All seasons
Lamb dysentery	Lamb (2 ml S/c)		Annual	All seasons
Black Quarter	Lamb Adult (2 ml S/c, 3 ml S/c)		Annual	All seasons preferably May/June
Enterotoxaemia	Lamb Adult (2.5 to 5 ml S/c)	7 – 10 days	Annual	Lambing season
Haemorrhagic Septicaemia	Adult (2 ml S/c)		Annual	March/June
Sheep pox	Lamb	at 6 months	annually	December/

	Sheep (3 ml S/c)			March
Lung worm	3 months age (1000 larvae first dose)	One month later 2000 larvae		

Vaccination schedule for Pig:

Disease	Type of Vaccine	Age at first vaccination	Booster/Re-vaccination
Swine fever	Inactivated virus vaccine	8 weeks	6 months interval & revaccination once in a year (I/m or S/c)
Swine erysipelas	Swine erysipelas vaccine (Alum treated vaccine)	3-4 weeks	repeat 3-6 weeks later and then every 6-9 months 1ml s/c
FMD	Raksha FMD Vaccine	4-8 wks	Booster 3wks after the primary and revaccination after every 6 months.
Haemorrhagic Septicaemia	Raksha-H.S. vaccine	2 months	Booster One month after the 1st vaccine and Annually

Prevention and control measures for ASF

Vaccines or drugs are under research to prevent or treat ASF infection. Intensive surveillance, epidemiological investigation, tracing and stamping out of infected herds can only prevent and control ASF combined with strict quarantine, biosecurity measures and animal movement control.

Other measures to be adopted in the livestock farms

- Surveillance
- Quarantine and movement control
- Biosecurity
- Zoning
- Stamping out and disposal
- Cleaning and disinfection
- Public awareness

Conclusion:

Animal production units should create an environment that is optimal for the animal and hostile for disease-causing agents. Prevention is obviously better than cure, and having a herd health plan will help to minimize disease incidence. Controlling and eradicating of these diseases is based on transparency and trust, and should be strengthened at every opportunity

at both regional and sub-regional level. The mortality in the livestock sector can be greatly reduced with timely mass vaccination and de-worming. Improved bio-security and hygiene at farm level are essential in controlling zoonotic diseases. The success of prevention and control largely depends on the good functioning of veterinary services, which need to be thoroughly prepared for crisis situations.

Care at and after calving

L. Sunitibala Devi, S. S. Hanah, Vikram R, J. K. Chanuah

Care and management of pregnant animals

The good care and management practices given to pregnant animal will ultimately results in healthy calf and also high milk yield during the successive lactation. Therefore, we need to take appropriate measures in order to succeed the management of our animals. Given below are some of the important steps which should be followed by our livestock rearer:

- Extra concentrate feeds should be provided for pregnant animal along with feeding of good quality leguminous fodder.
- The animal should not be not - lean - not fat in condition.
- Always provide clean drinking water and protection from thermal stress
- Do not allow them to mix with other animals that have aborted or that are suffering from or carriers of diseases like brucellosis
- Do not allow them to fight with other animals and take care that they are not chased by dogs and other animals.
- Provide always free access to drinking water.
- We should avoid slippery flooring conditions which may lead to fall of animal, fractures and other injuries.
- Separate the pregnant female from rest of the herd by 1-2 weeks before the expected date of calving.
- We should feed extra 1 kg concentrates during the last 2 months of gestation
- Always keep an eye on the animal for symptoms of delivery in order to identify any difficulty face by the animal. If any difficulty, then contact a veterinarian immediately.

Care and management of calving animals

Calving is a natural process which normally takes place without any help. However, close observation is required in case the cow has difficulties. Cows calving for the first time (heifers) tend to have more problems than older cows and therefore need more attention when calving.

Signs of calving

By observing some of the signs we will know that the cow is about to calve or give birth. Signs includes:

9. The increased in size of belly, especially on the right flank of animal.
10. The udder is enlarge and the teats are stiffening.
11. Red and swollen vulva with the presence of mucous and blood coloured fluid.
12. The animal become restless
13. The appearance of water bag at the vulva.

Signs of normal calving

- The water bag appears through the vulva.
- The cow will strain more.
- The head of the calf will appear and this breaks the bag.
- You will then be able to see both of the calf's front feet.
- It takes 4 - 6 hours for the calving to reach this stage.
- In heifers, it might take longer.

During the process of normal calving we can able to see that once the chest of calf comes through the vagina the calf starts to breathe. It is better to leave the cow alone to give birth naturally. However, if you want to help with the calving you can gently pull the calf by its feet. If the navel cord is still attached to the cow you can cut it with a clean sharp knife or a pair of scissors, then put tincture of iodine or alcohol on the end of the navel cord. This will help in preventing entry of any infectious agents through navel cord. Sometimes the back feet of the calf appear first. You will see that the back feet come out from the vulva with the soles of the feet showing uppermost. You should then look (or feel with your hands) for the tail and the hock joints

Difficulties in calving

During the process of calving if any difficulties arise like only the head of the calf has appeared or head and one foot has come out or two front feet showing but no head then immediately ask for help of a veterinarian.

Steps for helping a cow having difficulties in calving

e. You will need a bar of soap, hot water, a clean rope and clean vegetable oil such as olive or sunflower oil which will act as lubricant.
f. Wash the area around the vulva and wash your hands well before inserting into vagina.
g. Make sure that your fingernails are cut short and are thoroughly clean. Long nails can injure the animal.
h. If you have oil put some over your hand and arm, if not, soap your hand and insert it into the vagina to discover what is wrong.
i. You will need to recognize the difference between the front and back legs of the calf in the womb.
j. Touch the fetlock joint and then run your hand up the leg to the next joint. There will be a knee joint on the front leg and a hock on the back leg.
k. Push the calf either to one side or back into the uterus so that you can correct the situation and move the head and legs into the right place for birth.
l. When the calf's head and legs are in the correct position tie a clean rope around both feet.
m. Pull gently on the rope. You may need someone to help you pull.
n. Sometimes the water bag will burst but neither the feet nor the head will have appeared. This is a very difficult position to sort out and if you can you should immediately ask your veterinarian for help.

Caring for the cow after Calving

- Give the cow clean water to drink immediately after she has calved as she will be thirsty.
- The placenta (afterbirth) will come out naturally but you can help to remove it by gently pulling it.
- The placenta should have come away by 24 hours after the birth.
- If the placenta remains in the uterus it will cause an infection and you will need to get your veterinarian to help.

Caring for the newborn calf

- Always handle the calf carefully. Clean the mucous (sticky fluid) in and around the nose and mouth and check that the calf is breathing normally. If it is not breathing you must act immediately by:
    - Pump the chest with the palm of your hand.
    - Keep the calf's head lower than its back.
    - Insert a straw into its nose in an attempt to make it sneeze and start breathing
- Allow the calf to suckle from its mother as soon as possible so that it takes in the colostrum, the yellowish milk which is produced immediately after birth. The colostrum is rich in protein and protects the calf against disease.
- Some people use the colostrum for their food but it is essential to make the calf strong and healthy and should be left for the calf.
- You must allow the calf to take colostrum for at least four days after its birth.

Care and management of calf

L Sunitibala Devi, S. S. Hanah, Vikram R, J. K. Chamuah

Survival of neonatal calf is imperative for livestock propagation. The care and management of the calf should be start when the dam is conceived. The performance of the calf is a good indicator that reflects the management system adopted by the farmers or the herdsman from conceiving to calving. Calf morbidity and mortality represent an irrefutable and irrecoverable financial and genetic loss to the dairy industry. The future of any dairy farm depends on the successful raising of calves whether it is orphan or normal calves as they are the future replacement stock.

We must give good feeding and management for the calves so that they develop well and, useful for replacement stock. The feeding and care of the calf being before its birth. The dam should be dried 6-8 weeks before expected calving and should be fed well. Under fed animals will give weak and small calves.

A) Early Management:

14. Immediately after birth remove any mucous or phlegm from those nose and mouth.
15. Normally the cow licks the calf immediately the birth. This helps' dry off the calf and helps in stimulating breathing and circulation. When the cows does not lick or in cold climate, rub and dry the calf with a dry cloth or gunny bag. Provide artificial respiration by compression and relaxing the chest with hands.
16. The Naval should be tied about 2-5 cm away from the body and cut 1cm below the ligature and apply Tr. Iodine or boric acid or any antibiotic.
17. Remove the wet bedding from the pen and keep the stall very clean and dry in condition.
18. The weight of the calf should be recorded.
19. Wash the cow's udder and teats preferably with chlorine solution and dry.
20. Allow the calf to suckle the first milk of the mother i.e. Colostrums.
21. The calf will be standing and attempts to nurse within one hour. Otherwise help too weak calves.

B) Feeding of calves:

- Feed colostrums i.e. the first milk of the cow for the first 3 days. The colostrums is thick and viscous. It contains higher proportions of Vitamin A Care and management of dairy animal 53 and proteins. The proteins are immune globulin which gives protection against many diseases. Colostrums contains anti trypsin which avoid digestion of immunoglobulin in the stomach and is absorbed as it is.
- Whole milk should be given after 3 days it is better to teach to, drink the milk from the pail or bucket. Feed twice a day which should be warmed to body temperature. For weak calves feed thrice a day.
- The limit of liquid milk feeding is 10 % of its body weight with a maximum of 5-6 liters per day and continue liquid milk feeding for 6 to 10 weeks. Over feeding causes 'Calf Scours'.
- The milk replaces can be given to replace whole milk.
- Give calf starter after one month of age.
- Provide good quality green fodder and hay from 4th month afterwards.
- Feeding of antibiotics to calves improves appetite, increases growth rate and prevents calf scours. E.g. aureomycin, Terramycin etc

MANAGEMENT PRACTICES

- Identity the calf by tattooing or tagging or ear notching in the ear at birth, and branding after one year (not practiced in mithun).
- Deworm the calf regularly to remove worms using deworming drugs. Deworm at 30 days interval.
- Fresh water should be given from 2 -3 week onwards.
- House the calves in individual calf pens for 3 months afterwards in groups. After six months males and females calves should be housed separately.
- Weigh the calves at weekly interval upto 6 months arid at monthly interval afterwards to know the growth rate.
- Mortality in calves is more in first month due to pneumonia, diarrhea (calf scous) and worms.
- House them under warm condition, clean condition to avoid above condition.
- Extra teats beyond 4 should be removed at 1-2 months of age.

- 8-9 weeks of age, males should be castrated.
- Keep the body clean and dry to avoid fungal infection.
- Mineral-blocks should be provided, so that the calves lick and no changes for mineral deficiency.
- Wean the calf from the mother and feed through pail feeding system.

Milk Feeding Schedule: Care must be taken not to over and underfeed the calves especially during the first three weeks of life, otherwise diarrhoea may result. The farmers can follow the given schedule.

0-3 days	Colostrum (1/10th of body weight)
4-28 days	Whole milk Colostrum (1/10th of body weight)
29-42 days	Whole milk Colostrum (1/15th of body weight)
43-56 days	Whole milk Colostrum (1/25th of body weight)
57-65 days	Whole milk Colostrum (1/25th of body weight)

Feeding of starter

Calf starter is a mixture consisting of ground farm grains, protein feeds and minerals, vitamins and antibiotics. After a calf attains the age of 2 weeks the amount of whole milk given to it may be cut down. One should then rub a small amount of starter on the calf's mouth, after each milk feeding for a few days until the calf accustomed to it. When they reach four months of age, one should then transfer the calves to a "growing" grain ration.

Water

Feeding of milk does not provide enough fluid or the liquid that is required by the body system. Therefore, fresh, cool and clean water should be available at all times which will help to keep calves healthy. Calves will begin to drink water when they are about a week old.

Solid Feeds: Grass and Pellets

Milk is a highly digestible energy source with the correct balance of protein, vitamins, and minerals required for the first weeks of life. To ensure continued normal growth, this balance must be maintained during weaning from milk and the transition to solid feed. The calf should have access to hay and concentrates from one week onwards to stimulate the rumen activity. The rumen is usually functioning well by 10–12 weeks of age. Adding a rumen modifier such as Rumensin® to grain mixes will assist rumen activity and also help to prevent coccidiosis. Concentrates can be introduced by placing a small amount in the milking bucket

after the milk is fed. As the calf finishes drinking, rub a little concentrate on its muzzle to encourage the calf to taste it. By three weeks of age, a calf should be able to digest small amounts of grain.

Roughage for the young calf

The young calves start nibbling the roughage in 2nd of life if provided, it help in rumen development.

o. Fine stemmed leafy leguminous hay is the best roughage for the young calf. Hay can be offered from two weeks of age onwards.
p. Sun-cured hay which possesses a fresh green colour is a good source of Vitamins A and D as well as B-complex vitamins.
q. Silage can be given additionally in small quantities at 6 to 8 weeks onwards. Feeding of silage too early will cause scours.

Care of Joint ill

r. This is caused by the infection entering from infant's navel. Any bugs picked up by the navel will be transferred to the liver and then distributed around the body in the blood stream. Signs and symptoms of an infection appear at about 2 to 4 weeks of age. Generally infected calves are lethargic, have an elevated temperature. They hesitate to move. A joint or joints (mainly knee joints) will become swollen, and hot. Treatment should be giving as soon as possible with a long course of antibiotics.

Scours

s. Generally, there are two causes of scours in calves, nutritional and infectious. Nutritional scours includes lack of colostrum, overfed of milk or too concentrated/ diluted/ inadequately mixed milk, incorrect milk temperature being fed or irregular feeding times whereas infectious scours include viruses (rotavirus and coronavirus), bacteria (salmonella and *E. coli*), and protozoa (coccidia and cryptosporidia).

Pneumonia

t. Calf respiratory (pneumonia) problem generally developed from the first week of life. A "running eye" or discharge from the eye and nostril may be the first sign, a cough becomes noticeable: A chesty cough. Their breathing may quicken, pneumonic calves appear to have difficulty in inhaling sufficient air, as they arch their backs, and have their heads down. These calves will have lost their appetite, and will possibly stand away from the group. They may have a raging temperature and will be quite sweaty. Isolate infected

animals from the group. Complete dose of antibiotics should be giving in time and for sweaty animals, encourage them to drink lot of water so as to replace lost fluids

Drenching

- Routine drenching of calves with a broad spectrum anthelmintic is advisable to reduce internal parasite burden prior to weaning. It is important to follow the manufacturer's instructions when dosing calves.

Milking Potential of Mithun

Laishram Sunitibala Devi, S. S. Hanah, J. K. Chamuah

Importance of Milk

Milk

Milk is the first food for young mammals. It provides high quality protein, vitamins and minerals and is a source of energy. Worldwide many mammalian species are used to produce milk and milk products ● iz cattle, buffalo, goats, sheep, horses, yaks, Mithun etc.

It is the colloidal dispersion of the protein caesin and the whey proteins and an emulsion with fat globules suspended in the water phase. Milk is composed mainly of water about 87-89%. Milk solids make up the other 12-13% out of the total milk composition. Solids include the carbohydrate, lactose, fat, protein and minerals.

Nutrients found in milk and milk products

Calcium, Vitamin D, Vitamin A, Magnesium, Zinc, and Protein. We already heard about calcium, but dairy products have many other nutrients other than calcium. They have vitamin D, vitamin A, magnesium, zinc, and protein. All of which are necessary in our daily diet for us to have energy, to grow, and to fight infection.

Mithun

Mithun is a domesticated bovine species of north-eastern hill region of India. Mithun is the state animal of 2 states (Arunachal Pradesh and Nagaland). They are mostly reared for meat purpose. At present, Mithun farmers rear this animal at an altitude of 1000 to 3000 meters above mean sea level under free grazing condition in its natural habitat. Due to gradual denudation of forests (natural habitat of Mithun) and tremendous socio-economic and cultural importance of Mithun in the life of the local tribal population, initiatives are being taken to popularise economic Mithun farming under semi-intensive condition with controlled breeding.

The present population of Mithun in different Mithun rearing states during 20th Livestock Census is given below:

STATE	2003	2007	2012	2019
Arunachal Pradesh	**1,84,343**	**2,18,931**	**2,49,000**	**3,50,154**
Nagaland	**40,452**	**33,385**	**34,871**	**23,123**
Manipur	**19,737**	**10,024**	**10,131**	**9,059**
Mizoram	**1,783**	**1,939**	**3,287**	**3,957**
TOTAL	**2,46,315**	**2,64,279**	**2,97,289**	**3,86,293**

Presently, milking and consumption of Mithun milk is not an accepted practices in Mithun rearing community. However, it has high potential for milk production with good nutrients content. Mithun produces around 1 to 1.5 kg milk per day. However, Mithun milk is nutritionally superior to any other domesticated species as it contains high fat (8 to 13%), solid-not-fat (18 to 24%) and protein (5 to 7%). Hence, Mithun has a scope to be promoted as moderately good milk animal for home consumption in these hilly areas. Due to high fat and protein content in Mithun milk, it may be used for the preparation of different value added milk products such as paneer, various sweet products, ghee, cream, curd and cheese. The National Research Center on Mithun, the premier Institute of Indian Council of Agricultural Research, has successfully standardized the process of making paneer, barfi, rasgulla, curd and lassi from Mithun milk.

Various research has been conducted in Mithun milk:

Table 1: Physical properties of Mithun milk

Particulars	Observation
Colour	**White to creamy, White**
Flavour	**Aromatic**
Taste	**Sweet**
Appearance	**Clear to flaky surface**
Lactometer reading at 15.5°C	**36.03 ± 0.98**
PH	**7.09 ± 0.06**
Density (g/ml)	**1.023 ± 0.002**

Mondal et al.2001

Table 2: Milk composition of Mithun milk

Particulars	Average (N=12)
Milk Protein (gm/dl)	**6.59 ± 0.08**
Milk Fat (%)	**8.43 ± 0.09**
Milk Lactose (%)	**4.43 ± 0.04**
Milk SNF (%)	**12.99 ± 0.11**
Total solids (%)	**21.42 ± 0.11**
Ash	**0.89 ± 0.01**

Vupru et al. 2016

Table 3: Milk composition of Mithun during different lactation stages

Particulars	Early Lactation	Mid Lactation	Late Lactation
Milk yield, Kg/d	**1.46 ± 0.04 a**	**1.22 ± 0.05 a**	**0.87 ± 0.05**
TS, %	**20.94 ± 0.19 a**	**21.76 ±0.21 a**	**22.62 ± 0.36 b**
Fat, %	**7.72 ± 0.15 a**	**8.61 ± 0.16 b**	**10.25 ± 0.25 c**
Total protein, %	**6.31 ± 0.08**	**6.71 ± 0.16**	**6.78 ± 0.09**
Casein, %	**4.38 ± 0.05**	**4.77 ± 0.09**	**4.44 ± 0.10**
SNF, %	**13.41 ± 0.20**	**13.70 ± 0.38**	**13.40 ± 0.22**
Lactose, %	**4.60 ± 0.07**	**4.36 ± 0.14**	**4.44 ± 0.08**
NPN, %	**0.43 ± 0.01**	**0.41 ± 0.02**	**0.43 ± 0.01**
Urea, %	**36.65 ± 0.87 a**	**39.14 ± 0.94 a**	**43.54 ± 1.59 b**
Ash, %	**0.93 ± 0.01**	**0.90 ± 0.01**	**0.90 ± 0.01**

Mech et al. 2008

Fig: Mithun milk products

Scientific management of hilly livestock for better productivity

Sapunii S Hanah, L Sunitibala Devi. J.K. Chamuah and Lalzampuia

Introduction

In general, high altitude environment is challenging in many respects, as it is accompanied by decreased of atmospheric pressure and air density, higher wind speed, higher proportion of shorter wavelength radiation (violet and ultraviolet) etc. One of the most distinctive features of thermal regime in mountains is the great difference between air temperature and the temperature of the upper soil layer in the daytime, which is cause by the absence of decrease in soil temperature with increasing elevation. As the elevation increased there is a greater proportion of snow and snow cover remains for a longer period of time. Hence the weather becomes a constraint on efficient livestock production systems.

The main purpose of animal husbandry is to convert the energy in feed into products that can be utilized by human beings, such as milk, eggs, meat, wool, hair, hides and skins, draught power and manure (fertilizer). However, in hilly or high altitude region livestock management becomes a challenging job due to climatic variation. It is reported that, in hilly region shortage of feed and fodder is estimated to be 65 per cent and magnitude of the problem varies from zone to zone. Similarly, experience has shown that animal health problems are closely linked to nutrition. Shortage of quality feed has been found to affect animal production and reproduction as nutritional stress contributes significantly to their performance.

Housing

The welfare of an animal is very important while planning and designing of suitable housing accommodation for any livestock. Improper planning in the arrangement of animal housing may result in additional labour charges and that curtail the profit of the owner. As the principal function of any system of housing for animals are: (i) Provision a congenial environment for better growth, reproduction and production performance (ii) Provision of desirable working conditions for labour and supervisory staff and (iii) integration of housing with feeding, watering, milking and manure handling systems. In other words, housing management is more or less synonymous to the system of management of animals. The animals house should be properly located, constructed spaced out and grouped. The animal house may be constructed in different shape, type, etc. but health and comfort of the animals should receive special attention. Further a good animal house must permit a dry and comfortable surface for the animals to rest, that does not permit breeding of internal and external parasite and other pathogens within the shed. The good manager plan and build the animal house to reduce heat gain and promote heat loss from the structure of the house by radiation and conduction during summer. During winter the structures, especially those parts that come in constant physical contact with animals, like floor and walls, should not get too cold and should give protection from the cold winds.

Wherever they are housed animals are entitled to the Five Freedoms. The Five Freedoms are a set of five basic rules concerning the welfare of animals. They apply to the housing of both large and small animals. They are as follows:

- Freedom from hunger and thirst
- Freedom from discomfort
- Freedom from pain, injury and disease
- Freedom to express normal behavior

- Freedom from fear and distress

Type and system of housing for animals

The single housing system may not be wholly suitable for all agro-climatic zones in India, as the climate varies from region to region. Housing of the animal is therefore to be planned and designed as per the agro-climatic conditions prevailing in a particular area. The most widely prevalent practice in this country is to tie the cows with rope on a Katcha floor except some organized dairy farms belonging to government, co-operatives or military where proper housing facilities exist. For dairy cattle, it may be successfully housed under a wide variety of conditions, ranging from close confinement to little restrictions except at milking time. However, two types of dairy barns are in general use at the present time.

- The loose housing barn in combination with some type of milking barn or parlor.
- The conventional dairy barn.

Each system has its own advantages and limitations. The final decision can be based upon the prevailing environmental condition of a particular area.

Loose housing

- It is a system of housing in which animals are kept loose in an open paddock in group (40-50) throughout the day and night except at the time of milking and some other specific purposes like treatment, breeding etc., when the animals are required to be tied.
- Common shelter is provided along one side of open paddock under which animals can retire when it is very hot or cold or during rains, enclosed by brick wall or railing.
- Common feed manger and water tank along with covered standing space is provided and concentrates are fed at the milking time which is done in a separate milking barn or parlour in which cows are secured at milking time and are milked.

Conventional barns or Stanchion barns

On the other hand in the conventional or stanchion barns closed system there is greater protection during winter season but proportionally the cost is very high.

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

Generally under conventional barn system animal are arranged in a single row if the numbers of animal are less, say 10 or in a double row if the herd is a large one. In double row housing, the animal should be so arranged that the animal face out (tail to tail system) or face in (head to head system) as preferred. Ordinarily, not more than 80 to 100 cows should be placed in one building.

Orientation of animal house

In general, animal sheds are located with long axis east to west the paddock side facing the north to get direct sunlight during winter and to prevent entry of direct sunlight into the shed during other seasons. In deciding which orientation to build, the following factors need be considered:

- With the east-west orientation the feed and water troughs can be under the shade which will allow the cows to eat and drink in shade at any time of the day. The shaded area, however, should be increased to 3 to 4m² per cow. By locating the feed and water in the shade, feed consumption will be encouraged, but also more manure will be dropped in the shaded area which in turn will lead to dirty cows.
- With the north-south orientation, the sun will strike every part of the floor area under and on either side of the roof at some time during the day. This will help to keep the floored area dry. A shaded area of 2.5 to 3m² per cow is adequate if feed and water troughs are placed away from the shaded area.
- If it is felt that paving is too costly, the north-south orientation is the best choice in order to keep the area as dry as possible.
- In regions where temperatures average 30°C or more for up to five hours per day during some period of the year, the east-west orientation is most beneficial.

Temperate high altitude areas

In temperate area, partially loose housing along with the closed conventional system of housing is desirable. In this system due attention is given to protect animal from heavy snow fall, rain and strong wind. Tail to tail system of conventional barn, completely roofed and enclosed with side wall is suggested with adequate provision of tying, feeding, watering and milking inside of the barn. Open paddock area with continuous manger in one side along with covered standing space is provided attached to the barn for housing during warm/comfortable weather. In addition, the following important aspects also need adequate attention while deciding about the housing structure for dairy animals.

Housing at heavy rainfall areas

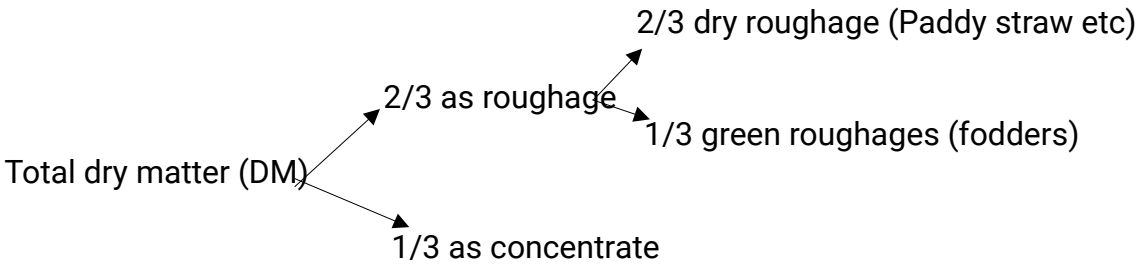
The design of typical loose housing structure for the adult animals would be similar to general loose housing system except additional provision of covered resting area in one side of the paddock which will provide sufficient dry area for the animals during rainfall and provide protection against strong wind. The floor of the resting area should be slightly elevated from open paddock and one side should be closed with brick wall which will work as wind break.

Type of animals	*Floor space requirement m²*		*Maximum No. of animals/pen*	*Height of shed at cm*
	Covered area	*Open paddock*		
Bulls	12.0	24.0	1	175 cm in medium and heavy rainfall and 220 in dry areas
Cows	3.5	7.0	50	
Buffaloes	4.0	8.0	50	
Down -calvers	12.0	12.0	1	
Young calves	1.0	2.0	30	
Old heifers	2.0	4.0	30	

Feeding

A dairy animal's health and productivity, as well as the quality and safety of its milk, depends largely on providing the right feeds and water. The farmer must ensure feeds are well-balanced. Fibre, proteins, energy and minerals should be part of the primary constituents of the

diet. Grasses and legumes are good sources of protein, while minerals may be sourced from commercial salt licks. However, to reach a cow's optimal milk production, additional sources of energy may be obtained from commercial feeds. The daily feed required for an individual animal i.e. ration, may be given at a time or in portions at intervals. The ration of a cow consists of two parts viz., maintenance and production. In the computation of ration for animals, the prime consideration is to meet the total requirement in terms of dry matter, digestible protein (DCP) and energy (TDN) for 24 hours. Dry matter requirement depends on the body weight of the animal and also with the nature of production. Cattle generally eat daily 2.0 to 2.5kg dry matter for every 100 kg live weight and since the bulk is also essential for all ruminants, their dry matter allowances should be divided as follows:



Thumb rule feeding

The farmers can prepared a concentrate mixture/dairy mixture/hard grain mixture in such a way that 3.5-4kg of it may support animal producing 10kg of milk, when fed over the maintenance ration. Normally they should be fed at the rate of 1kg per 2.5-3 kg of milk yield in case of cattle and 1kg per 2kg of the milk yield in case of buffaloes assuming concentrate mixture contain 14-16% DCP and 68-72% TDN and it may be prepared either by using equal parts of mustard cake, wheat bran and barley or oats with addition of 2% mineral mixture and 1% common salt or by mixing Maize crushed, Rice bran 50%, Wheat bran 17%, Ground Nut cake/Till/Mustard cake 30%, Mineral mixture 2% and common salt 1%. The dairy animals can be fed according to their body requirements as follows:

- **Maintenance ration:**

Feed stuffs	for Local/Zebu cattle	for crossbred Cattle/Buffalo
• Hard grain mixture	1-1.25kg	2.0kg daily
• Paddy/wheat Straw	4.0kg	4.0-6.0kg daily

- **Extra allowances during pregnancy:** During the last trimester of pregnancy, an extra 1.25 and 1.75kg concentrate is recommended for zebu cattle and crossbred, respectively.
- **Extra allowances for milk production:** An additional amount of 1kg concentrates for every 2.5kg of milk yield over and above the maintenance requirements in case of zebu cattle (4% fat) or 1kg concentrate per 2.0kg of milk yield in case of buffaloes (6% fat).

Feeding pregnant Cows

In feeding of pregnant animals special attention is required after 6 months of pregnancy i.e. in the last trimester of gestation period, as it is the active growing period of foetus whenever about 60% growth occurs during this last 3 months of pregnancy. For these purposes a feeding

method known as "**steaming up**' is practiced. In this method, dry pregnant cows are offered extra quantities of concentrates which increase gradually during the last 6 week of pregnancy. By the time of calving, the amount of concentrate given is about 75% of the quantity required in early lactation. Besides, high yielding animals are fed on increasing quantity of concentrate feed challenging them to produce at their maximum milk production potentiality which known as "**challenge feeding**" and it starts two weeks before the expected date of calving. Feeding of the concentrate mixture should be started initially at 500g per day which increases gradually to a level of 500-1000g per 100 kg body weight. Challenge feeding helps in higher milk yield during the subsequent lactation.

Health

Vaccination

Vaccination is not a replacement for good management; it is only a tool use in herd health programs for the protection of animal health. However, vaccines often do not protect health by themselves, and should be used in conjunction with good management practices. The overall goal of vaccine usage should be to maintain a preventative, protective level of "herd immunity" rather than a stop gap method. Therefore, all animals should be vaccinated against the recommended disease. A sound vaccination program requires planning and consultation with your herd veterinarian who will be aware of the diseases of importance in your area. Several questions need to be answered before designing a vaccination program: *Why? With What? When? How?*

Prevent entry of disease onto the farm

Only buy animals of known health status (both herd and individual animals) and control their introduction to the farm using quarantine if indicated. The most effective way to prevent the spread of infectious diseases is to keep a closed herd. This means no new animals enter the herd and previously resident animals do not re-enter after they have left the herd. This might be difficult to achieve in practice, so strict control of any animal introductions is essential.

Monitor the risk

The risk factors should be monitor from adjoining land and neighbours and have secure boundaries. Be aware of local (endemic) diseases and/or exotic diseases which have the potential to affect the health of the herd or flock, especially from neighbouring farms. Contain animals appropriately to ensure there is no risk of disease spread between farms and within farms.

Regular check up for signs of disease

Observe all animals regularly and use proven methods to aid in detection and accurate diagnosis of infectious disease. Some useful tools may include thermometers, observation of animal behaviour, body condition, examination of foremilk etc. Detailed breeding and reproductive records should be check routinely at appropriate stages as many diseases are associated with reproduction. Clinical diseases should be investigated to determine the underlying cause(s) so that animals can be treated and further cases prevented.

Housing Management at Mid and High Altitude

Sapunii S Hanah, L. Sunitibala and Kobu Khate

Introduction

In general, high altitude environment is accompanied by decreased of atmospheric pressure and air density, higher wind speed, higher proportion of shorter wavelength radiation (violet and ultraviolet) etc. One of the most distinctive features of thermal regime in mountains is the great difference between air temperature and the temperature of the upper soil layer in the daytime, which is cause by the absence of decrease in soil temperature with increasing elevation. As the elevation increased there is a greater proportion of snow, and snow cover remains for a longer period of time. Hence the weather becomes a constraint on efficient livestock production systems. Evaluation of the degree of constraint is a difficult, but necessary task before selection of appropriate modifications in management or environments can be made. The climatic stress in livestock has continued to improve, particularly with the development of rudimentary functional relationships between animal performance and weather parameters. Such relationships, when combined with probabilistic knowledge of the weather parameters, permit prediction of the reducing of stress in animal performance under natural conditions.

In planning and designing of suitable housing accommodation for any livestock, consideration should be given to the welfare of the animal. As the principal function of any system of housing for animals are: (i) Provision a congenial environment for better growth, reproduction and production performance (ii) Provision of desirable working conditions for labour and supervisory staff and (iii) integration of housing with feeding, watering, milking and manure handling systems. In other words, housing management is more or less synonymous to the system of management of animals. The animals house should be properly located, constructed spaced out and grouped. The animal house may be constructed in different shape, type, etc. but health and comfort of the animals should receive special attention. Further a good animal house must permit a dry and comfortable surface for the animals to rest, that does not permit breeding of internal and external parasite and other pathogens within the shed. The good manager plan and build the animal house to reduce heat gain and promote heat loss from the structure of the house by radiation and conduction during summer. During winter the

structures, especially those parts that come in constant physical contact with animals, like floor and walls, should not get too cold and should give protection from the cold winds.

Wherever they are housed animals are entitled to the Five Freedoms. Basic requirements such as an agreeable physical environment are necessary, and the animal should be well cared for. The Five Freedoms are a set of five basic rules concerning the welfare of animals. They apply to the housing of both large and small animals. They are as follows:

1. Freedom from hunger and thirst
2. Freedom from discomfort
3. Freedom from pain, injury and disease
4. Freedom to express normal behavior
5. Freedom from fear and distress

Type and systems of housing for animals

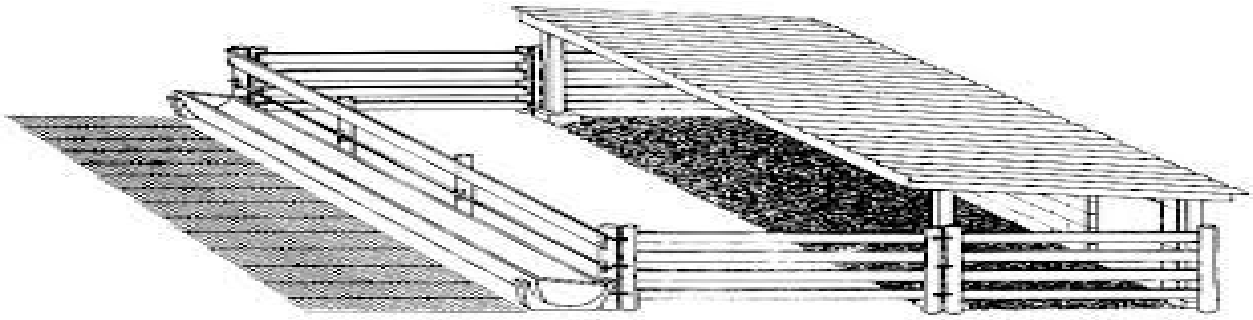
The single housing system may not be wholly suitable for all agro-climatic zones in India, as the climate varies from region to region. Housing of the animal is therefore to be planned and designed as per the agro-climatic conditions prevailing in a particular area. Generally, there are two systems of housing for livestock, namely ***loose and conventional***. Each system has its own advantages and limitations. The final decision can be based upon the prevailing environmental condition of a particular area.

Loose housing

It is a system of housing in which animals are kept loose in an open paddock in group (40-50) throughout the day and night except at the time of milking and some other specific purposes like treatment, breeding etc., when the animals are required to be tied.

Common shelter is provided along one side of open paddock under which animals can retire when it is very hot or cold or during rains, enclosed by brick wall or railing.

Common feed manger and water tank along with covered standing space is provided and concentrates are fed at the milking time which is done in a separate milking barn or parlour in which cows are secured at milking time and are milked.



Advantage

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

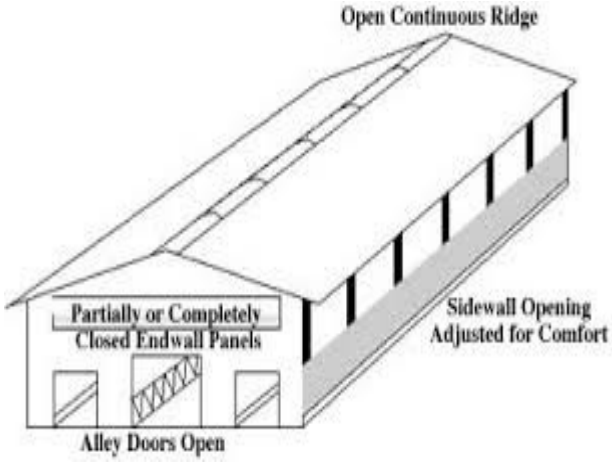
Disadvantage

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

Conventional barns

On the other hand in the conventional closed system there is greater protection during winter season but proportionally the cost is very high.

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



The same type of housing can be utilized for tropical region with slight modification

Advantage

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

Disadvantage

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

Generally under conventional barn system animal are arranged in a single row if the numbers of animal are less, say 10 or in a double row if the herd is a large one. In double row housing, the animal should be so arranged that the animal face out (tail to tail system) or face in (head to head system) as preferred. Ordinarily, not more than 80 to 100 cows should be placed in one building.

Advantages of tail to tail system

1. Under the average conditions, 125 to 150 man hours of labour are required per cow per year. Study of Time: Time motion studies in dairies showed that 15% of the expended time is spent in front of the cow, and 25% in other parts of the barn and the milk house, and 60% of the time is spent behind the cows. 'Time spent at the back of the cows is 4 times more than, the time spent in front of them.
2. In cleaning and milking the cows, the wide middle alley is of great advantage.

3. Lesser danger of spread of diseases from animal to animal.

4. Cows can always get more fresh air from outside.

5. The manager can inspect a greater number of milkmen while milking. This is possible because milkmen will be milking on both sides.

6. Any sort of minor disease or any change in the hind quarters of the animals can be detected quickly and even automatically.

Disadvantage

Advantages of face to face system

1. Cows make a better showing for visitors when heads are together.
2. The cows feel easier to get into their stalls.

3. Sun rays shine in the gutter where they are needed most.

4. Feeding of cows is easier; both rows can be fed without back tracking.

5. It is better for narrow barns

Housing at heavy rainfall areas

The design of typical loose housing structure for the adult animals would be similar to general loose housing system except additional provision of covered resting area in one side of the paddock which will provide sufficient dry area for the animals during rainfall and provide protection against strong wind. The floor of the resting area should be slightly elevated from open paddock and one side should be closed with brick wall which will work as wind break.

Temperate high altitude areas

In temperate area, partially loose housing along with the closed conventional system of housing is desirable. In this system due attention is given to protect animal from heavy snow fall, rain and strong wind. Tail to tail system of conventional barn, completely roofed and enclosed with side wall is suggested with adequate provision of tying, feeding, watering and milking inside of the barn. Open paddock area with continuous manger in one side along with covered standing space is provided attached to the barn for housing during warm/comfortable

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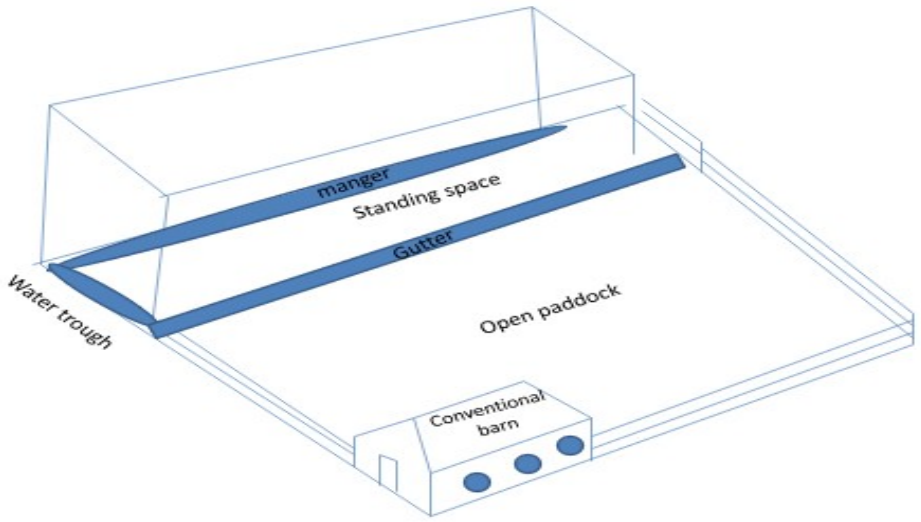
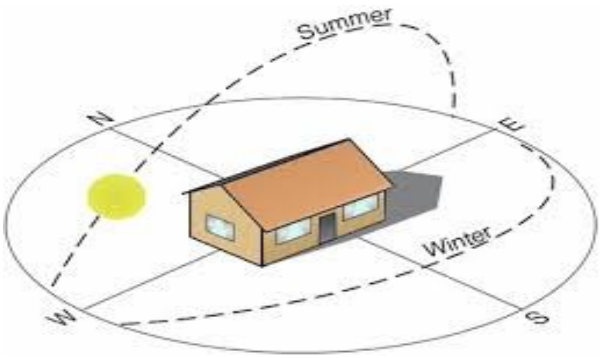


N.B: the same housing designed can be constructed in mid altitude region

Orientation of animal house

In general, animal sheds are located with long axis east to west the paddock side facing the north to get direct sunlight during winter and to prevent entry of direct sunlight into the shed during other seasons. In deciding which orientation to build, the following factors need be considered:

- With the east-west orientation the feed and water troughs can be under the shade which will allow the cows to eat and drink in shade at any time of the day. The shaded area, however, should be increased to 3 to 4m² per cow. By locating the feed and water in the shade, feed consumption will be encouraged, but also more manure will be dropped in the shaded area which in turn will lead to dirty cows.
- With the north-south orientation, the sun will strike every part of the floor area under and on either side of the roof at some time during the day. This will help to keep the floored area dry. A shaded area of 2.5 to 3m² per cow is adequate if feed and water troughs are placed away from the shaded area.
- If it is felt that paving is too costly, the north-south orientation is the best choice in order to keep the area as dry as possible.
- In regions where temperatures average 30°C or more for up to five hours per day during some period of the year, the east-west orientation is most beneficial.



Space requirement

The Indian Standards Institution (ISI) has brought out certain standards of space requirement for farm animals. These standards are basically for loose housing.

Type of animals	*Floor space requirement m^2*		*Maximum No. of animals/pen*	*Height of shed at cm*
	Covered area	*Open paddock*		
Bulls	12.0	24.0	1	175 cm in medium and heavy rainfall and 220 in dry areas
Cows	3.5	7.0	50	
Buffaloes	4.0	8.0	50	
Down -calvers	12.0	12.0	1	
Young calves	1.0	2.0	30	
Old heifers	2.0	4.0	30	

Type of animals	*Space per animal (cm)*	*Total manger length in a pen for 50 animals*	*Total water tank length in a pen for 50 animals*	*Dimensions of manger/tank(cm)*		
				Width	*Depth*	*height of inner wall*
Adult cattle & buffaloes	60-75	3000-3750	300-375	60	40	50
Calves	40-50	2000-2500	200-250	40	15	20

Flooring materials

Different materials are used for animal house flooring. The choice depends on availability and cost of the materials. Commonly used materials are: cement concrete floor, vitrified paving bricks, stones, building bricks and gravel.

Sanitation in livestock housed

Sanitation is another important point in managing the livestock house for eliminations of all micro organisms that are capable of causing disease to the animals. Dry floorings keeps the houses dry and protects from foot injury and breeding of pathogenic organism. Similarly the presence of flies and other insects in the livestock house not only , disturbs the animals but also spreads deadly diseases to the animals.

Sanitizers

Sunlight is the most potent and powerful sanitizer which destroy most of the disease producing organism. Disinfection of animal sheds means making these free from disease producing bacteria and is mainly-carried out by sprinkling chemical agents such as bleaching powder, Iodine and Iodophor, sodium carbonate, Washing soda, Slaked Lime (Calcium hydroxide), Quick Lime (Calcium oxide) and phenol.

Conclusion

Safety and ease in handling a comfortable shed for protection from weather and a provision for exercise are the key points while planning housing accommodation for the livestock. The response of the animal to its environment is complex both in its biological responses and in the description of the environment. Knowing the factors that cause stress to the animal in mid and high altitude will greatly help the manager to plan properly for the construction of animal's house.

Impact of Global warming on animal reproduction and its ameliorative measures

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Introduction

Years of man's greed have paid the price, the world's climate has changed radically from hot to cold and wet to dry and back again. Tomorrow's world may not be as we see it today. The signs of climate change are everywhere and every summer appears to be hotter than the last. If today's level of greenhouse gases held steady, the average temperature of the earth will increase by 0.6°C by 2100. The Intergovernmental Panel on Climate Change (IPCC) projections for the concentration of atmospheric CO2 in the year 2030 range from 400 to 480 ppm. Climate change has become a major scientific and political topic and a great deal of debate continues about the solutions. Many scientists estimate that by the year 2100 the average global temperature will increase by 1.4 degrees to 5.8 degrees Celsius (approximately 2.5 degrees to 10.5 degrees Fahrenheit). The earth has gone through many natural climatic cycles during its long history. The scary part is we are causing changes to happen at an unbelievable rate, much faster than normal. We must alter the way we live or we will suffer staggering consequences. The livestock sector which accounts for 40% of the world's agriculture Gross Domestic Product (GDP) and employs about 1.3 billion people, were struggling in supplying the demand of seven billion world population at the same time struggling to tackle the reproductive efficiency, which is the key factor affecting profitability in livestock production systems from the effect of climate change.

There is a range of thermal conditions within which animals or the livestock are able to maintain a relatively constant body temperature (i.e. between 38.4 and 39.0°C) by means of behavioral and physiological responses which is essential to preserve the multitude of biochemical reactions and physiological processes that occur with normal metabolism. However, when the environmental temperatures move out of the themoneutral zone or comfort zone animals begin to experience thermal stress. For animals, the most stressful factor of all the thermal stress is heat. As environmental temperature increases, thermoregulatory responses may be noted down as sign of heat stress such as; restlessness, crowding under shade, panting, increased salivation, increased respiration rate, lethargy, decreased activity, increased maintenance energy requirement by 20-30%, decrease in the intake energy available for productive functions, decrease in dry matter intake by 10 to 20%, decrease in milk

production from 10 to 25%, decrease in reproductive performance, increased risk of morbidity and mortality particularly young animals and decreased average daily weight gain.

Impact of climate change on reproduction.

Animal's environment is affected by many climatic factors that include temperature, humidity, radiation and wind. Surrounding environmental conditions directly affects the mechanisms and rates of heat gain or loss by all animals moreover, increase of temperature will lead to influence of etiologic bacteria and parasites around the animal's environment finally affect the reproductive efficiency of livestock.

EFFECTS ON FEMALE REPRODUCTIVE PERFORMANCE

Estrous period and follicular growth

Heat stress reduces the length and intensity of estrus besides increases incidence of anestrous and silent heat in farm animals. It increases ACTH and cortisol secretion and blocks estradiol-induced sexual behavior. Roth*et al*. (2000) reported that when the body temperature exceeds 40°C it can alter the follicular growth, steroid secretion (Ozawa*et al*. 2005) and gene expression (Argov*et al*. 2005). In female goats, heat stress reduced plasma concentrations of oestradiol and lowered follicular oestradiol concentration, aromatase activity and LH receptor level, and delayed ovulation (Ozawa*et al*. 2005). Low estradiol secretion suppresses signs of estrus, gonadotropin surge, ovulation, transport of gametes and ultimately reduced fertilization. A temperature rise of more than 2°C in unabated buffaloes may cause negative impacts due to low or desynchronized endocrine activities particularly pineal-hypothalamo-hypophyseal-gonadal axis altering respective hormone functions. They also reported that low estradiol level on the day of estrus during summer period may be the likely factor for poor expression of heat in Indian buffaloes. In rats, heat stress reduced the levels of gonadotropin receptors and aromatase activity of granulosa cells and the follicular fluid concentrations of oestradiol (Shimizu*et al*. 2005).

Fertility

Multifactorial mechanisms involved in reducing fertility of dairy animals depending on the magnitude of heat stress. Heat stress reduces oocyte development by affecting its growth and maturation. It increases circulating prolactin level in animal's results to acyclicity and infertility. Moreover, 80% of estrus may be unnoticeable during summer, which further reduces fertility? A

period of high-temperature results to increase secretion of endometrial PGF-2α, thereby threatening pregnancy maintenance leads to infertility. Plasma follicle-stimulating hormone (FSH) surge increases and inhibin concentrations decrease during heat stress leading to variation in follicular dynamics and depression of follicular dominance that could be associated with low fertility of cattle during the summer and autumn. However, FSH secretion is elevated under heat stress condition, probably due to reduced inhibition of negative feedback from smaller follicles which ultimately affect the reproductive efficiency of dairy animals. Conception rates were drop from about 40% to 60% in cooler months to 10-20% or lower in summer, depending on the severity of the thermal stress. About 20-27% drop in conception rates or decrease in 90-day non-return rate to the first service in lactating dairy cows were recorded in summer. Amundson*et al*. (2005), reported a reduction ($p<0.01$) in pregnancy rate in summer (62%) and decreasing in spring (44%) when the average daily minimum temperature and average daily THI were equal to or above 16.7°C and 72.9 respectively. Oocytes of cows exposed to thermal stress lose their competence for fertilization and development to the blastocyst stage.

Embryonic growth and development

Embryonic growth and survival also affected by thermal stress in dairy animals. Heat stress causes embryonic death by interfering with protein synthesis, oxidative cell damage, reducing interferon production for signaling pregnancy recognition and expression of stress-related genes associated with apoptosis. Low progesterone secretion limits endometrial function and embryo development. Exposure of lactating cows to heat on the 1st day after estrus reduced the proportion of embryos that developed to the blastocyst stage on the day 8th after estrus. Further, exposure of post-implantation embryos (early organogenesis) and fetus to heat also leads to various teratologies. The deleterious effects of heat in the embryo are most evident in early stages of its development. However, embryos subjected to high temperatures *in vitro* or *in vivo* until day 7 of development (blastocyst) showed lower pregnancy rates at day 30 and higher rates of embryonic loss on day 42 of gestation and lactation yield as well as postpartum ovarian activity. Fetal malnutrition and eventually fetal growth retardation under thermal stress were also reported.

Effects on male reproductive performance

Bull is considered as half of the herd and hence, bull's fertility is equally or more important for fertilization of oocyte to produce a good, viable and genetically potential conceptus. It is well known that bull testes must be 2-6°C cooler than core body temperature for fertile sperm to be produced. Therefore, increased testicular temperature results from thermal stress could changes in seminal and biochemical parameters leads to infertility problems in bulls. The significant seasonal difference in semen characteristics was reported by several studies.. Cardozo*et al*.(2006), reported seasonal effects on changes in testicular volume, hormonal profiles, sexual behavior and semen quality that affect the reproductive performance of males. Balic *et al*. (2012), studied seasonal influence on 19*Bos taurus*bulls and found decreased semen quality parameters in summer. They also reported that younger bulls are more sensitive to elevated air temperatures during the summer seasons. Mishra*et al*. (2013) in a study observed that membrane integrity status of fresh spermatozoa in four different breeds of bulls (crossbred, Red Sindhi, Haryana and Jersey) were affected significantly ($p<0.01$) with increases in air temperature from 10 to 18°C to more than 35°C. Bhakat*et al*. (2014) observed optimal semen qualities during winter, poor during summer and intermediate during rainy season and conclude that hot-dry or summer season adversely affect the various bio-physical characteristics of semen in Karan Fries bulls. Hence, high temperature significantly lowers conception as well as fertility rates per insemination of male and subsequently reduces male's fitness.

Ameliorative measures to combat against global warming

The negative effects of climate change have become a matter of concern for governments all around the world. A researcher, predicted that rise in the planet's temperature will continue, get much worse in the future and the effects of this change are irreversible. Therefore, the measures taken should focus on alleviating rather than eliminating the heat from the animal. Three basic management measures to combat against climate change on animals are (a) *physical modification of the environment* (b) *improved nutritional management schemes* and (c) *genetic development of less sensitive breeds.*

Physical modification of the environment:

Modification of microenvironment to enhance heat dissipation mechanism to relieve from heat is one of the most important measures to be considered in hot environment. It includes shades, ventilation, combination of wetting and ventilation. Shades are the simplest

method to reduce the impact of high solar radiation and it can be either natural or artificial. Artificial shades can be used to protect from the effects of solar radiation in absence of natural shade. Trees are an excellent natural source of shade. A large, leafy, non-deciduous tree is effective blocker of solar radiation and the evaporation of moisture from leaf surface cools the surrounding air. Cooling ponds can also be used to cool the environment. Cooling can also improve reproductive performance in cows and heifers, and probably, the most effective cooling systems currently in use are those that couple evaporative cooling with tunnel ventilation or cross ventilation. Using of sprinkler (mist and fog) is also very effective in cooling the animal from heat. It has been reported that sprinkling water on buffaloes or making them wallow in clean water helps to improve fertility in summer months. Ideally in tropical area loose housing system is recommended and the shelters materials provided, should have a low radiation coefficient or high insulating properties and should be extensive enough to eliminate much of the radiation from the sky. Thatch from palm leaf, and straw or grass is a very satisfactory material moreover, it is essential to double space in hot and humid area to provide additional open area for improved air movement.

Improved nutritional management schemes:

Feeding of animals in cooler hour (morning and evening) should be promoted. Feeding strategy like providing green fodder, mixing of dry fodder with green fodder, grazing during morning and evening hours etc. is very useful to overcome from heat stress. In summer soak the concentrate in equal amount water for 20-30 minutes is also proved to be beneficial. Feed containing low fibre rations during hot weather is logical since heat production is highly associated with metabolism of acetate compared with propionate. Heat stress causes oxidative damage which could be minimized through supplementation of vitamins C, E and A and also mineral such as zinc. Vitamin E acts as an inhibitor – “chain blocker”- of lipid peroxidation and ascorbic acid prevents lipid peroxidation due to peroxyl radicals. Further, vitamin C assist in the absorption of folic acid by reducing it to tetrahydrofolate, the latter again acts as an antioxidant. Use of vitamin C along with electrolyte supplementation was found to relieve the animals of oxidative stress and boosts cell-mediated immunity in buffaloes. West reported that Na^+ and K^+ status of the body stayed normal during heat stress when supplemented with electrolytes which could be due to better regulation of acid-base balance in the blood. Yeast product supplementation plays an important role in digestibility of nutrient by altering the volatile fatty acids production in the rumen, decrease the production of ruminal ammonia and increase in

ruminal microorganism population. Water requirements parallel the increase in ambient temperature and water intake may increase as much as 50% when the ambient temperature increases to maximum. Animals need ample amount of fresh, clean, cool and good quality drinking water to compensate losses from sweating and increased respiration rates.

Genetic development of less sensitive breeds:

Advances in environmental modifications and nutritional management partly alleviate the impact of thermal stress on animal performance during the hotter seasons. However, long-term strategies have to be evolved for adaptation to climate change. Differences in thermal tolerance exist between livestock species provide clues or tools to select thermotolerant animals using genetic tools. The identification of heat-tolerant animals within high-producing breeds will be useful only if these animals are able to maintain high productivity and survivability when exposed to heat stress conditions. Cattle with shorter hair, hair of greater diameter and lighter coat color are more adapted to hot environments than those with longer hair coats and darker colors. This phenotype has been characterized in *B. Taurus*, and the dominant gene found in them is associated with an increased sweating rate, lower rectal temperature and respiration rate in homozygous cattle under hot conditions.

There is heat shock gene related to thermotolerance that was identified and being used as marker in marker assisted selection and genome-wide selection to developed thermotolerant bull that are used in breeding program. Major families of Hsps are Hsp100, Hsp90, Hsp70, Hsp60, Hsp40 and the small Hsps (so-called Hsps of sizes below 30 kDa). HSPs have a critical role in the recovery of cells from stress and in cytoprotection as well as guarding cells from subsequent insults. Hsp gene expression under thermal stress changes include: (i) Activation of heat shock transcription factor 1 (HSF1); (ii) increased expression of Hsp genes and decreased expression and synthesis of other proteins; (iii) increased glucose and amino acid oxidation and reduced fatty acid metabolism; (iv) endocrine system activation of the stress response; and (v) immune system activation via extracellular secretion of Hsp. If the stress persists, these gene expression changes lead to an altered physiological state referred to as “acclimation,” a process largely controlled by the endocrine system. Further, thermotolerant bull can be used in breeding policy to have thermal adapted offspring.

Conclusion

Climate change is an irreversible process however, we can reduce it by integrating of different sectors like Energy, Forest, Animal Husbandry, Agriculture and Health, etc. and setting common strategy to control the rise of temperature, radiation and humidity. The extended periods of high air temperature coupled with high relative humidity compromise the ability of dairy animal to dissipate excess body heat which affects feed intake, milk production, and reproductive efficiency and ultimately reducing profitability for dairy farmers. The loss of electrolytes via skin secretions has to be minimized by improvement of housing and cooling of the animals. Standardization of mineral supplement to control acid-base balance should be considered in animal under different level of thermal stress. Increase pregnancy rate of cows could be achieved by improving various managemental conditions. Identification of genes associated with thermotolerance and using these genes as markers in the breeding program or marker assisted selection should be applied to identify animals adapted to thermal stress considering genotype-environment interactions (G × E) in addition to higher productivity. Further research on climate resilient animal agriculture is the need of the hour for sustainability in dairy farming system, especially in hot humid climatic regions.

A Note on Important Diseases of Poultry and Their Management

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Diseases in the flock can be caused by direct or indirect factors. The direct factors of diseases affecting poultry are Infectious diseases (bacterial, Viral, fungal and protozoal), parasitic diseases, metabolic and nutritional diseases, Chemical poisons, overmedication and unknown causes. Indirect causes are condition that put the animal under stress and lower their resistance to diseases (overcrowding, heat or cold stress, insufficient feed etc.) We may put practises in place to limit the risk of disease by understanding its causes and how it spreads. The following are the common and important poultry diseases prevalent in our backyard and commercial farms.

Newcastle Disease

Newcastle disease is a highly contagious viral infection that affects poultry of all ages. Affected species include chickens, turkeys, pigeons and ducks. The virus involved is Paramyxovirus PMV-1, which is of variable pathogenicity. Signs are typically of disease of the nervous, respiratory or reproductive systems. Morbidity is usually high and mortality varies 0-100%. Higher mortality is seen in velogenic disease in unvaccinated stock. Transmission is via aerosols, birds, fomites, visitors and imported psittacines (often asymptomatic). The virus survives for long periods at ambient temperature, especially in faeces and can persist in houses (in faeces, dust etc) for up to 12 months. However it is quite sensitive to disinfectants, fumigants and sunlight. It is inactivated by temperatures of 56°C for 3 hours or 60°C for 30 min, acid pH, formalin and phenol, and is ether sensitive.

The signs include sudden death, depression, in-appetance, coughing, dyspnoea, diarrhoea, nervous signs, paralysis, twisted neck, severe drop in egg production and moult. Post-mortem lesions include airsacculitis, tracheitis, necrotic plaques in proventriculus, intestine, caecal tonsil, haemorrhage in proventriculus, intestinal lesions primarily occur in the viscerotropic form. A presumptive diagnosis may be made on signs, post-mortem lesions, rising titre in serology.

Treatment is none, only antibiotics to control secondary bacteria. Vaccination programmes may involve Hitchner B1 vaccine at day old followed by LaSota-type vaccine at 14 days. The LaSota-type vaccine may even repeated at 35-40 days of age if risk is high.

Infectious Bronchitis

Infectious Bronchitis (IB) is probably the commonest respiratory disease of chickens. Morbidity may vary between 50-100% and mortality from 0-25%, depending on secondary infections. The cause is a Coronavirus that is antigenically highly variable; new sero-types continue to emerge. Infection is via the conjunctiva or upper respiratory tract with an incubation period of 18-36 hours. The infection is highly contagious and spreads rapidly by contact, fomites or aerosol. Some birds/viral strains can be carriers to 1 year. The virus may survive 4 weeks in premises. The virus is sensitive to solvents, heat (56°C for 15 mins), alkalis, disinfectants (Formal 1% for 3 mins). *Poor ventilation and high density are predisposing factors.*

Signs include depression, huddling, loss of appetite, coughing, gasping, dyspnea, wet litter, diarrhoea, and diuresis. The Post-mortem lesions include mild to moderate respiratory tract inflammation, tracheal oedema, tracheitis, airsacculitis, caseous plugs in bronchi, kidneys and bronchi may be swollen and they and the ureters may have urates. Tentative diagnosis is based on clinical signs, lesions and serology.

Treatment is by sodium salicylate 1gm/litre (acute phase) where permitted - antibiotics to control secondary colibacillosis (q.v.). Prevention is by live vaccines of appropriate sero-type and attenuation, possible reactions depending on virulence and particle size. Maternal immunity provides protection for 2-3 weeks.

Infectious Bursal Disease

Infectious Bursal Disease(IBD) is a viral disease, seen worldwide, which targets the bursal component of the immune system of chickens. The age up to which infection can cause serious immunosuppression varies between 14 and 28 days according to the antigen in question. The infective agent is a Birnavirus (Birnaviridae), Sero-type 1 only. Morbidity is high with mortality usually 0- 20% but sometimes up to 60%. Signs are most pronounced in birds of 4-6 weeks and *White Leghorns are more susceptible than broilers and brown-egg layers*. The route of infection is usually oral, but may be via the conjunctiva or respiratory tract, with an incubation period of 2-3 days. *The disease is highly contagious*. The virus is very resistant, persisting for months in houses, faeces etc. Subclinical infection in young chicks results in deficient immunological response to Newcastle disease, Marek's disease and Infectious Bronchitis; susceptibility to Inclusion Body Hepatitis and gangrenous dermatitis and increased susceptibility to CRD.

The signs include depression, inappetance, unsteady gait, huddling under equipment, vent pecking, diarrhoea with urates in mucus. The Post-mortem lesions include oedematous bursa, may have haemorrhages, rapidly proceeds to atrophy, haemorrhages in skeletal muscle, dehydration, swollen kidneys with urates. Diagnosis is by history, lesions and histopathology.

No specific treatment is available. Prevention is by vaccination. In most countries breeders are immunized with a live vaccine at 6-8 weeks of age and then re-vaccinated with an oil-based inactivated vaccine at 18 weeks. A strong immunity follows field challenge. Immunity after a live vaccine can be poor if maternal antibody was still high at the time of vaccination. When outbreaks do occur, biosecurity measures may be helpful.

Fowl Pox

A relatively slow-spreading viral disease characterised by skin lesions and/or plaques in the pharynx and affecting chickens, turkeys, pigeons and canaries worldwide. Morbidity is 10-95% and mortality usually low to moderate, 0-50%. Infection occurs through skin abrasions and bites, or by the respiratory route. It is transmitted by birds, fomites, and mosquitoes (infected for 6 weeks).

Signs include warty, spreading eruptions and scabs on comb and wattles, caseous deposits in mouth, throat and sometimes trachea, depression, in-appetence, poor growth, poor egg production. Post-mortem lesions include papules progressing to vesicles then pustules and scabs with distribution described above. Less commonly there may, in the diptheritic form, be caseous plaques in mouth, pharynx, trachea and/or nasal cavities. Microscopically-intra-cytoplasmic inclusions (Bollinger bodies) with elementary bodies (Borrel bodies). A presumptive diagnosis may be made on history, signs and post-mortem lesions.

No specific treatment is available. Prevention is by vaccination. There is good cross-immunity among the different viral strains.

Marek's Disease

Marek's disease is a Herpes virus infection of chickens. The disease has various manifestations: a) Neurological - Acute infiltration of the CNS and nerves resulting in 'floppy broiler syndrome' and transient paralysis, as well as more long-standing paralysis of legs or wings and eye lesions; b) Visceral - Tumours in heart, ovary, tests, muscles, lungs; c) Cutaneous - Tumours of feather follicles. Morbidity is 10-50% and mortality up to 100%. In 'late' Marek's the mortality can extend to 40 weeks of age. The route of infection is usually respiratory and the disease is highly contagious being spread by infective feather-follicle dander, fomites, etc. Infected birds remain viraemic for life.

Signs include paralysis of legs, wings and neck, loss of weight, grey iris or irregular pupil, vision impairment, skin around feather follicles raised and roughened. Post-mortem lesions are grey-white foci of neoplastic tissue in liver, spleen, kidney, lung, gonads, heart, and skeletal muscle, thickening of nerve trunks and loss of striation, microscopically - lymphoid infiltration is polymorphic. Diagnosis can be made based on history, clinical signs, distribution of lesions, age of affected birds, histopathology.

Prevention is by hygiene, all-in/all-out production, resistant strains, vaccination generally with 1500 PFU of HVT at day old (but increasingly by *in-ovo* application at transfer), association with other strains (SB1 Sero-type 2) and Rispen's.

Avian Influenza- Bird Flu

Bird Flu is transmitted by direct contact with secretions from infected birds, especially faeces, waterfowl, equipment, clothing and drinking water. Avirulent in one species may be virulent in others. Broken contaminated eggs may infect chicks in the incubator simulating vertical transmission. The virus is moderately resistant. It can survive 4 days in water at 22°C, over 30 days at 0°C. It is inactivated by a temperature of 56°C in 3 hours and 60°C in 30 min, by acid pH, by oxidising agent and by formalin and iodine compounds. *Avian Influenza is a potential zoonotic disease.* It can result in in-apparent infection, conjunctivitis or severe pneumonia.

Signs include ruffled feathers, soft-shelled eggs, depression and droopiness, sudden drop in egg production, loss of appetite, cyanosis (purplish-blue coloring) of wattles and comb, edema and swelling of head, eyelids, comb, wattles, and hocks, green diarrhea, blood-tinged discharge from nostrils, in-coordination, including loss of ability to walk and stand, pin-point hemorrhages (most easily seen on the feet and shanks), respiratory distress, increased death losses in a flock, sudden death, nasal discharges, nervous signs such as paralysis. Post-mortem lesions are inflammation of sinuses, trachea, air sacs and conjunctiva, ovarian regression or haemorrhage, necrosis of skin of comb and wattles, subcutaneous oedema of head and neck, dehydration, muscles congested, haemorrhage in proventricular and gizzard mucosae and lymphoid tissue of intestinal tract, turkey lesions tend to be less marked than those of chickens, while ducks may be symptomless, lesion-less carriers of highly pathogenic virus. A presumptive diagnosis may be made on history and post-mortem lesions. Commercial Elisa test kits are now available.

Prevention is by hygiene, quarantine, all-in/all-out production, etc help in prevention. Minimise contact with wild birds, controlled marketing of recovered birds. Vaccination is not normally recommended because, although it may reduce losses initially, vaccinated birds may remain carriers if exposed to the infection. In outbreaks, a regime of slaughter, correct disposal of carcasses, cleaning, disinfection, isolation, 21-day interval to re-stocking should be followed. Survivors can be expected to have a high degree of immunity but may harbour virulent virus.

Chronic Respiratory Disease (CRD)

CRD caused by *Mycoplasma gallisepticum* is associated with slow onset, in chickens, turkeys, game birds, pigeons and other wild birds. The route of infection is via the conjunctiva or upper respiratory tract with an incubation period of 6-10 days. Transmission may be transovarian, or by direct contact with birds, exudates, aerosols, airborne dust and feathers, and to a lesser extent fomites. Fomites appear to a significant factor in transmission between farms. Recovered birds remain infected for life; subsequent stress may cause recurrence of disease.

Signs include coughing, nasal and ocular discharge, poor productivity, slow growth, leg problems, stunting, in-appetence, reduced hatchability and chick viability, occasional encephalopathy and abnormal feathers. Post-mortem lesions are airsacculitis, pericarditis, perihepatitis (especially with secondary *E. coli* infection), catarrhal inflammation of nasal passages, sinuses, trachea and bronchi, occasionally arthritis, tenosynovitis and salpingitis in chickens. Diagnosis is by lesions, serology, isolation and identification of organism, demonstration of specific DNA can be used for diagnosis.
Treatment is by tilmicosin, tylosin, spiramycin, tetracyclines, fluoroquinolones could be used.

Pullorum Disease (Bacillary White Diarrhoea)

Disease is caused by one of the two poultry-adapted strains of *Salmonella* bacteria, *Salmonella pullorum*. The disease causes mortality in birds up to 3 weeks of age. Occasionally it can cause losses in adult birds, usually brown-shell egg layers. Morbidity is 10-80%, mortality is increased in stressed or immunocompromised flocks and may be up to 100%. The route of infection is oral or via the navel/yolk. Transmission may be transovarian or horizontal mainly in young birds and may sometimes be associated with cannibalism.

Signs are in-appetence, depression, ruffled feathers, closed eyes, loud chirping, white diarrhea, vent pasting, gasping and lameness. The post-mortem lesions are grey nodules in lungs, liver, gizzard wall and heart, intestinal or caecal inflammation, splenomegaly, caecal cores, urate crystals in ureters. Diagnosis is by Isolation and identification. Differentiate from Typhoid, Paratyphoid, para-colon, other enterobacteria, chilling and omphalitis.
For treatment, Amoxycillin, poteniated sulponamide, tetracylines, fluoroquinolones could be used.

Colibacillosis

Coli-septicaemia is the commonest infectious disease of farmed poultry. *It is most commonly seen following upper respiratory disease (such as Infectious Bronchitis) or Mycoplasmosis*. *It is frequently associated with immunosuppressive diseases such as Infectious Bursal Disease Virus in chickens or Haemorrhagic Enteritis in turkeys, or in young birds that are immunologically immature*. It is caused by the bacterium *Escherichia coli* and is seen worldwide in chickens, turkeys, etc. Morbidity varies, but mortality may range between 5-20%. Infection is by the oral or inhalation routes, and via shell membranes/yolk/navel, water, fomites, with an

incubation period of 3-5 days. Poor navel healing, mucosal damage due to viral infections and immunosuppression are predisposing factors.

Signs are respiratory signs, coughing, sneezing, snick, dejection, reduced appetite, poor growth, omphalitis. The post-mortem lesions include airsacculitis, pericarditis, perihepatitis, swollen liver and spleen, peritonitis etc. Diagnosis can be made by isolation, sero-typing, pathology.

Treatment is by amoxycillin, tetracyclines, neomycin (intestinal activity only), gentamycin or ceftiofur, potentiated sulphonamide, flouroquinolones.

Fowl Cholera

Fowl Cholera is a serious, highly contagious disease caused by the bacterium *Pasteurella multocida*. The disease can range from acute septicaemia to chronic and localised infections and the morbidity and mortality may be up to 100%. The route of infection is oral or nasal with transmission via nasal exudate, faeces, contaminated soil, equipment, and people. The incubation period is usually 5-8 days. The bacterium is easily destroyed by environmental factors and disinfectants. Reservoirs of infection may be present in other species such as rodents, cats, and possibly pigs. Predisposing factors include high density and concurrent infections such as respiratory viruses

Signs are dejection, ruffled feathers, loss of appetite, diarrhea, coughing, nasal, ocular and oral discharge, swollen and cyanotic wattles and face, swollen joints, lameness. Post-mortem lesions are sometimes none, or limited to haemorrhages at few sites, enteritis, yolk peritonitis, focal hepatitis, purulent pneumonia (especially turkeys), cellulitis of face and wattles. Diagnosis is by impression smears, isolation.

Treatment is by sulphonamides, tetracyclines, erythromycin, streptomycin, penicillin. The disease often recurs after medication is stopped, necessitating long-term or periodic medication. Prevention is by biosecurity, good rodent control, hygiene, bacterins at 8 and 12 weeks, live oral vaccine at 6 weeks.

Infectious Coryza

A usually acute, sometimes chronic, highly infectious disease of chickens characterised by catarrhal inflammation of the upper respiratory tract, especially nasal and sinus mucosae. Infectious Coryza is caused by the bacterium *Haemophilus paragallinarum*. Morbidity is high but mortality low if uncomplicated although it may be up to 20%. The route of infection is conjunctival or nasal with an incubation period of 1-3 days followed by rapid onset of disease over a 2-3 day period with the whole flock affected within 10 days, resulting in increased culling. Carriers are important with transmission via exudates and by direct contact. It is not egg transmitted. The bacterium survives 2-3 days outside the bird but is easily killed by heat, drying and disinfectants.

Signs are facial swelling, purulent ocular and nasal discharge, swollen wattles, sneezing, dyspnea, drop in egg production of 10-40% etc. Post-mortem lesions are catarrhal inflammation of nasal passages and sinuses, conjunctivitis, eye-lid adherence, caseous material in conjunctiva/sinus, tracheitis. A presumptive diagnosis may be made on signs, lesions and identification of the bacteria in a Gram-stained smear from sinus. Confirmation is by isolation and identification.

Treatment is by streptomycin, Dihydrostreptomycin, sulphonamides, tylosin, and erythromycin. Flouroquinolones are bactericidal and might prevent carriers. Vaccines are used in areas of high incidence.

Aspergillosis

It is a fungal infectious disease, caused by *Aspergillus fumigates.* The typical sign is gasping for breath, especially in young chicks. Sometimes the same organism causes eye lesions or chronic lesions in older birds. The fungus can infect many species of animals including birds and man. The infection has an incubation period of 2-5 days. Morbidity is usually low, but may be as high as 12%. Mortality among young affected birds is 5-50%. Transmission is by inhalation exposure to an environment with a high spore count; there is usually little bird-to-bird transmission. Yellow to grey nodules or plaques are seen in lungs, air sacs, trachea, plaques in peritoneal cavity, may have greenish surface. Conjunctivitis/keratitis, and brain lesions may be seen in some birds with nervous signs.

Coccidiosis

Coccidiosis is infection caused by protozoa *Eimeria* species. The disease is seen in young birds under conditions of warmth and high humidity or conditions that lead to wet litter. Oocysts are present in the litter having been deposited there by infected chickens. Oocysts are easily transported by blowing dust, boots, clothing, crates, vehicle wheels, other animals, and people. Susceptible chickens ingest sporulated oocysts in feed, water, litter and become infected. If exposure is moderate, the chickens become immune to that species of coccidia.
Pathogenic species cause diarrohea which may be mucoid or bloody, dehydration, ruffled feathers, anemia, listlessness, weakness, retraction of the head and neck, somnolence, depigmentation of skin. Mild to severe enteritis that can lead to thickening of the mucosa is often seen. Transverse white to gray striations are often visible in the mucosa. With *E. tenella,* blood is often apparent in the ceca and feces in early cases. Later, *cheesy cecal cores may be found.*

Anticoccidials in the feed: DOT, Maduramycin, Salinomycin may help in prevention. Treatment is by amprolium, agribon, sulfaquinoxaline, sulfamethazine.

Roundworms

Ascaridia spp. are nematode worm parasites, stout white worms up to 12 cms in lengt. The parasite species vary: *A. galli* in fowl; *A. dissimilis* in turkeys; and *A. columbae* in pigeons. The route of infection is oral usually by direct ingestion of the embryonated egg and there is a 5-10-week prepatent period, shorter in young birds. Microscopic examination with identification of worms, oval smooth-shelled non-embryonated eggs in faeces aids in diagnosis.
Treatment is by Flubendazole, levamisole, piperazine as locally approved.

Tapeworms

Cestodes are tapeworms that are seen in many species; they may not be host specific. Most have intermediate invertebrate hosts such as beetles or earthworms.
Flubendazole is effective at a 60 ppm in diet.

External Parasites

The most common external parasites seen in poultry are lice and mites. Pyrethroids, organophosphates, carbamates, citrus extracts, vegetable oil and mineral-based products (both

liquid sand dusts) have been used to control external parasites. Treat the walls, floors, roosts, nest boxes, and the birds simultaneously.

Metabolic and nutritional diseases

These are conditions caused by a disturbance of normal metabolic functions either through a genetic defect, inadequate or inappropriate nutrition or impaired nutrient utilization. Rickets, Caged layer fatigue and Fatty liver syndrome are nutritional diseases that affect laying hens and can account for a high percentage of the flock mortality. Metabolic diseases affect internal body metabolism and development, and are the cause of a large portion of mortality in both commercial and back-yard poultry flocks. One of the main factors affecting these diseases is rapid growth rate. Two of the more important types of metabolic diseases are the cardiopulmonary disorders, sudden death syndrome and ascites.

Other diseases

Abnormal behavioral patterns can lead to injury or ill health of the abnormally behaving bird and/or its companions. These include Cannibalism (or aggressive pecking).

Proper health management of birds is very critical for a poultry farm to be successful and commercially profitable. Chickens are prone for various diseases (infectious, parasitic, metabolic, nutritional and behavioral), which significantly hamper their livability and performance. It is imperative to identify the disease based on symptoms, post-portem lesions, serology/molecular techniques etc. and develop appropriate protocols for its prevention and control through medication and vaccination.

Important parasitic diseases of mithun

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Introduction

Mithun (*Bos frontalis*), belongs to class mammalia, order Artiodactyla and family bovidae, plays a very important significant role in tribal society of Arunachal Pradesh, Nagaland, Manipur, and Mizoram. This animal confines to the jungle of the forest and also keeps in touch with both domestic and wild animals. Due to wild habitat and ecology, they pick up the different infections. Most of the infection is always unnoticed and always out of touch with a veterinary officer. Besides this tropical climates like high rainfall, high humidity (70%- 80%), varying temperature (15-35°C) favor the completion of the life cycle of parasites. This present article, will discuss the different parasites that occurred in mithun and their suggestive control measure.

Helminth parasites

Trematodes

The different gastro-intestinal trematode recorded in mithun based on faecal and Postmortem examination were as *Fasciola gigantica*, *Gastrothylax crumenitar*, *Paramphistomum epiclitum*, *Calicophoron calicophoron,* and with few unidentified Amphistome . Occurrence of this termatode is always based on a suitable climate along with the presence of a snail intermediate host in the particular mithun inhabited area for completion of their life cycle. As per our extensive investigation, the prevalence of these parasites was more common in Arunachal Pradesh and even clinical cases were also recorded in these areas. Mithun confining in this region more closely with the low lying areas of Assam particularly Lakhimpur, Sonitpur, and Dhemaji district of Assam. ICAR-NRC on Mithun, Medziphema has already extended help for this region in the form of Animal health Camp, Mithun Mela, and Technology injection programme as well as extensive regular deworming.

The existence and propagation of any fluke infection in any area not only depends on the presence of the snail but also on favorable climatic and ecological conditions that may be appropriate for the parasite as well as the intermediate host. In most of the tropical developing

countries, the temperature is generally favorable for the development of both the fluke and their intermediate host, but due to the variations in the precipitation and humidity, there are fluctuations in the development of snail and free-living stages of the parasites. There is a marked increase in the reproduction of snails in the rainy season that leads to a peak in the snail population towards the end of the season. This trend slows down or completely ceases during the dry or cold periods resulting in less snail population in the dry season which resulted in the fluctuation of herbage infestation and influences the survivability of the infective stage of metacercariae. The infective stage may survive up to 10 months in the humid tropics and also rate of egg production by the adult flukes which subsequently influences the degrees of pasture contamination. Besides, the grazing habits and management of the animals may significantly influence the epidemiology of liver fluke infection.

Gastrointestinal nematodiasis

Gastrointestinal nematodiasis is a major problem encountered in mithun calves. The different gastro-intestinal helminthes recorded are as follows *Trichostronglylus* sp, *Haemonchus* sp. *Mecistocirrus digitata*, *Toxocara vitulorum*, *Strongyloides papillosus*, *Bunostomum phlebotomu*n, Capillaria species, Oesophagostomum sp and *Nematodirrus* species . These parasites were directly or indirectly associated with parasitic gastero-enteritis. *T.vitulorum, S. papillosus*. *Haemonchus* and *Mecistocirrus* were mainly responsible for calfhood mortality . Reported clinically symptoms were progressive loss of body coat, emaciation, faces may contain blood & mucous. Mud-coloured diarrhoea is the common symptom of *T. vitulorum* infection. Frequent death of claves has been reported in *Haemonchus* and *Mecistocirrus* infection. Pale mucous membrane is the common symptoms of the blood-sucking worms. The infiltration of polymorphonuclear infiltration in the sub-mucosa with the hyper activity of goblet cells leading to occlusion of the gland is the major histopathological lesion in Toxocara infected case in tissue section of the small intestine. There was evidence of diffuse hyperemia, thickening, and ulceration of the intestinal mucousa in the Amphistomiasis cases. There was a record of petechial haemorrhage in the anterior part of the duodenum and jejunum. Presence of parasites in the abomasal mucosa revealed the presence of petechial haemorrhages.

In our farm condition, pimply gut is commonly observed in died mithun calves and is due to repeated infection and chronic exposure of Oesophagostomum infection and extensive

greyish white nodule observed in the entire rectum and large intestine. The nodules were greyish white in colour ranging in size from pinhead to a pea and the entire intestinal wall was thickened, congested and edematous with mild haemorrhages. Histopathologically, the rectum revealed congestion and haemorrhage of mucosa and submucosa . Most of the cases, encysted larvae were visible in the muscularis mucosae and in the submucosa surrounded by eosinophilic infiltration and fibrous connective tissue proliferation. Chronic enteritis is a common sequelae of this condition and its commonly evidenced by mononuclear cell infiltration comprising mostly machrophages, lymphocytes, and eosinophils. It occurs due to immunopathological phenomenon with, eosinophil, mass cell, leucocyte & neutrophil. The resulting nodules were often associated with diarrhoea of the infected animal and inability to digest food aeccompanied by extreme weight loss, weakness resulting in death. Animal showed hunched back condition and have a stiff gait whereas in less severe infection will have intermittent diarrhoea with weight loss and reduction in meat production. In farm conditions, management of the animals along with browsing habits of grazing significantly influence the epidemiology of *Oesophagostomum* and other strongyle infection in mithun. Whip like worms Trichuris also recorded in the rectum of mithun and histopathological showed both hypertrophy and hyperplasia of the goblet cells with hyperactivity of goblet cells. In some places, there is focal aggregation of mononuclear cells .

The development, survival and transmission of eggs and infective larvae are influenced by climatic and environmental factors like temperature, humidity and precipitation. These factors often lead to seasonal fluctuations in the availability of infective larvae which subsequently affects the prevalence of infections and worm burdens in the host. These epidemiological factors could be the same for mithun under farm conditions throughout the year, whereas, these factors might not be severe for precipitation of disease in mithun under free-range conditions in all the seasons.

With regard to transmission, it is anticipated that higher the stocking rate have higher may be the parasitic infection rate in the animal herds. The larvae of some genera of nematodes are able to delay the maturation to adult stages and this phenomenon is known as hypobiosis. However, the onset of the rainy season that is the most favourable period for larval development and transmission may be a predisposing factor for subsequent resumption of

parasitic development. This may occur as a manifestation of acquired immunity of parasites or as a result of prior exposure to adverse climatic conditions during the stages as free-living larvae. The grazing animals generally harbor a variable but a significant number of worms and high stocking rate of the animals help in transmission of parasite within the population of animals. Subsequently, faecal egg counts decline and remain consistently low during the dry season. At the onset of the rainy season, the pasture larval challenge and intake of infective larvae is high and as a result, there is a sharp increase in the egg output. This is the most common existing pattern. The commonly available drinking ponds may be sufficiently enough to maintain humidity for optimum larval development and transmission throughout the year.

Microfilaremia

Microfilaria is also a commonly observed condition in mithun and is mostly transmitted by Culicoids mosquito. However, it is not producing any clinical symptoms. It has been recorded from both Arunachal and Nagaland based on post-mortem examination. Based on gross morphology and PCR amplification of marker genes, it is identified as Setaria digitata .

Cestode infection

Among cestode infection, *Moneizia benedeni* and *M.expansa* are commonly recorded in adults and calves. The cyticercoid always develops in orbatid mite and which perpuates the completion of life cycle of parasite. Pot belly and dry skin is the common problem encountered in claves. The presence of a suitable intermediate host for cestode and favorable climatic conditions influence the epidemiology and prevalence of parasites in animals. The highest mean seasonal egg counts are observed in animals below 1year, then 1-3 years in the winter season. In animals above 3 years, the infection level is insignificant . Although fenbenolazole is the drug of choice but the management of claves with proper balance feed along with regular deworming is the ultimate choice . Another most common parasite recorded mithun in post-morterm is Hydatid cyst caused by *Echinococcus granulosus*, although we have reported *E. ortileppi* from two mithuns from Arunachal Pradesh which is very much zoonotic significance. Out of 110 animals examined in postmortem, 16 animals were found to be positive for Hydatid cyst. Based on molecular markers like Nad1 and Case1, we have genotyped the *Echinococcus granulosus* and documented this parasite. Histopathological examination of hydatid cysts in the

liver, showed extensive fibrous connective tissue proliferation with eosinophilic and lymphocytic infiltration, whereas in lung, parenchyma showed severe emphysema with infiltration of alveolar macrophages and lymphocytic infiltration . This parasites cause severe pressure atrophy in liver, lungs, spleen and kidney. Occurrence of these parasites in mithun population might be due to sharing of the wild sylvatic cycle with dogs, fox and wild canids.

Protozoal infection

Among tissue protozoa infection, coccidiosis is regarded as one of the commonly reported species with high morbidity in management. The common *Eimeria* species reported in mithun are *Eimeria bovis, E. zuernii, E. ovoidalis, E. bukidonensis E. auburnensis, E. ellipsoidalis, E.subspherica* and *E. albamensis* due to optimum climatic conditions for sporulation of oocyst. The prevalence of Eimerian species is generally highest in pre-monsoon than that of other season. Infestation with Eimeria species has been reported to be in all age groups of mithun. Comparatively, the pathogenicity has been observed to be always higher in young mithun. The severity of eimeriasis in ruminants may be correlated with different managemental factors. The incidence is higher in animal herds reared under the semi-intensive system with the unhygienic condition. On the contrary, the incidence of eimeriasis is compared to be low in animals raised under free-range system.

Toxoplasmosis is another tissue protozoan that affects most of the warm-blooded animals. However clinical cases of toxoplasmosis have not been reported in Mithun so far. However, there have been reports of serological prevalence in Mithun inhabited in Nagaland . The prevalence of *Toxoplasma gondii* infection in Mithun has been found to increase with the increase in age of the animal. The possible reason for the occurrence of *T. gondii* antibodies in the northeastern region could be due to the location of the area close to human settlements where cat's population is very high and being kept as pet animals. Wild canids like dog and fox are serious problem for Mithun rearing. Mithuns inhabited at lower altitude are more vulnerable to *T. gondii* infection as compared to Mithun inhabited in higher altitude. Probably, these wild carnivorous animals maintained sylvatic type of infection. Out of 195 animals examined, only 4.10% animals were found to be suspected and 0.51% found to be positive in terms of seroprevalence against *T. gondii* .

Ectoparasites:

Ticks cause huge economic losses as a result of injury, tick pyrexia and tick paralysis, besides transmitting various pathogens including bacteria, virus and protozoan parasites to the host animals. The environmental conditions of the region greatly favour the survival and reproduction of ectoparasites leading to poor body conditions, reduced growth leading to decrease production performance of animals. In the seasonal study, prevalence of *Rhipicephalus microplus* was highest in the summer season . The reason for such variation is that the major factors that govern the distribution of tick population have been well defined that the rainfall has been indicated as the limiting factor for distribution of ticks. Prevalence of *Amblyomma testudinarium* and *Linognathus vituli*, a sucking louse of cattle, has also been reported in Mithun. *Ixodes ovatus* and *I. acutitarsus* from mithun have been identified based on the morphology of ticks and PCR amplification and subsequent sequencing. The comparative efficacy of some plant extracts on *Rhipicephalus (Boophilus) microplus* infestation in Mithun in the Northeast has also been documented. Leech infestation is one of the common problem and regarded as the greatest nuisances faced by the farmers of this region is a common problem for cattle and mithuns reared under free-range conditions. The leech attaches to the body surface, nasal cavity as well as reproductive organs of the animals. The leech is an occasional blood-sucking parasite that secretes an anticoagulatory substance that lead to continuous bleeding, even after dropped off from the body of the animal. Therefore, the amount of blood loss by an animal due to leech infestation is enormous considering the amount of blood consumed by a leech.

Sustainable parasite control measures against parasite

Use of anthelmintics

Due to suitable environmental conditions prevailing in the region, the parasite population is at high level and causing severe health problem in free-ranging animals including mithun. The NEH region provides ideal condition mainly because of pastoral rearing of cattle for perpetuation of the life cycle of different parasites. The control of parasite is solely focused on the repeated application of synthetic chemicals leading to many problems in the form of anthelmintic resistance . There is a wide range of commercial anthelmintic formulations available in the market, which are effective against different helminth population. Therefore, a veterinarian should adopt real practical measures to prevent anthelmintic resistance

considering the different factors like mode of action of a particular anthelmintic, frequency of treatment, dose and route of drug administration., against which type of parasite as well as management system of particular farm or locality in their topography and geographical climate. The different drugs which are commonly used in mithun are shown in the table 1.

Table 1. List of commonly used Anthelmintics

Sr. No.	Anthelmintic	Used against	Dose (mg or ml / kg body wt.)	Route
1	Tetramisole	Roundworm	7.5mg	S/C ly
2	Levamisole	Roundworm	7.5 mg	S/C ly
3	Pyrantel	Tapeworm	10mg	Orally
4	Morantel	Broad spectrum	10-20 mg	Orally
5	Benzimidazole group	Broad spectrum	7-15 mg	Orally
6	Niclosamide	Fluke infestation	90 mg	S/C ly
7	Oxyclozanide	Fasciolosis Amphistomiasis	10mg	Orally
8	Triclabendazole	Fasciolosis	9 mg	Orally
9	Ivermectin	Broad spectrum	0.02ml	S/C ly
10	Doramectin	Broad spectrum	0.02ml	S/C ly

Herbal anthelmintics

Indiscriminate use of anthelmintic results in the development of resistance against parasites, which can increase the cost of treatment, reduce production efficiency and increase the risk of environmental contamination, which is one of the global phenomenon. There have been reports of resistance in *Cooperia spp*., *E. granulosus* as well as *Cooperia punctata*, *Haemonchus placei*, *Ostertagia ostertagi* against anthelmintic drugs like bezimidazole, imidazole and Ivermectin . In order to overcome this problem, herbal based remedy is the alternative solution in the present scenario of the world. Plant-derived anthelmintics are easily biodegradable, eco-friendly and cost-effective and free from adverse side effect in comparison to synthetic anthelmintic drugs which leaves leaves residues in faeces after treatment leading to deleterious effect on the environment. The most commonly known plants, which are used by

local people as an indigenous traditional knowledge for their anthelmintic principle areas *Allium sativum*, *Anacardium occidentale* (cashew), *Ananas comosus* L. Merr (pineapple), *Areca catechu, Cucurbita domestica and Nicotiana tabacum*. The part of these plants which are used for anthelmintic property are bulb , skin of fruit, fruit/juice of fruit, seeds, rhizome and leaves are commonly used as anthelmintic by the village since as old days.

Grazing Management based on epidemiological knowledge

In a worm control program, the role of grazing management based on epidemiological knowledge is to provide clean pasture on which animals may graze safely. Grazing management can be considered an important tool for reducing the helminth incidence in organized farming conditions. The different practices associated with the management of animal production are based on geographic location, choice of production system, and specific objective for reducing parasitism. The effects of managemental variables such as stocking rate, the timing of parturition and weaning, usage of fodder crops, fodder conservation, and choice of pasture species have been reviewed elsewhere. The grazing management also offers a formidable solution for organic animal production in near future.

Alteration of host species

To the extent that two or more host species in any given environment don't share common parasite species, alteration between species can be successful means of enhancing worm control. Grazing of mithun along with sheep may be another option in which not sharing of common species of parasites by the mithun as well as sheep.

Rotational grazing

This comprises the withdrawal of the susceptible host from the pasture/forest until the free living parasitic stages have died due to aging and environmental exposure. After that animals are allowed for grazing the pasture, which is free from larval contamination. It is impractical under intensive farming conditions and in the temperate climate since the long survival time of the infective larvae on pasture that requires a longer period of resting. Nevertheless, this may be a practical method for parasitic control in tropical countries where extensive farming is practiced and grazing fields are abundant.

Clean pasture approach

Under this practice collection and removal of deposits from pasture is done by pasture sweeping or vacuum cleaning twice in a week. This is a costly but effective measure that is practiced in some animal farms in USA. However, a similar type of practice is not feasible for Mithuns and other animals reared under Indian conditions.

Forecasting

On the basis of data on environmental factors like the number of rainy days, amount of rainfall, temperature, and prevalence of helminth infection in a year, it is possible to estimate the rate of parasitic infection in pasture and predict the risk of future worm infection. Adoption of such a forecasting system may assist farmers to implement timely and appropriate measures against specific parasitic infestations.

Biological Control

India has initiated the biological control using the nematode-trapping fungi, viz., *A. oligospora* and *D. flagrans* and two species of egg parasitic fungi, viz., *Paecilomyces lilacinus* and *V. chlamydosporium* were isolated from the organic environment of Gujarat and Chhattisgarh . The study indicated that the isolates of *D. flagrans* and *V. chlamydosporium* fulfilled all the possible criteria. Successful pilot-scale trials with *D. flagrans* chlamydospores through feed supplement, feed blocks and slow-release devices provide sufficient euphoria for commercial exploitation of fungal delivery devices in future integrated parasite control programmes. Besides being safe for animals and man, it is imperative that new technologies dealing with biological control need to be of no negative impact to the grazing environment.

Medicated Feed Blocks as an option for sustainable parasite control

Medicated feed block is one of the concepts of using of different anthelmintic along with feed supplements for sustainable parasite control in organized farm conditions. The prolonged presence of a low level of benzimidazole chemicals can efficiently control nematode parasites . With this principle, NDDB has been successfully initiated with benzimidazole group of drugs like Fenbendazole, Albendazole and other anthelmintic with varying degrees of success. In semi-intensive mithun farming, this medicated feed block can be a promising solution for helminth parasite particularly Strongyle group of parasites. The prolonged low-level administration of benzimidazole anthelmintics with feed block can be used for the only preventive purpose only; this option will not be feasible for a curative form of treatment.

Immunological approach to control helminth parasite

Recent development of molecular biotechnology has opened up a new chapter not only on disease diagnosis but also parasite control measures. Different diagnostic kit has been developed through recombinant DNA technology particularly for tissue protozoa (Knox *et al.* 2001). Based on diagnostic kits, many pre-parasitic stage of parasite in the blood and tissue stage can be identified and proper curative and preventive measures can be adopted. Development of GAVAC vaccine for *Rhipicephalus microplus* by Brazilian workers, tremendously successful for control of ticks. Likewise, irradiated vaccine of third stageof *Dictyocaulus viviparous* namely "Dictol" was a great success in parasite history. Moreover, India has also produced vaccine under the brand name 'Difil' that is effective against the lungworm *Dictyocaulus filarial* in sheep. Although, a lot of vaccines has been produced by the scientist of the world, however, none of vaccine company come forward for the marketing of vaccine against a parasite .

Summary and Conclusions

Based on faecal examination and post mortem examination in both free-ranging and semi-intensive condition, different recorded trematodes were as *Fasciola gigantica*, *Gastrothylax crumenifer*, *Paramphistomum epiclitum*, *Calicophoron calicophoron* and with few unidentified amphistome. Gastrointestinal nematodes present mainly as *Trichostronglylus* sp, *Haemonchus* sp. *Mecistocirrus digitata*, *Toxocara vitulorum*, *Strongyloides papillosus*, *Bunostomum phlebotomu*n, Trichuris sp., Capillaria species, Oesophagostomum sp and *Nematodirrus* species.The most prevalent *Eimeria* species reported in Mithun were *Eimeria bovis, E. zuernii, E. ovoidalis, E. bukidonensis E. auburnensis, E. ellipsoidalis, E.subspherica* and *E. albamensis* as well as *Toxoplasma gondii* in Mithun from north eastern hilly region of India. Among ectoparasites, recorded ticks were *Rhipicephalus microplus*, *Ixodes bovis*, *I. acutitarsus* and *Ambylomma testuidinarium* as well as lice *Lignothanus vituli* in Mithun.

The controlling measure against parasites have to be followed depending on the variations in the epidemiology parasites, ecology, microclimate of parasite along with suitable environment for parasite propagation. We have to broke down the chain of the infection cycle, so that infection could not spread by any means. Moreover, in a situation where the incidences

of anthelmintics resistance are increasing so rapidly, the herbal drug therapy may be considered as another promising option instead of synthetic or chemical anthelmintics. Moreover, the approach of veterinarians towards the parasite control along with farmer's active cooperation is the only solution towards the parasite control. Even though, we have many approach towards for parasite control, it is high time for scientific faculty to control these problem in semi-intensive farming and free range condition against the parasites by combining all the methods right from chemical to a vaccine against the parasite in the coming days.

DEMONSTRATION OF DRAUGHT POTENTIAL OF MITHUN

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Introduction

Draught animals still play an important role in some rural areas of the world; even with the present efforts of mechanisation it has not been possible to replace bullock power to an appreciable extent. According to Dayal (1982) 67 percent of energy input in Indian farming enterprises come from animal sources, 23 percent from human exertion and the remaining 10 percent from fossil fuels. Keeping in view the energy crisis, supply of petroleum product is short and their cost has accelerated. This problem is likely to increase in future and it is possible that oil may not be available for agricultural operations. Bullock power being an alternative source of energy is, therefore, a boon to the Indian economy, especially in the era of energy crisis.

The role of Draught Animal Power (DAP) on Indian farms is slowly decreasing due to partial replacement of animal power by electric motors and petroleum run vehicles. However, draught animals still contribute and will continue to do so to farm power and provide necessary transport to majority of rural villages in India. At present energy for ploughing more than 75% of cultivated area is contributed by these animals. Tractors and power tillers become viable only for those people having holdings above 5 hectares (S.V. Singh and R.C. Upadhyay, 1997). Marginal and small farmers thus are unable to afford the mechanization.

Work performance largely depends on animal structure and coordination in various physiological capacities related to work. Heavy animals possess more pulling capacity than light animals (Goe and McDowell 1980). The body dimensions and morphology of large animals differ from small animals. Large Animals, though they are able to pull more, are not as manoeuvrable as small animals and hence more slowly (Upadhyay), 1989).

Mithun

Mithun (Bos Frontalis), “The cattle of the mountains” is a rare species of bovine and has a limited geographical distribution. Mithun is rightly known as “Pride of NEHR” of India and plays an important role in the economic, social, cultural and religious life of the tribal population. The animal is reared by the tribal community mainly for meat purpose.

Looking at the diversity of the animal (Mithun) in terms of adaptability, quality of meat, ability to thrive on coarse fodder, grazing on steep hills, semi wild nature of the animal, cross ability with cattle etc. there is much scope for the improvement and utilization of this species of animal. No studies on the ability of this species in reference to agricultural operations and their effect on the physiological, hematological and biochemical picture was carried out as per available literature till date.

Load carrying and fatigue evaluation:

An attempt was made to calculate the fatigue score and to determine the ability of Mithun to carry load. Prior to actual experiment, the animals were trained to carry load (10% of their body weight) and the physiological parameters were also recorded before the start of the experiment. All the experimental animals carried (load) 10% of their body weight and then they were made to walk on an even ground for one and half hour after which physiological parameters were recorded. To evaluate the fatigue score in mithun the duration of load carrying was increased to two hours. The duration was increased to see the sustainability of mithun on load carrying. The physiological parameters like respiration rate, pulse rate and rectal temperature were recorded after one hour work and after two hour work.

The fatigue score system followed for animal fatigue evaluation was based as per the model of Upadhyay and Madan (1985) which is presented in Table-1. The fatigue score was used to record the level of fatigue and expression of behavioural and distress symptoms. Physiological reactions, namely pulse rate, respiration rate and rectal temperature were scored on five point basis. For pulse rate each 10 pulse/min rise above initial resting rate was assigned a score of +1 point. For respiration a rise of 15 breaths/min and for rectal temperature 0.5°C rise above resting values meant a score of +1 point. Animal excitability was given a score of 5 point with no excitement to highly furious. Leg in-coordination and no movement inhibition were scored in similar manner. Appearance of froth was scored, froth appearance to full mouth frothing considered in ascending order. Tongue protrusion was taken into account from occasional appearance to full mouth open and tongue remained out continuously. This score totalled 40 points out of which, the animals if attained a value of 20 were declared fatigued.

Based on the model used by Upadhyay and madan (1985) the fatigue score was recorded after one hour work and it was found to be 19.40 ± 0.304 with the value ranging from 18 - 22 and in case of two hours work it was found to be 30.20 ± 0.561 with the value ranging from 28 – 33. The experimental animals during work were observed for behavioural manifestations and physiological reactions. The animals were scored for the increase in rectal temperature, respiration rate and pulse rate after one and two hours of work. The changes in frothing, leg in-coordination during work, level of excitement, tongue protrusion and panting and inhibition of movement during the work were scored. So far, there is no standard fatigue score card for mithun and no studies have been carried out in this respect. So, basing on the visual observation the animals were scored. The details are given in the Table-2

Parameters	Load carrying	
	1 hour	2 hours
Pulse rate (min)	3	3.37
Respiration rate (min)	5	5
Rectal temp.(°F)	3.04	3.87
Frothing	3.62	4.70
Leg incoordination	0.33	1.91
Excitement	0.41	3.33
Inhibition of progressive movement	0.25	3.20
Tongue protrusion	3.75	4.83

Table-2 : Mean fatigue scores for physiological and physical parameters after one hour and two hours of load carrying in mithun.

Parameters	Work (load carrying)	
	1 hour	2 hours
Mithun	19.40 ± 0.304 (18 – 22)	30.20 ± 0.561 (28 – 33)

Table - 3: Mean fatigue score during load carrying.

In Mithun the fatigue score varied from 18 – 22 with an overall mean of 19.40 ± 0.304 out of total score of 40 after one hour work, indicating that the animal showed vigorous changes in behavioural manifestations and changes in physiological reactions. The level of fatigue at two hours of work showed an overall mean of 30.20 ± 0.561. The fatigue score in this case varied from 28 – 33. In the first hour the animal had the capacity to carry a moderate load (10% of body weight) though the animals were near fatigue. In the second case (two hours work) the animals were declared fatigue because of continued work. At this stage the animals exhibited

signs of distress i.e. profuse salivation, excitement, leg in-coordination, movement inhibition and tongue protrusion etc.

Conclusion

Behavioural symptoms due to work were more pronounced as the work duration increased. However, as per the visual observation upon the animal for evaluation of fatigue, the sustainability of the animal towards work seemed low. Moreover the score assigned to the animal as per the model of Upadhyay and Madan (1985) the animal showed capability to carry load (10% of body weight) for one hour but signs of distress towards the end of two hours of load carrying was noticed. It is however, envisaged, that proper training and management would further improve the efficiency towards work.

Table-1: Fatigue score card used for fatigue measurement of experimental animals

Parameters	Scre card ans Score scale					
	1	2	3	4	5	Total
Respiration rate (RR) per min	RR+15	RR+30	RR+45	RR+60	RR+75	5
Heart rate(HR)/Pulse rate(PR) per min	PR+10	PR+20	PR+30	PR+40	PR+50	5
Rectal temperature(RT) (°C)	RT+0.5	RT+1.0	RT+1.5	RT+2.0	RT+2.5	5
Frothing	First appearance	Dribbling of saliva starting	Continuous dribbling	Appearance of froth on upper lips	Full mouth frothing	5
Leg in- coordination	Stride uneven	Occasional dragging of feet	Movement of legs, feet uncoordinated and frequent dragging of feet	No coordination in fore and hind legs	Unable to move	5
Excitement	Composed	Disturbed	Nostrils dilated and bad temperament	Movement of eye wall prominent with excitement	Furious and trying to stop	5
Inhibition of progressive movement	Brisk	Free movement	Slow walking	Very slow	Stop walking	5
Tongue protrusion	Mouth closed	Occasional opening of mouth	Frequent appearance of tongue	Continuous protrusion of tongue	Tongue fully out	5

RR, HR/ Pulse rate and RT represent initial respiration rate, pulse rate and rectal temperature, respectively.

Source: Upadhyay and Madan (1985)