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Golden Jubilee Celebrations

VET ALUMNUS

Special Issue

.....Official organ of the Alumni Association, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana.....

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Note: Authors are sole responsible for the contents given in articles

Message from President

Dr. Parkash Singh Brar
Dean, College of Veterinary Science
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It gives me immense pleasure to welcome you on the alumni association meet to commemorate fifty years of glorious journey of the College of Veterinary Science, Ludhiana from 1969 to 2019. Since the establishment, the college has taken many strides to reach among the top veterinary colleges of the country. This alumni meet is the part of the golden jubilee celebration of this college.

The alumni association of the College of Veterinary Science was established in 1987 with Dr. Balwant Singh as its founder president. The association was formed with the prime objective of building a strong relationship between the alumni and the college for providing technical information to the alumni and keep them abreast with advancements in veterinary Science. Such meets provide an opportunity for alumni to meet their teachers, classmates, senior and junior pals.

Alumni are the pillars as well as the mouth piece of an institute. They serve as brand ambassadors to disseminate the message of the institute. Though over the years, the college has made phenomenal growth in every sphere, the knowledge, skills and feedback of alumni can help in many ways in futuristic development for making the college competent at the global level.

I feel extremely honoured to serve our alumni in the capacity of president. I would like each one of you to revisit your alma mater to revive your golden memories created during your college days.

In the end, I again welcome you all and invite suggestions for the all-round growth of the college to produce the global competent human resource.

Sd/-
P.S. Brar

From Secretary's Desk

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GOLDEN JUBILEE CELEBRATIONS OF COVS

It gives me immense pleasure to pen down for the golden jubilee celebrations of the college of veterinary science during the Alumni association meet. Since, the start of college in 1969, it has produced one of the best Veterinarians of the globe. Alumni association feel proud in sharing that thousands of veterinarians are serving at different places, positions and organizations around the globe. People respect and try to learn etiquettes as well as commitment of the alumni of the Veterinary College, Ludhiana. I've seen and heard people talking when vets from Ludhiana are out of its nurturing place, they are at different level and commitment. They work sincerely, dedicatedly and keep the reputation of its Alma mater in mind. They are sober in dealing but hard in performing and providing best of the care to the animals and homosapien.

Now, Alumni association is celebrating golden jubilee of the COVS, Ludhiana. Earlier, association celebrated Silver Jubilee of the alumni association in 2013 followed with Pearl Jubilee celebrations in 2018. I'm thankful to Respected late Dr Balwant Singh, the founder president and other executive members who made strong pavement of this association. Further, I thankful and acknowledge all the veterinarians /authors/scientists/alumni for performing exceptionally well and also for submitting the articles to the Vet Alumnus. Suggestions are always welcome with smiling face.

I wish you all a very Happy, Prosperous and Memorable New Year – 2020.

Sd/-
H. K. Verma

COLLEGE OF VETERINARY SCIENCE: GLORIOUS 50 YEAR OF SERVICE TO ANIMAL HEALTH AND PRODUCTION

The greatness of a nation and its moral progress can be judged by the way its animals are treated." — Mahatma Gandhi

The knowledge of veterinary science existed since the ancient periods when the veterinary education was imparted by the Gurus through their experiences & expertise. Animal Husbandry progressed in the Mauryan age and received further push during the regime of King Ashoka, who opened hospitals for humans & animals. East Indian Company in later part of 18th century opened veterinary schools in India to dial with rampant equine diseases & cattle plague. First Veterinary School was established in 1862 at Poona. Later on, it was upgraded as the first Veterinary College of pre-independent India at Lahore in 1882 and was named Punjab Veterinary College. A part of the Lahore Veterinary College was shifted to Hisar soon after partition of India in 1948. With reorganization of Punjab State, College of Veterinary Science, Ludhiana was established at Punjab Agricultural University in November, 1969. The College was shifted to the Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana in 2005. The College has become center of regional, national and international excellence in research and learning in animal health and production over the years.It caters to the needs of Punjab by carrying out teaching, research, and extension education programmes relevant to livestock production and health. It has been instrumental in ushering in an era of **'White Revolution'** in the State.

The college has a highly competent and experienced faculty who have made significant contributions to alleviate animal health issues, bring about technological innovations to improve livestock production and thereby winning several accolades. From academic session 2016-17, the college has implemented the Veterinary Council of India- Minimum Standards of Veterinary Education for B.V.Sc. & A.H. Regulations-2016. The programme leading to award of the B.V.Sc. & A.H. degree is designed to equip graduates with the knowledge and skills essential to a prolific veterinary career. The programme is divided into three phases, pre-clinical, para-clinical and clinical phase exposing the graduating students to all the nuances of a professional career. All the departments in the college have excellent laboratory facilities and adequate infrastructure for the undergraduate and postgraduate teaching and research. A well-equipped veterinary teaching hospital is the most sought after facility to cater to the needs of large and small animal health care in northern India. In addition, the college also has an elite dairy herd, pig & goat farms and a poultry farm which provide excellent facilities for teaching and research. The college has the distinction of having three Centres for Advanced Faculty Training in Veterinary Gynaecology and Reproduction; Veterinary Surgery and Radiology and Veterinary Pathology. The college also has experiential learning programmes for students in Livestock Production and Management, Teaching Veterinary Clinical Complex, Department of Veterinary Medicine and Livestock Product Technology.

The college has an ultimate goal to produce Veterinary graduates, scientists and extension workers for promoting livestock health and production, thus improving the quality of rural life and economy of the farmer in Punjab.

It provides consultancy and specialist services to livestock owners, government, semi-government and allied agencies. Faculty development and students personality development programmes by providing them with opportunities to participate in appropriate training programmes, conferences, workshops, seminars, symposia, exchange programmes etc. It also encourages cooperation and collaboration with other departments, colleges, universities and industries, both nationally and internationally.

The college has completed 50 glorious year of its existence in 2019. The Alumni of this College are occupying several eminent positons at National and International levels. Its graduates have immense contributions towards nation building and uplifting the livestock sector as a whole. May this College continue to grow further and continue to contribute towards development of the livestock sector and economy of Punjab.

Parkash Singh Brar

Dean, CoVS

GADVASU, Ludhiana

SINGLE CONCEPT SINGLE TRAINEE INCULCATION APPROACH OF GADVASU

H K VERMA

DIRECTOR OF EXTENSION EDUCATION,

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Traditional livestock farming is undertaken by majority of farmers in India, which are either small, marginal or landless and possess major treasurer of livestock, however lack scientific knowledge for rearing them. Govt. is stressing on doubling of farmers income which is only possible through livestock farming either on commercial or through integrated farming. Punjab is an agrarian state with animal husbandry sector as an important subsector. Around seventy percent people of the state are involved in agriculture and allied activities and more than 83 per cent of the total land in the state is under agriculture. In 2016-17, agriculture had 23.96 per cent share in State's GDP while livestock had 8.63 percent share (Statistical Abstract Punjab, 2017). In the recent past, the share of livestock GDP in agriculture increased steadily. Livestock economy including fisheries contributed 29.60 per cent of the agricultural GDP in 2000-01 while the share increased to 36.01 per cent in 2016-17 and 37.65 (9.10%) in 2017-18. Livestock productivity of Punjab is highest in the country, however the major constraints faced by livestock sector are small herd size or livestock units, poor extension services concerning livestock sector, lack of proper and scientific nutrition interventions for different categories of animals, insufficient prophylaxis , poor value addition of the produce procured from small and marginal farmers, absence of culling policy for stray animals and male calves, poor linkages with consumer market etc. However, few farmers have adopted direct marketing and few self help groups or producer organizations are operational, but not sufficient to take full harvesting of the livestock productivity, later being in the hands of middlemen. Organizations like GADVASU are hub of knowledge, technologies and procedures and loaded with literature as well as newer protocols prevailing around the globe, for enhancing livestock productivity for its sustainability among the farmers. In spite of the best management practices provided at the farms, diseases in animals are bound to come

In India there are huge economic losses in animals occurring due to diseases amounting to more than one lac crore annually. There exists information burst at the institutions but the ground reality is that the percolation to the field level is poor (only 5% farmers have access to animal related information compared to 40% in crop and agriculture, NSSO). So, information crunch livestock farmers need information and capacity building for getting higher as well as healthy productivity from animals. It makes the way for Extension to come into play for penetration of information to them. This necessitates strong, aggressive and focused approach in the field which can be in tandem with institutions as they bring the procedures and their methodology for diffusion. Development departments take them forward to the major producers dwelling in form of small and marginal farmers.

Directorate of Extension Education, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana has adopted a farmer friendly cum multisided, multitier and all-round approach to make livestock/dairy farmers acquainted with latest trends of farming. Innovation and research outcome of the university over the years have led to the propagation of various livestock development strategies to the farmers, through various extension methodologies. Punjab stands sixth among states of India regarding milk production at 11.28 million tonnes from 2.53 % dairy animals of country and per capita availability is 1120 gm, 7% share of India with 32.5 million litres daily production. The increase has been maintained irrespective of the slight increase in cattle and 20% decrease in buffaloes(2012 to 2017, latest census). Buffalo is the main stay of dairy and its number has decreased in the current census(51 lac to 40 lac)The field problems and constraints in dairy sector are mainly two fold either on the animal husbandry front or on the health aspect. Main factors contributing to animal husbandry sector are lower nutritional status of the animals and poor management practices causing reproductive problems. The nutritional feeding of animals reared for dairy are still below the standards adopted in developing countries and those recommended by FAO and veterinary institutions. Requirements of ingredients in fodder and concentrate rations are still out of the knowledge of common farmers producing maximum milk. On the other hand the management practices of housing, feeding and production are not adequate enough for ideal dairy practices. The health problems mainly are of reproduction and disease prevention.

Reproduction problems of the dairy animals mostly pertain to repeat breeding, anoestrous, prolapse of the uterus and placental retention and abortion. All these problems are based on poor nutritional status of the animal. Moreover faulty management practices also contribute towards the development of these reproductive affections. Further the lack of awareness of farmer on the basis of evaluation and identification of reproduction problems and to have the sufficient involvement and consultancy of veterinary experts precipitates these problems. Nutritional aspects of present day dairy farmers also demand when look into the constraints of dairy development in recent times. Inadequate feed formulation lack of refined techniques by feed manufactures, poor quality of available market feed tells upon the production traits of milking animals. The principle of high energy-low bulk feed for high producing dairy animals has still to be followed by the farmers in our country. The notion of high energy diet containing soya and other high protein constituents is totally out of the mind of the common farmer. Various bye pass energy rich technologies have been developed which meet the nutritional requirements of high yielders

Present day dairy farms depicts increased size of farms, increase milk Production per milch animal, high level of mechanization, different farm organization Observation, a core issue leading to late detection of heat and health disorders, control of production costs is major issue, more attention for sub clinical diseases, health problems are considered to be the major constraint for profitability, formulation of least cost ration as feed costs are the highest variable costs in production, development of farming skills and management of animals, equipment and farming conditions, while Progressive dairy farmer fea-

tures have an advantage over common farmer,invest in knowledge through practitioners, mind set up with self assessment and positive evaluation considered as risk takers, commercially and market oriented, gather information from various sources, innovative, planners and turn threats into opportunities, highly skilled in communication so, newer ways of making profit, group parturitions through technological interventions and bring more innovations

Present Dairy Farming Scenario in the State - Dairy farming in the state run by three groups of farmers one who follow traditional dairy farming practices and are small/ marginal farmers, other medium category farmers (rearing>10 animals) and can be categorized as common farmers, others those who have adopted and are in the scientific raising of dairy animals and belong to the category of progressive dairy farmers. The number of progressive dairy farmers in the state has increased significantly from around 100 in the initial stages to around 2500-3000 at present. Different categories of dairy farmers have varied problems, majority want to survive, better one want to flourish while commercial one are progressive which invest and are more mechanized as well as well off. In a normal conversation with the rural dairy farmers major problems encountered by themdairy animals mainly suffer from Mastitis and reproductive disorders like Anestrus and Repeat Breeding,Small herd group farmers are more affected due to different livestock diseases, Mastitis occurrence can be seen both cattle and buffaloes, however Cross bred animals are more affected, major losses occur from the mortality of animals or their replacement values followed by reduction in milk yield,24X7 AI Services and treatment facilities are not available to them,Vaccination with good cold chain facilities still lack in rural areas,more user friendly technologies are needed by them and better financial support and insurance facilities.

The dissemination of knowledge and technology to the farmers/livestock owners is a regular feature for meeting one of the basic mandates of the university. The fulfilling the three mandates of teaching, research and extension has lead to grab the ***top position*** among the state veterinary varsities of India (ICAR ranking, 2019).

Livestock population trends in Punjab (Lakh)

Census year	Buffalo	CB Cattle	Indigenous Cattle	Total cattle
1997	61.71	18.28	8.11	26.39
2003	59.95	15.31	5.09	20.40
2007	50.02	12.60	5.03	17.62
2012	51.60	20.65	3.63	24.28
2019	39.99	NA	NA	25.19

Share of livestock in agricultural GDP over time (Rs Crore)

Years	Total Agri.GDP including fisheries	Crop GDP	% share of crop GDP	Livestock and Fisheries GDP	% share of Livestock and Fisheries GDP
1980-81	2423.5	1696.42	70.00	727.08	30.00
1990-91	8253.67	6116.01	74.10	2137.66	25.90
2000-01	26635.32	18751.21	70.40	7884.11	29.60
2010-11	63805.2	44573.37	69.86	19231.83	30.14
2015-16	92818.25	59526.48	64.13	33291.77	35.87
2016-17	103904.26	66489.36	63.99	37414.99	36.01
2017-18	114899.73 (24.16%)	71638.43	62.35	43261.30	37.65* (9.10%)

*36.40 % Livestock, 1.25 % fisheries

Note: Figures in parentheses indicate percentage to total state GD

Major extension activities for information infusion-Extension should reach to all the farmers including unreached ones. We thrive on the concept where there is any broach of livestock, poultry or fisheries, GADVASU offers assistance and help. Institution goes beyond that and is ready to undertake single farmer single concept training under rapid fire approach. Major extension activities are as -

1 **Field Service:** Ambulatory Clinical Service provides treatment facilities and counseling services to the farmers particularly in adopted villages. This facility helps the farmers to get rationale treatment and is a great experience for students to work under field conditions for the whole week.

Extension should reach to all the farmers including unreached ones. We thrive on the concept where there is any broach of livestock, Poultry or Fisheries, GADVASU offers assistance and help. Institution goes beyond that and is ready to undertake single farmer, single concept training under rapid fire approach.

2 **Field Camps:** Extension wing organizes animal welfare camps and animal welfare days – in the field for treatment for sick animals, advice as well as question answers session. On these occasions, demonstrations regarding the collection, dispatch and transport of clinical material and farmers were made aware of correct method of milking, teat dip, heat detection, acaricide drug application, silage making, computation of ration, vaccination and deworming regimes.

3 **Trainings:** University conducts various training programmes in dairy farming, poultry farming, pig farming, goat farming, fish farming and value addition. These trainings help farmers in gaining technical skills and the knowledge to start these activities for self-employment in line with the government's policy of diversification of agriculture. University is also undertaking commercial dairy farming and AI training programmes. Various tailor made courses are also organized by the university. Farmers can be trained at district level milk unions or help of institute can be taken for dedicated

programmes under mission mode for clean milk production or controlling of common diseases.

4 **Farmers fair:** GADVASU organizes Pashu Palan Mela twice (March and September) a year at its Ludhiana campus. During Pashu Palan Mela, the whole university is showcasing its activities, research and procedures through display inform of exhibitions, demonstrations, lectures and interactions. Chief Minister Award are conferred to innovative and progressive rural farmers in the field of dairy, and other farming including value addition of livestock produce. These awards are granted for bringing healthy competitions among the farming community to perform better. Expert talks are given on the occasion of "Pashu Palan Melas", "Kisan Melas", Field days & 'Regional Kisan Melas', Farmers' day celebrations' etc. other regional research stations and KVKs of the University. In addition, the farmers seek advice through personal contact with the experts at these fairs. Farmers can be motivated to participate in such fairs for updation also for applying for dairy awards separately in cattle or buffalo along with pig, goat,fish, poultry and value addition category.

5 **Mass media:** Use of Mass media in the form of Press, Radio , T.V. talks and through Cable channels and Private channels by the University experts, is helping in the dissemination of knowledge in a significant way due to its vast reach. Important aspects of animal health and production are covered from time to time to keep the masses abreast with the latest recommendations. The messages of urgent concern which need immediate attention are flashed through T.V. and radio through DD Jalandhar, Pvt and Cable channels and AIR, Jalandhar as well as FM and Gold channels in the local state and North India. The timings of such programmes can be shared with potential milk farmers to listen or participate in them.

6 **Messaging:** University has registered farmers (n=>30,000) for sending them regular message through central portal and advisory also sent through whatsapp and text message. The livestock farmers can be enrolled with university or separate initiative can be started.

7 **Farmer Information centre**: To provide the farmers the needed information under one roof, "Farmer Information Centre" is operational. This centre helps the visiting farmers, students, unemployed youth, women farmers to get the information related to trainings, education, camps or various inputs as single window system.

8 **Literature** : University has developed huge literature in Punjabi, English as well as in Hindi language for the livestock farmers covering all aspects of livestock, poultry and fish farming. GADVASU'S Punjabi publication, a monthly magazine "Vigyanak Pashu Palan" carries informative articles dealing with Veterinary and Animal sciences. Such published material make a long lasting impression on its readers and can also be used as reference source by veterinarians, field officers as well as by farmers.

9 **Handy tools:** GADVASU has developed management calendars (calf rearing, feeding, general management, vaccination , de-worming and reproduction) to provide farmers readymade and handy information for up-keeping their animals in a nice way for getting healthy produce for society. Livestock calendar contains information on animal husbandry practices for the whole year.

10 **Linkages**: University has liaison with line departments of Punjab State viz; Animal Husbandry and Dairy Development for undertaking animal welfare activities. These departments organize various camps and field days. University provides latest technical know-how in these activities which is a two way learning for field officers / veterinarians. Such activities can be planned by milkfed or can work in tandem with university and other state departments.

11 **Farmer field schools:** Farmers field schools concept has been introduced for better penetration into field through learning of farmers through horizontal approach as farmers learn better from fellow farmers. This step can be initiated at few places for better message dissemination.

12 **Specialized hospital services:** University extends diagnostic facilities constituting biochemical, pathological and parasitological, culture sensitivity, mastitis and rabies testing and post mortem facilities etc. the post mortem is done even on holidays and Saturdays and Sundays. Such facility can be made available to dairy farmers/milk producers for better utilization of special university services.

There is no single perfect technology or procedure which can cater to all the needs of livestock farmers. Technologies must be considered with regards to their total cost for owner. Modern extension tools especially digital ones can save time, man power and money. Extension must be provided on 24x7 basis for the growth development and sustainability. Technology must be user friendly, cheaper, easily updated, accessible and locally available. Technologies must reach to the target people, otherwise they rot lying on shelves or in the books. (Technologies and Fish are always preferred and welcomed fresh)

13 **Fire brigade Veterinary Services:** Emergency services when required by the livestock/dairy farmers in case of disease outbreaks, accidents, calamities are undertaken without any delay as a sort of fire brigade type service and farmers can contact at no. 0161-2414030. Dairy farmers can be made aware of that to contact in case of emergency.

14 **Outreach stations:** To bridge the gap between the universities and the field and to know the field and grass root level scenario through Regional / Outreach Stations and three Krishi Vigyan Kendras. These centers are demonstrating developed technologies and research in their operational areas and also organizing various training programmes for unemployed youth/ women in Dairy, other farming activities and also demand driven courses. They are catering to the routine needs of farmers and livestock farmers of the areas along with showcasing of various correct manage mental practices as well dedicated programmes for better productivity.

15 **Digital Strategies:** Nobody on this earth whether homosapien or animal is un-

touched with ICT in the present era and it is proving as a lifeline for all. Now it is very much clear that through digitalization or ICT one can reach to the unreached in far flung rural areas. Fortunately, new developments in information and communication technology and wide spread of Internet access and mobile communications appear to offer some solutions to meet the information and advisory need of small-scale livestock farmers. Access to Internet based information centers is growing rapidly and village information kiosks with user-friendly features such as touch-screens appear to be a promising development. The ICT related initiatives in livestock extension, give extension workers an opportunity to produce customized extension materials that meet the real needs of the farmers they serve. ICT tools are proving handy in filling this knowledge and accessibility gap and extending digital literacy to the end users. As in this century, majority of farmers (including family members) are having access to smart phones along with internet and they can seek desired information from various sources. Many ICT initiatives in livestock sector have been taken by public and private agencies but the scope of improvement still lies. The digitalized services have major advantages as -Access to huge store-house of information is free, Information is available instantaneously 24X7X365, Communication can also be interactive and Information is available from any point on the globe.

…..Most powerful digitalized tool is the cell phone which has replaced many gadgets and the number of users are around one billion in India. This is the only technology which has brought literacy and alertness even in aged , senile and lethargic people though its user friendly multiple uses. It is a wonderful tool to reach masses through a click of button and has proven useful in emergency situation. Use it maximum to reach dairy farmers

Major digitalized strategies of GADVASU are-

1 Mobile advisory

2 Mass Media- Radio, TV, newspaper, Cable network, Pvt. Channels.

3 Messages- Flash, Short and Advisory

4 Videos CD -Repeat Breeding, Anoestrus, Abortion, Calf Management

5 GADVASU friends, Farmers groups/Associations,

6 Website(www.gadvasu.in), E- mail

7 Mobile Applications-

(a) Precision dairy farming App (b) Goat farming

(c) Dairy Prajanan App (d) Pig farming

Important Inputs and services to dairy farmers for better productivity:

I. Services

- 24x7 treatment facilities through Veterinary hospital, equipped with all modern facilities' known as PGI for animals.
- Surgical operations of conditions like Fracture Impaction, Diaphragmatic Hernia, Tumors, Teat and Urine Blockage and spaying of bitches.
- Treatment of all species of animals like Large, Small, Pet, Bird , Lab, Wild and Zoo animals in university hospital
- Treatment of Gynecological diseases like Anoestrus, Repeat breeding, Uterine disease, Dystocia, facility for Caesarean Section.
- Laboratory testing of blood, urine, faeces, mucous, C.S.F. semen and disease diagnosis through culture sensitivity testing. X-rays, Ultrasound Laparoscopy and Endoscopy.
- Testing of animals for Brucellosis, Tuberculosis and Johne's disease.
- Facility for insecticide/pesticide and mycotoxin testing.
- Attending to disease outbreaks/ epidemics and calamities like fire, flood, electrocution etc.

II. Inputs-

- Estrus Synchronization protocos
- Mastitis diagnostic kit for farmers and Herbal Teat Dip
- Milk adulteration detection kit for farmers
- ETT and IVF
- Publications (Punjabi/Hindi/English)
- Vaccination and Deworming Calendars
- Improved germplasm of crossbred cows, buffaloes as semen, embryos, bull calves (HF, Sahiwal and Murrah)
- Supply of mineral mixture (area specific) and Uromin lick and bypass fat.
- Formulation of balanced ration for dairy animals.
- fodder conservation and preparation of concentrate for animals.
- Analytical laboratory for feed testing.
- Ideal housing for dairy farming. And climate resilient sheds.
- Rotatory handy calendars
- Nutrition calendar
- Video CD on Repeat Breeding and Anoestrus and their management in Dairy Animals
- Mobile Apps

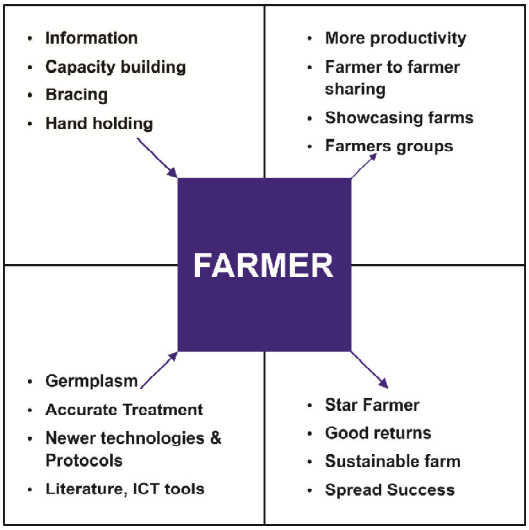
It always a strong commitment among the faculty and staff to help the farmers coming from all parts of the state and adjoining areas with a trust in the institution. GADVASU, Ludhiana has taken many steps to alleviate sufferings of dairy farmers through valued services. These facilities have been developed for the livestock farmers, but they need to contact veterinary varsity. .Ultimate beneficiaries are farmers and they must understand the importance of these public institutions and bring their problems to the scientists. The success will only come if their queries are met in time and suitable answers are provided to them and hand holding is done in right direction, this is what GADVASU is up for it, through unique farmer friendly cum multitier approach.

Focused area of extension-

- Target Buffalo and Sahiwal.
- Zero wastage technology of buffaloes
- Clean milk production with focus on SCC, Antibiotics/ insecticide/pesticide residues
- Value addition of buffalo for future bulk demanding products
- Separate branding of Sahiwal milk

Sustainable success can be

- Knowledge dissemination
- Handholding
- Strong extension and timely services(feed, breed and treatment)
- In Toto approach especially small farmers(reach to unreached)
- Patting and spreading success



Farmer Friendly Approach for Better Dairy Productivity

TIPS TO MANAGE COLD STRESS IN DAIRY COWS

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Cows are warm blooded animals and need to maintain a constant core body temperature. Normal rectal temperature for a cow is around 38°C (101°F). Within a range of environmental temperatures called the "thermoneutral zone," animals do not have to expend any extra energy to maintain their body temperature. At the lower end of this range, normal metabolic processes supply enough heat to maintain body core temperature. Within their thermoneutral zone, animals may modify their behaviour, such as seeking shelter from wind, and respond over the long term by growing a thick hair coat for winter, without affecting their nutrient requirements. However, below the lower limit of the thermoneutral zone, in the "lower critical temperature," the animal experiences cold stress. To combat cold stress, the animal must increase its metabolic rate to supply more body heat. This increases dietary requirements, particularly for energy.

Exposure to cold decreases the portion of cardiac output flowing to the gastrointestinal tract, lower limb, hoof bone and diaphragm. Cold stress also increases secretion of the catabolic hormones cortisol and catecholamine and the more modest changes in secretion of the anabolic hormone insulin which results in a net catabolic response. The combined effect of these endocrine changes is to increase the mobilisation of energy sources for use by the shivering muscles. Cold weather is known to increase the susceptibility to pregnancy ketosis. This may be a nonspecific response to stress or starvation. Additionally, some of the metabolic adaptations to cold exposure may increase susceptibility to ketosis when food supplies are limited.

Growth rate and feed conversion efficiency of cattle are reduced under cold stress. Cows try to increase feed intake in an effort to meet their energy requirements. Also, the maintenance energy requirement of cattle has been calculated to increase by 0.91% for each degree below a temperature of 20°C to which animals have been adapted, thereby reducing the efficiency of energy utilisation for growth and other biological functions. Studies have also shown that cold stress influences protein turnover in ruminants. The protein degradation rate is increased more than synthesis, resulting in a loss of muscle mass and carcass quality.

If cows are not fed additional feed or the quality does not allow them to eat enough to meet their additional energy requirements, body mass will be "burned" to produce metabolic heat. These cows lose weight as both feed energy and stored fat are diverted to maintain body temperature and vital functions. Cows that start to lose weight soon enter a downward spiral: the more weight (fat) they lose, the less insulation they have, the more susceptible they are to further cold stress, and they lose weight even faster. Cows, and

especially heifers that lose weight, calve in poor condition. The consequences are increased calving difficulties, an increase in the number of lighter, weak calves and higher calf mortality. These dams produce a reduced amount of colostrum (of lower quality) and have lower milk production, increased neonatal mortality and reduced growth rate in surviving calves. These cows usually have delayed return to estrus, longer days open and poorer reproductive success.

Points to consider to limit the effect of cold stress in animals:

1 Provide a shelter for cattle.

2 Provide clean, dry bedding to keep the animals warm.

3 Cows need more calories to keep themselves warm. Provide higher quality forage or supplement energy with grains or by-products.

4 Cows need to eat more roughage of good quality in cold weather to get the calories for heat production since the fermentation and breakdown of cellulose generates heat energy.

5 Provide adequate quantities of dry crop residues such as wheat straw, paddy straw and cereal stovers specially during late evening and night.

6 Feeding in the late afternoon or evening can provide higher amount of heat from fermentation overnight when temperature is the lowest. This is because incremental heat production reaches its maximum 6-8 hours after the feed is consumed.

7 Do not make drastic adjustments to feed intake as this could lead to reduced intake or cattle going off-feed.

8 Sort out thin cows or heifers in order to provide them more specialized care such as a higher energy ration.

9 Cows in the last trimester require additional grain feeding during periods when the effective temperature falls below the lower critical level.

10 Be sure to check the waterers regularly as excessively cold water significantly limit water intake of cattle. Make sure cows have ample water available at all times. Limiting water will limit feed intake and make it more difficult for cows to meet their energy requirements.

11 Some cows are designed to handle the cold better than others. Keep a close eye on the herd to watch for additional signs of stress caused by cold weather. Older cows, cows with previous health issues, and calves are the groups most susceptible to the cold weather.

12 Under-ventilation in winter is most serious threat to the environment of the animal. Do not restrict the ventilation rate as it can result in build-up of toxic gases like

carbon monoxide, hydrogen sulfide and nitrogen dioxide leading to sudden death of animals housed in poorly ventilated building.

13 Teat dipping should not be discontinued during cold weather to prevent mastitis. Teat skin chapping can become a problem in lactating cows during cold, windy weather. Chapping makes the teat more susceptible to bacterial infections, particularly Staphylococcus. So pre and post-milking teat dips should include skin conditioners like glycerin and lanolin. In very cold weather it may be advisable to dip just the teat end. When teats are dipped, dip only the end and blot off any excess with a single-use paper towel. Teats should be dry before turning cows out of the milking parlour. Warming the teat dip reduces drying time.

We can't control the weather but we can do everything reasonably possible to reduce the effects of cold weather on cows. This will help reduce treatment costs and improve production efficiency.

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FARMER'S PRODUCER ORGANIZATION (FPOS): A KEY STRATEGY TO EMPOWER SMALL AND MARGINAL FARMERS

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Agriculture is the primary source of livelihood for about 58 % of Indian population. (APEDA Union Budget 2018-19). India is the largest producer of pulses, rice, wheat, spices and spice products (Madhusudhan L 2015) and also ranks first in milk production with a production level of 176.4 million tonnes of milk with per capita availability is around 374 gram per day in 2017-18 (19th Livestock Census). Indian agriculture and livestock sector contributes around 17-18 % and 4% to the country's GDP respectively and provides employment to around 50 % of the countries workforce. (India economic survey 2018). In India there are about 138 million farm holdings, which include 92.8 million marginal holdings (1 ha) and 24.8 million small holdings (1-2 ha) (Agriculture Census 2010-11) and majority of the farmers are small and marginal farmers which account for 86.2% of all the farmers (Agriculture Census 2015-16). Smaller and scattered land holdings are one of major reasons for the poor condition of the farmers in India. Existence of large number of small and marginal farmers make it challenging for government extension arms to reach them with new technology and farm support schemes. As most agricultural policies tend to favor large farmers, not even 10 percent has reached the small and marginal farmers. Along with small holdings, small and marginal farmers are suffering from various problems like drought and famine. It is estimated by FAO that during 2005-2015 more than 6,43,000 crores worth crop damaged due to natural disasters in the developing world. Other factors like middlemen involvement, market uncertainties, inadequate price of the produce, and lack of awareness among farmers also contribute major loss to the farmers. Therefore, concept of FPOs came into existence, to make small holdings viable and growth more inclusive, and to integrate smallholders with agricultural markets. Several initiatives have been taken by the Government, financial institutions such as NABARD, private organizations, and many other institutions to support the growth of the FPOs and facilitate their emergence as successful business enterprises.

Concept of Farmer's Producer Organizations (FPOs)

FPO is an organization of the producers, by the producers and for the producers. FPOs consists of collectivization of primary producers (person producing basic agricultural commodities, such as a farmer or cattle producer) who organize themselves into producers organizations with the objective of increasing farm income through improved production, marketing and local processing activities. Producers are shareholders in the organization. Farmer's organizations adopt all the good principles of cooperatives

like voluntary and open membership, democratic farmer member control, farmer-member economic participation, autonomy and independence, education, training and information, co-operation among FPOs etc. Three stages involved in sustainable development of FPO are Incubation and early stage (Grant Support for training, exposure & system development); Emerging and growing stage (Equity Financing, Working Capital); Matured stage i.e. business expansion stage (Debt Capital, Term loans). FPO provides a variety of services including financial, input supply, procurement and packaging, marketing, insurance, technical and networking Services to its members.

Formation and structure of FPOs

FPOs are registered under Indian Companies Act, 1956, as amended in 2002-03 & 2013 and can be formed by 10 or more primary producers and two or more producer institutions. There is no restriction on the maximum number of membership. About 700 to 1000 active producer members are required for the sustainable operation of a FPO. A FPO can be Producer Company, Cooperative society, SHG, Farmer's association, Federation, FIGs etc. Organization structure comprises of General Body, Executive Body (2 representative per FIG), Board of Directors, General Manager, FPO staff, and local resource person. Farmers may be organized at four levels; Farmer Interest Groups (FIGs); 15-20 farmers in each group, Sectoral Farmers Associations (SFA), District Farmers Forum (DFF) and State Farmers Federation (SFF). Steps involved in establishment of FPOs are cluster identification, diagnostic study, feasibility analysis, baseline assessment, business planning, farmers mobilization, organizing and formalizing, resource mobilization, systems development, business operations, assessment and audit.

Need of FPOs

Almost 87% of rural households have suffered from extreme poverty and serious deprivations due to rural agrarian crisis caused by increased fragmentation of land and variety of problems faced by small and marginal farmers, over the last two decades. Farmers are the backbone of our country but due to policy failure, economy failure, technology failure, person's failure; they are in a very bad condition. About 3 lakh farmers have committed suicide and on an average 47 farmers commit suicide everyday in India (NCRB 2017 report). To tackle all these problems, Farmer producer organizations (FPOs) were proposed as a way forward to get some form of land consolidation and an integration of smallholders within an agricultural value chain. Various benefits of collectivization of farmers into producer organizations are:

- Ensure better income; as aggregation of produce and bulk transport reduces marketing cost.
- Cost of production can be reduced by procuring all inputs in bulk at wholesale rates.
- Through aggregation, the primary producers can avail the benefit of economies of scale.

- Improved bargaining power and social capital building.
- Dissemination of information about price, volume and other farming related advisories among the producer members.
- Farmers get better access to latest markets and technology.
- Reduce farmer's dependency on intermediaries.

Policies and schemes for promotion of FPO's

Government has issued the National Policy and Process Guidelines in March, 2013 for the promotion of FPOs, with a dedicated source of funding from the Rashtriya Krishi Vikas Yojana (RKVY). It has also launched the "Equity Grant and Credit Guarantee Fund Scheme" for FPOs in January, 2014, enabling the FPOs to access a grant up to INR 10.00 lakh to double members' equity and seek collateral-free loan up to INR 1.00 crore from banks, which in turn can seek 85 percent cover from the Credit Guarantee Fund. Other govt. supported programmes are Venture Capital Assistance Scheme (VCA), National Food Security Mission (NFSM), Mission for Integrated Development of Horticulture (MIDH), Vegetable Initiative for Urban Clusters (VIUC), Producer Organization Development Fund (PODF), NABARD, Gramin Bhandaran Yojana (GBY), MP special project (ISAP 2018). Small Farmer's Agri-Business Consortium (SFAC) and NABARD have emerged as driving force in supporting FPOs and provide technical & financial support to them. GoI provides SFAC with budgetary support and NABARD with PRODUCE fund for promotion of FPOs. There are approx. 5000 FPOs in India. Out of these, around 3200 are registered as Producer Companies and the remaining as Cooperatives/ Societies, etc. There are 897 FPOs promoted by SFAC in India out of which 773 are registered and 124 are under the process of registration. (Annual report SFAC 2017-18); while NABARD has promoted 4004 FPOs out of which 2044 are registered. (Annual report NABARD 2017-18)

SWOT Analysis of FPOs

Strengths: 1. Provide efficient input delivery system 2. Create market linkages including direct selling for optimum returns 3. Aggregation and value addition 4. Member's empowerment 5. Improved extension services.

Weakness: 1.Weak financials 2. Inadequate market linkages 3. Non-availability of credit 4. Low equity base 4. Lack of clarity on business plans 5. Lack of awareness amongst members 6. Inadequate access to infrastructure

Opportunities: 1. Potential of SHGs, Farmer's clubs, Farmer's association etc. to be developed into FPOs 2. Availability of potential commodity clusters 3. SFAC support for equity and credit guarantee.

Threats: 1. Dependence on farmer producer organization promoting institutions 2. Lack of governance and management capabilities 3. Limited scope, scale, market.

Conclusion

Major share of Indian agriculture and livestock is covered by small and marginal farmer. Marketing is still a challenge for the farmers. Low quantum of market surplus by the individual small and marginal farmers, large number of intermediates and lack of adequate price for agriculture produces are the main reason for poor income and non- viability of the small farmers. In order to improve the condition of small farmers, FPOs are considered to be helpful in integrating the small farmers directly, through their institutions to market for both inputs and output and enabling them, to reach large and high value markets to realize better price for their produce through collectivization. Some suggested measures should be taken by the Govt. of India/ other stakeholders for further strengthening of the FPO movement in the country; like private institutions/ Agricultural Universities may introduce special courses on FPO promotion with focus on rural youths including women so as to create large pool of professionals in rural areas for managing FPO activities. There is need of extension to create awareness among the farmers regarding FPOs and to synchronize the stakeholders including govt. officials, financial institutions and elected members to popularize the concept of FPOs. If FPOs are handled properly, can help to reduce the distress of farmers. Collectivization through concept of business & cooperation is the best solution for small and marginal farmers.

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NUTRITIONAL APPROACHES TO OBTAIN DESIRED MILK SOLIDS

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The amount of money a milk producer gets for his milk depends upon three factors. Firstly, the quantity of milk produced, secondly fat and solid not fat (SNF) content and thirdly the levels of other quality parameters such as drug residues, somatic cell account, M1 levels and off flavor etc. The higher the fat and SNF content of the milk, the higher the price paid.

Close to 70% of milk sold in India is considered adulterated as it doesn't conform to standards set up by Food Safety and Standards Authority of India (FSSAI). The standards of milk and milk products have undergone amendment since 2nd August 2017. The fat content of milk ranges between 1.5% and 6%; as the definition says that Milk which is adjusted for milk fat or SNF content or both, may also be named 'milk'. Another major difference is with regard to 'milk' when offered to sale without indication of class shall have the standards of mixed milk (4.5% fat and 8.5% SNF) instead of buffalo milk. The standard of cow milk is on all India basis, now. The minimum standards are 3.2% fat and 8.3% SNF. Similarly buffalo milk should have 6% fat and 9.0% SNF in northern states and 5 % fat in southern states with same SNF.

Fairly good positive relationships between level of fat and SNF in milk exist. Of the two, the SNF is of great nutritional importance as it contains valuable animal proteins. Fat content is much more variable than SNF. Attention to improve fat percent becomes more rewarding when payment is based on its level in the milk. Milk yield and total solids percentage are related inversely, yet correlation is not so good that improvement of both yield and total solid percent cannot be made. Some feel that improvement in yield is more difficult to achieve when total solid concentration is to be maintained or improved.

The various nutritional approaches which alter the milk yield and composition are discussed below:

Of all the factors affecting milk composition, nutrition and feeding practices are most likely to cause problems; however, management changes made here are able to quickly and dramatically alter production of fat and protein. Milk fat depression can be alleviated within seven to 21 days by changing the diet. Milk protein changes may take 3 to 6 weeks or longer if the problem has been going on for a prolonged period. Nutrition or ration formulation changes are more strongly correlated to milk fat content than milk protein. Milk fat can be changed by 0.1 to 1.0 percentage points, while protein is seldom altered more than 0.1 to 0.4 points by nutritional changes. For these reasons, nutrition and feeding management are considered the best solutions to a milk fat or protein problem

other than genetics.

a Rumen

Digestion of fiber in the rumen produces the volatile fatty acids (VFAs) acetate and butyrate. Butyrate provides energy for the rumen wall, and much of it is converted to betahydroxybutyrate in the rumen wall tissue. About half of the fat in milk is synthesized in the udder from acetate and betahydroxybutyrate. The other half of milk fat is transported from the pool of fatty acids circulating in the blood. These can originate from body fat mobilization, absorption from the diet, or from fats metabolized in the liver. Rumen microbes convert dietary protein into microbial protein, which is a primary source of essential amino acids. These amino acids are used by the mammary gland to synthesize milk proteins. Glucose is required to provide energy to support this protein synthesis. Glucose is either formed from the VFA propionate in the liver, or absorbed directly from the small intestine. If too little propionate is absorbed from the rumen, the cow will have to breakdown amino acids and convert them to glucose (a process called gluconeogenesis); this can reduce the supply of amino acids available to make milk protein. In addition, some albumin and immunoglobulin protein is transferred directly to milk from the blood. The relative amounts of protein and energy that are available in the rumen at a given time is the major factor affecting rumen fermentation and therefore milk components. Any diet or management factors that affect rumen fermentation can change milk fat and protein levels. Consistently providing adequate energy and protein and balanced amounts of rapidly fermentable carbohydrate and effective fiber are keys to maintaining optimum levels of milk components. The challenge in feeding for milk components is that high energy; low fiber diets that increase milk protein are likely to reduce fat levels.

b Feeding Management

Any situation that causes animals to eat abnormally or limits feed intake may affect milk components. Examples include: overcrowding at feed bunks, housing heifers with older cows in facilities at or near full capacity, feeding rations that encourage sorting, feeding infrequently in a conventional system (non- TMR), failing to push feed up or feed TMR often enough, feeding protein feeds before energy feeds and feeding grain before forage in non-TMR systems. These conditions can create slug feeding (one or two meals per day versus 5 to 6) or allow cows to eat high grain meals part of the time and high forage meals the remainder of the day. Ensure that fresh feed is available 18 hours each day, spoiled feed is removed from bunks, and shade or cooling is provided during hot weather to help maintain normal intake and normal meal patterns. Poor ventilation or cow comfort also can depress milk fat and protein production by reducing intake. Finally, make ration changes gradually to allow rumen microorganisms time to adapt. Any reduction in rumen microbial protein production from nutrition or feeding management imbalances will reduce milk protein by way of less microbial protein for the cow to digest and depress fat by limiting VFA production in the rumen.

c Body Score

Proper body condition is essential so that high producing cows can draw on body stores of nutrients to support milk production. If body stores are minimal, yields of milk and milk components will suffer. On the other hand, excessive body condition increases the risk of metabolic problems and calving difficulty. Weight loss in early lactation can increase milk fat content for a short period of time. Both thin and fat cows tend to have low milk fat in later lactation. Protein can be depressed at calving if animals are overly obese or underweight. In addition, some research shows that underfeeding protein during the last three weeks before calving can depress milk protein.

d Energy

In general, as energy intake or ration energy density increase and/or fiber decreases, milk fat content will be reduced, while protein is increased. In contrast, as ration fiber levels increase and/or energy is reduced, milk protein is depressed and milk fat is increased. Lack of energy intake or lower ration digestibility may reduce milk protein by 0.1 to 0.4%. This reduction may result from underfeeding concentrates, low forage intake, poor quality forage, and failure to balance the ration for protein and minerals, or inadequately ground or prepared grains. Shifting rumen fermentation so that more propionic acid is produced is apt to increase milk protein and decrease fat content. However, excessive energy intake, such as overfeeding concentrate, may reduce milk fat content and increase milk protein. Normal protein levels can be expected when energy needs are being met for most of the cows. Often this is impossible to achieve with high producing animals.

e Protein

A deficiency of crude protein in the ration may depress protein in milk; marginal deficiency could result in a reduction of 0.2%, while more severe restriction of diet crude protein would have greater impact. However, feeding excessive dietary protein does not increase milk protein, as most of the excess is excreted. Dietary protein has little effect on milk fat levels within normal ranges. Diet protein type also could affect milk protein levels. Use of non-protein nitrogen (NPN) compounds, like urea, as protein substitutes will reduce protein in milk by 0.1 to 0.3% if the NPN is a main provider of crude protein equivalent. Rations higher than recommended in soluble protein may lower milk protein by 0.1 to 0.2 points. NPN levels in milk will be increased by excessive protein or NPN intake, heavy feeding of ensiled forages, ensiled grains, immature pasture and lack of rumen undegradable protein in the diet. Balance rations for crude protein, rumen undegradable protein, rumen degradable protein, and soluble protein. For high producing cows, balancing for amino acids also may be required.

f Concentrate

An increase in the intake of concentrates causes a decrease in fiber digestion and acetic acid production. This creates an increase of propionic acid production. Propionic acid production encourages a fattening metabolism that is in opposition to milk fat. Addition

of buffers to some rations may help to prevent acidosis; this will not change milk protein, but will increase milk fat content. Animals that eat a substantial amount of concentrates or a low ratio of dietary forage to concentrate may develop acidosis even when buffers are added to the ration. The non fiber carbohydrate (NFC) portion of the diet is highly digestible and can influence both fat and protein in milk. Excessive amounts of NFC can depress fiber digestibility, which reduces the production of acetate and leads to low milk fat (1% or more reduction). At the same time, greater propionate production allows higher milk protein levels of 0.2 to 0.3%. Generally an NFC of 32 to 38% of ration dry matter is recommended to optimize production of milk fat and protein.

g Fodder

Balance rations for lactating cows to contain at least 40 to 45% of ration dry matter from forage. This may be altered by the level of corn silage in the ration and the level of high-fiber by-product feeds in the ration. Low forage intake can cause a major reduction in the fat content of milk due to low fiber levels. Several potential reasons for low forage intake are inadequate forage feeding, poor quality forage, and low neutral detergent fiber (NDF) content in forage that was cut too young or late in the fall. Target a forage NDF intake of 0.9% of bodyweight daily. Although low forage (high energy) diets increase milk protein production, this strategy is not recommended. The low forage levels contribute to acidosis and laminitis; they do not promote good health for the rumen or the cow in the long run. Protein and fat content also can be changed due to the physical form of forage being fed. Much of this is related to ration sorting and failure to provide a consistent diet throughout the day. Coarsely chopped silage and dry hay are the most common causes of sorting. At the other extreme, very finely ground diets negatively affect rumen metabolism and depress fat and protein production. Monitor ration particle size to ensure that adequate effective fiber is provided, TMRs are mixed properly, rations are distributed evenly to all cows, and sorting is minimal.

h Dietary Fat

Adding fat to the ration can affect milk component levels depending on the amount and source of fat. Fat is generally toxic to rumen microbes and may reduce fiber digestibility when fat from natural sources exceeds 5% of ration dry matter. If rumen inert or bypass fat is used, total fat content may safely reach 6 to 7%. At low levels of dietary fat, milk fat content could increase slightly or show no change at all. Milk fat is reduced at higher levels, especially with polyunsaturated oils. If fat or oil is rancid, milk fat content decreases even at low levels of consumption. Milk protein content may be decreased by 0.1 to 0.3% in high-fat diets. This may occur due to reduced blood glucose levels.

High milk fat content often occurs in herds that are off in feed and may have ketosis problems. Percent fat may be reduced for sick animals, but total fat may be higher for the herd. This may occur in herds fed large amounts of good quality forage combined with moderate concentrate levels. Producing an abnormally high level of fat is not economically feasible, because it usually indicates that total milk production is low. Herds that

depend primarily on milk income would be better served to increase total milk yield and keep fat percentage somewhat below the attainable maximum. Herds with unusually high milk fat are encouraged to reduce forage intake if it is on the high side, increase concentrate feeding, and manage the nutrition of dry and transition cows more closely to control problems with low intakes and ketosis.

i Feed Additives

Rumen buffers increase milk fat and possibly yield, when low-fiber, high-grain rations are fed. Feed sodium bicarbonate with or without magnesium oxide when concentrate contain more than 30 kg grains or high levels of rumen fermentable fiber. This will not only help milk fat percentage, but also maintain a healthy rumen environment. Rations in which all the forage is berseem generally do not benefit from buffers.

Niacin can alleviate the milk protein percentage but can also slightly reduce fat percentage. Niacin notably prevents ketosis in early lactation, especially with over conditioned animals.

Maximum feed intake is the most important factor for improving and stabilizing the milk protein and fat content. Yeast supplement helps to increase the number of beneficial bacteria which stabilize the rumen pH and improve the digestibility of ration and its fiber fractions.

j Designer Milk

i Reduction of saturated fat in the milk

Feeding of unsaturated fats in an encapsulated or protected form results in quick rise in the degree of unsaturation of the serum lipids, tissue fat and milk fat. Feeding of high unsaturated oil causes depression in total fat, but increases the proportion of unsaturated fatty acids (USFA) to saturated fatty acids (SFA) in milk. There is increase of linoleic (18:2) and linolenic (18:3) acids in milk by feeding oil in encapsulated form. As the melting point of milk fat containing USFA is less, the spreadability of butter made from such milk is improved tremendously. When taken out of fridge at 5^0 C, the butter was nearly as spreadable as margarine, without compromising its special eating qualities. Efforts are underway to determine if genetic difference among breeds and individual animals are translated into ratios of SFA and USFA.

ii Escalating conjugated linoleic acid (CLA) levels in milk fat

Dairy products are rich in CLA, a product synthesized in the rumen during the bio-hydrogenation of linoleic acid. Diets rich in linoleic acid lead to increase the CLA levels in the milk fat two folds. Milk from grass/fodder fed animals has five times more CLA than milk from a grain fed animal. CLAs reportedly inhibit carcinogens, proliferation of leukaemia, colon, prostate, ovary and breast cancers. They are the only natural fatty acids accepted by the National Academy of Sciences, USA as exhibiting reliable antitumor properties. The

other valuable health beneficial effects of CLA are anti-atherogenic effect, altered nutrient partitioning and lipid metabolism, immune enhancement and improved bone mineralization.

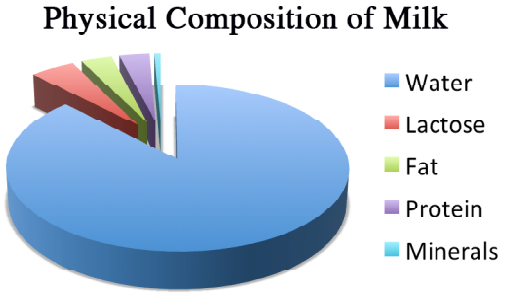
iii Enhancement of Omega fatty acids

Milk from pasture fed cows contains an ideal ratio of essential fatty acids (EFAs). It is evident that replacing grass in the diet with grains or other supplements increases the proportion of omega-6 to omega-3 fatty acids. Too much omega-6 in the diet creates imbalance that can disturb the production of prostaglandins leading to increased tendency to form blood clots, inflammation, high blood pressure, irritation of the digestive tract, depressed immune function, sterility, cell proliferation, cancer and weight gain. On the other hand deficiency of omega-3 is associated with asthma, heart disease and learning deficiencies. There are reports that roughly equal amounts of these two fats in the diet will result in lower risk of cancer, cardiovascular disease, autoimmune disorders, allergies, obesity, diabetes, dementia and some mental disorders.

Scientists are on the verge of running a novel concept of designer milk into reality for the needs of modern consumers. Designer milk is designed by changing the feeding system or expressing or suppressing the target genes in milch animals. Table 2 summarizes the feeding practices which influence milk solids. Correct feeding is the only way to produce milk with maximum levels of milk fat and protein.

Table 2 Feeding management changes witch alter milk solids

Management Factor	Milk Fat %	Milk Protein %
Dry Matter Intake	Increase	Increase
Frequency of feeding	Increase	May increase
Underfeeding	Little effect	Decrease
High Non Fiber Carbohydrates	Decrease	Increase
Small particle size	Decrease	Increase
High crude protein	No effect	Increase
Escape protein	No effect	Increase
Added fat	Variable	Decrease



APPLIED ANATOMY OF HOOF IN DIFFERENT ANIMALS

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The hoof is a complex structure that plays a key role in animal's overall health and productivity. Although the anatomical structure of the hoof differs from species to species, but the basic anatomy is very similar between species. For proper care, management and treatment of the hoof, it is important to understand the basic structure of the hoof in different animals. In cloven-footed animals like cattle, sheep, goats and pig, the hoof consists of two digits, instead of one solid entity as in horse. In the ruminants, there is the outer, or lateral digit, and the inner, or medial digit. In cattle, the lateral digit is slightly larger in the hind feet, while the medial digit is the larger in the front feet. The space between the two digits is called the interdigital cleft which is covered by the interdigital skin.

Structure of hoof in cattle: The hoof consists of a hard outer covering or hoof horn, the corium, which contains the blood vessels and horn forming cells, and the skeleton of hoof. Thus, hoof is made up of sensitive and insensitive structures which must be kept healthy and undamaged. Sensitive structures are nerve and blood vessels and corium, whereas insensitive structures are horny layer structures e.g. insensitive laminae, periople, wall, bars, sole and frog

External Anatomy of hoof: The external surface of the hoof consists of skin, coronary band and hoof wall. The outer covering of the hoof is known as the hoof wall or horn. The horn is a hard surface and functions as the epidermis of the skin. The cells forming the horn are produced by the tissue beneath the hoof wall, called the corium. The corium is highly vascular tissue and capable of producing the new cells, which are gradually pushed away and produce the hard outer new growth that is keratinized or corniûed. The new growth comes out at the coronary band, the point where the hoof meets the hairy skin. The soft tissue that has just come to the surface is referred to as the perioplic horn and is shiny and holds moisture of the hoof.

The dorsal, axial and abaxial hoof wall is made up of three of these segments

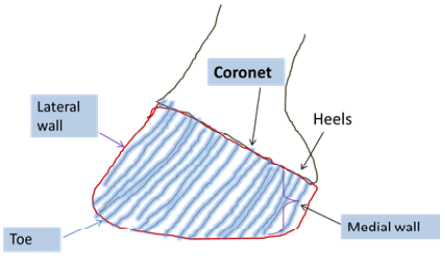
- The perioplic segment (stratum externum)
- The coronary segment (stratum medium)
- The parietal segment (stratum internum)

The periople is a thin waxy layer of tubular and intertubular horn on the outside of the hoof adjacent to the haired skin. It provides a smooth, waxy surface over the hoof,

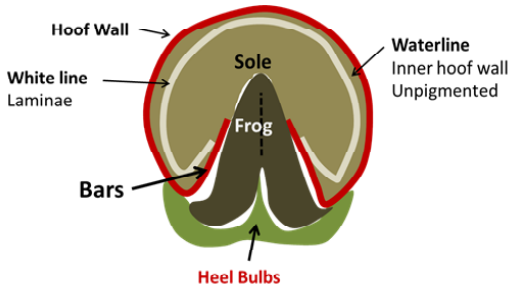
which prevents excess water loss and the hoof from becoming brittle. The coronary segment also consists of tubular and intertubular horn and arises from a portion of epidermis at the coronary band. The coronary band is the region where haired skin becomes hoof wall (Frandson *et al.,* 2009). The tubules are circularly arranged cells formed parallel to the dorsal hoof wall. The spaces between the tubules are filled with intertubular horn (Monteiro-Riviere *et al.,* 1993). The parietal horn, or the wall segment, is the also known as the stratum internum. This layer is continuous with the stratum medium, and projects sheets (laminae) of stratum corneum to interdigitate with similar dermal laminae.

The hoof wall is divided into regions:

- Toe
- Quarters
- Heel



The ground surface (solar surface) of the hoof is composed of the sole, frog, bulbs, and bearing edge of the hoof wall. Underneath the hoof is a slightly softer region, called the sole which is produced by the corium of the sole. The junction between the horn forming tissues of the hoof wall and sole is called as the white line and is located around the circumference of the bottom of the hoof. This area is susceptible to physical damage and bacterial invasion (Ishler *et al*., 1999). The front part of the sole is called the toe, and the two bulbs at the opposite end of the foot are referred to as the heel bulbs. The frog is elastic, wedge-shaped mass of horn that fills a triangular space at the back of the foot. Cattle toe length and sole thicknesses are associated as dorsal wall length of 7.5 cm was associated with sole thickness of 5 to 7 mm (Toussaint Raven, 1989) or 8.2 mm (Van Amstel *et al.,* 2002).



Internal anatomy of hoof: it is made up of elastic tissue and bones. Elastic tissues are capable of changing shape in response to foot impact and comprised of ligaments, tendons, digital cushion, hoof wall, sole, frog and bulbs of the heel. The digital cushion is a pad of fatty tissue that protects the corium and serves as a shock absorber for the phalanges. Ligaments are composed of elastic connective tissue that binds bone to bone e.g. cruciate ligaments binding the two digits of the foot. Extensor and flexor tendons attach muscles to the bones e.g. deep ûexor tendon attaches to the pedal bone and allow the animal to ûex its foot; the extensor tendons in front allow the animal to move its foot forward. Directly below the ûexor tendon is the digital cushion, which aids in pumping blood throughout the foot and up the rest of the leg as well as serving as a shock absorber to protect the sensitive tissues from the bones of the hoof.

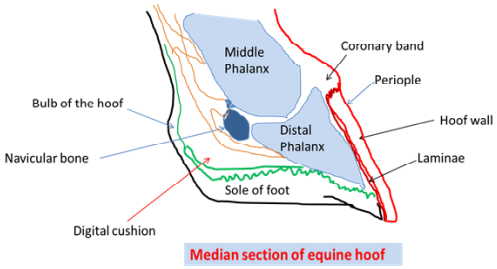
Each digit is composed of three phalanges and three sesamoid bones. The third phalanx (pedal bone) is present directly above the digital cushion and is the largest bone in the hoof. The pedal bones provide the framework for the general shape of each claw and are key components in the movement of the animal. The pedal bone is attached to the corium by sensitive connective tissue called the laminar tissue, or laminae. The deep ûexor tendon is attached to the posterior surface of the pedal bone, making it very important for locomotion and ûexion of the foot. The second phalanx articulates with top of the pedal bone to form coffin joint and behind this joint is the navicular bone, which serves as a fulcrum for the movement of the joint. The first phalanx articulates with second phalanx to form the pastern joint. On the palmar/plantar side of the pastern joint, there are two rudimentary digits which are also protected with horn called dewclaws.

Horn rings on the hoof varies due to nutrition, health, and living conditions of the animals e.g. in general, bovine hooves grow about 1/5 to 1/4 of an inch per month whereas that of horse 1/4 to 3/8 of an inch per month. Trimming of hooves is done to restore the natural shape of the hoof so that weight is distributed evenly and in a manner that is best for all structures of the hoof and the comfort of the animal. Trimming schedules depends on a variety of factors e.g animals which are kept in pasture are less likely to develop painful foot problems than those living on hard cement. Generally, in a dairy cow, hooves are trimmed twice a year.

Difference in other species:

Equine Hoof: The structure of the equine foot is very similar to the cloven-footed hoof anatomy described above, but there are a few differences. In horse, hoof is a continuous structure and a V-shaped cleft is present in the middle of sole is the frog. The frog serves as a cushy, weight-bearing surface that absorbs shock and aids in pumping blood throughout the hoof and up the leg. On either side of the V, there are deep clefts, followed by ridges called the bars. The bars are a continuation of the hoof wall from the heel. The general anatomy ff a horse's hoof is like that of a cow, except that the horse only has one set of bones and the third phalanx is known as the cofûn bone in the equine hoof. The general rule for equine hooves is that they should be trimmed every six to eight weeks, but this varies from animal to animal, as well as from season to season as feet tend to grow

faster during summer when pasture is abundant.



Porcine Hoof: The hooves of pigs are similar to those of ruminants, however, the wall is straight, not bent medially at the toe, and they have a soft bulb that is well distanced from the wall and sole. The hooves of the accessory digits have same structure as the principal digits, but only bear weight on soft ground. Like the ruminant, the third and fourth digits are the weight-bearing digits with the second and fifth being referred to as dewclaws. In the pig, the dewclaws are not rudimentary and contain the necessary phalanges, metacarpals/metatarsals and sesamoids to be considered a complete digit (Sisson *et al.,* 1975).

Sheep and Goat Hoof: Goats have strong feet and legs, and have good balance that allows them to climb along steep hills and narrow mountain pathways. Sheep and goats may be trimmed once to twice in a year, although this largely depends on the conditions they are raised in and any health issues of the hoof. All animals kept in rocky conditions may not need their hooves trimmed at all because the hard surface will wear their feet down naturally. However, sheep and goats kept on softer surfaces should be evaluated periodically for overgrowth (Anonymous, 2016).

Conformation of hoof: the knowledge about normal conformation of the hoof is very important for diagnosis of various disease conditions.

Hoof (foot) Axis: It is the angle of the foot in relation to the ground surface. In cattle, hoof angle equal to or slightly greater than 45° and a dorsal toe length of approximately 7.5 cm. However, in buffalo, the front and hind hoof angles of 53.5° and 50.3° respectively and a toe length is 8.09 and 8.47 cm respectively. Hoof angles in equine are 45-50º for the front foot and 50-55º for the hind foot, whereas zebras showed an inverse relationship with the average front foot angle of 58°and that of hind foot 55°.

Club Foot: When the dorsal angle to the ground is more than 60º

Run under heel (low heel; long toe): When the dorsal angle to the ground is less than 45º

Pastern axis: It is the angle of third phalanx with relation to the ground. This axis should be in the same plane as the foot axis, if it is not so then the animal has a broken foot pastern axis.

Level foot: The foot with equal length to the medial and lateral quarters and heels.

Off-Level foot: The foot with one lower quarter than the opposite quarter

Flat Foot: A foot with little concavity to the sole

Common Hoof problems in different animals:

The most common signs of hoof diseases are sudden onset of lameness, hot or painful hoof, foul-smelling of black discharge from hooves, rise in body temperature and pulse, shifting weight off of a leg, some cracks or hole in hoof wall, swelling and bruises near the base of the hoof. If you noticed any of the above signs in your animal, you must immediately contact your vet and take necessary care of hoof.

Laminitis or Founder: It is inûammation of the laminar tissue which is sensitive connective tissue holding the pedal bone to the wall of the hoof. Laminitis occurs due to dysfunction of the blood vessels supplying the laminae and softening of the ligaments of the suspensory apparatus leading to rotation of the pedal bone and compression of the digital cushion.

Abscess: The condition is manifested by the presence of swelling in the hoof, pus or blood come out from the sole and generally hot in the area.

Canker: It is hypertrophy of horn-producing tissue in drought horses. The causes of Canker are the standing on the damp floor or urinated floor and lack of pressure on frog of the horse hoof

Kerotoma: Formation of tumour in the inner side of the hoof wall is keratoma. Size of the tumour can be 1 inch to 3 inches. The causes of the disease are regular irritation in the sensitive laminae of coronary band and excessive hit on the soft tissues.

Quittor: It is chronic inflammation of lateral cartilage of hoof and is characterized by pus formation in the site of cartilage, necrosis and coronary band. This disease is usually seen in the front leg of the horse.

White line disease: When there is any abnormality in the hoof white line. It may be due to some bacteria or fungi.

Ringbone: Excessive accumulation of horn tissues in the first, second and third phalanx is known as ringbone. The cause of the disease is mostly genetic, and insufficient Calcium or Phosphorus in the ration and continuous injuries in the periosteum of the digits. The disease is characterized by the presence of new bony structure around the pastern or coffin joint.

Thrush: Degeneration of frog with black necrotic material due to bacterial infection. This condition developed in the sole due the long-time standing of the horse in the wet floor and lack of pressure on the frog which leads to necrosis of tissues.

Foot Rot: inflammation of interdigital subcutaneous tissue common in bovines

Corns and Sole Bruises: Corn is proliferation of the tissue in interdigital cleft due to chronic irritation. Injury to sensitive laminae of the sole area is sole bruises. The cause of the corn and some bruises is insufficient trimming of the foot, improper balance of weight in the frog, excessive erosion on the coronet and over racing.

Crack of the hoof wall: When there is a crack in the wall of a hoof and it is also termed as Sand crack. This disease is seen in a quarter of foreleg and the region of the hind leg.

Navicular Disease: The condition is seen when there is any type of heel pain and is characterized by lameness and painful gait of the horse. The cause of the disease is genetic, improper nutrition, continuous exposure of unusual ground like hard, rocky surface, etc.

Ulceration of sole: Occurs at the junction of sole and heel due to trauma

Subsolar Abscess: occurs due to puncture of the sole

Interdigital dermatitis: A wet inflammation of the interdigital cleft occurs mostly in dairy cattle.

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BREEDING STRATEGIES FOR PRODUCTIVITY ENHANCEMENT IN BUFFALOES

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DEPARTMENT OF VETERINARY & ANIMAL HUSBANDRY EXTENSION EDUCATION

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India possess the largest buffalo population having high genetic diversity with 16 recognized breeds including world renowned buffalo breeds viz. Murrah, Nili-Ravi, Jaffrabadi, Surti, Mehsana, Bhadawari, Pandharpuri, and Banni. The buffalo population has shown consistently increasing trend in the country and a larger increase has been recorded in the states which are home to well-defined, milch breeds of buffaloes. Despite potential advantages, little attention has been paid to buffalo improvement programs. With selective breeding, improved management and the establishment of more dairy herds, milk yields are increasing worldwide. Buffalo milk contains about twice as much butterfat as cow milk.

Riverine breeds of the Indian sub-continent are mainly raised for milk production. Their milk yield is about six to seven litres per day. The important milk breeds of India are the Murrah, Nili-Ravi, Surti, Mehsana and Jaffrabadi. The high-yielding Murrah is called as Holstein-Friesian of the buffalo world. Murrah buffalo originate from Haryana- Delhi, and the breed has been spread from that area to other parts of India due to its wide adaptability and adequate production potential. The Nili-Ravi buffalo, a native breed of Punjab, were two different breeds (Nili and Ravi) but are now considered to be a single breed. Nili-Ravi breed of buffalo has been originated from border area mainly Ferozepur district of Punjab state and this breed has production potential as good as Murrah and even out performing it in Punjab of Pakistan. Despite Nili Ravi having high production potential, the genetic improvement of this breed was somewhat neglected due to higher attention focused towards Murrah.

Selection schemes in buffaloes

In dairy animals, selection based on production related traits has been in practice since very long for getting higher milk production. Contrasting the buffaloes from cattle production system, reproduction becomes of great importance in buffalo rearing due to higher age at puberty and service periods along with silent heat during summers observed among majority of the buffalo breeds. Thus an immediate attention to reproduction performance along with milk production in selection of breeding buffaloes is warranted. Further, male and unproductive female buffaloes can add to farmers' income as source of meat, so appropriate attention to their growth traits is also desirable.

Most of the river buffalo are of desi type and do not belong to the defined breeds. In the national breeding policy, improvement in these non-descript buffaloes was recommended through grading up with defined breeds. Preferably Murrah, Nili-Ravi, Surti or other local defined breeds were used in the grading-up program in the Indian sub-continent where river buffalo predominate. Although no large scale scientific evaluation of these schemes

has been made, large proportionate increase in share of buffalo milk over time suggests the effectiveness of grading up schemes. In Sri Lanka, grading up of local buffalo with Murrah and Surti from India, resulted in a significant increase of approximately 290 per cent in milk yield over the local buffalo, through the grading up program, which is highly satisfactory.

In the defined breeds the selection in the initial years was done through culling of low yielders and selection of bulls on the basis of body confirmation and dam's milk yield. Government farms for important buffalo breeds with herd size of around 300 breedable females and 10 bulls were established for production and testing of bulls for improving milk yield in them. The results of these studies have not been encouraging mainly because of small herd size, poor accuracy of sire's breeding values and non-availability of semen freezing facilities at most of the farms.

Selective breeding at organized herds

To exploit the vast genetic variability within the buffalo breeds, the genetic improvement of buffalo herds can be brought through selective breeding within breeds by approach of progeny – testing of bulls associating multiple organized herds as well as farmers herd under field conditions. The genetic improvement in buffalo breeds for higher milk production, reduction in age at maturity, reduction in service period, dry period and calving interval will lead to higher economic returns to the farmers.

Grading up for non-descript buffaloes

The production of non-descript buffaloes can be increased rapidly through mating with superior sires of improved breeds like Murrah, Surti, Nili Ravi and Mehsana. Surti is recommended for Karnataka, Kerala, parts of Gurjarat, Rajasthan and Madhya Pradesh. Murrah and Nilli Ravi are recommended for Punjab, Haryana and Western U.P. and in other parts of the country where sufficient feed and fodder resources are available. Through grading up with superior breeds in four to five generations, the low producing non-descript buffaloes can be replaced with high producing buffaloes conforming to well define breeds.

Progeny testing

The associated herd progeny testing through Network Project on Buffalo Improvement was initiated in 1993 with the objective to increase the intensity of selection of bulls from large population and increased number of progeny per bull for testing in Murrah buffaloes. 12-15 bulls are tested on about 800 breedable buffaloes located at 6 institutional herds participating in this project namely GADVASU Ludhiana, HAU Hisar and NDUAT Faizabad from SAUs, CIRB Hisar, NDRI Karnal and IVRI Izatnagar from ICAR institutions. Performance evaluation and improvement of other important breeds of buffaloes under Network Project on Buffalo Improvement involves Nili Ravi breed at CIRB sub campus Nabha Panjab, Jaffarabadi breed at JAU Junagarh Gujarat, Bhadawari breed at IGFRI Jhansi Uttar Pradesh, Surti breed at MPUAT Vallabhnagar Rajashthan and Pandharpuri breed at MPKV Kolhapur Maharastra. Top ranking bulls are selected for nominated mating on the elite buffaloes at

the farm as well as on identified buffaloes in the field.

Field progeny testing under Network Project on Buffalo Improvement was initiated to strengthen the ongoing sire evaluation programme of associated herd progeny testing at institutional herds by involving performance recording on farmers' animals using the semen of bulls selected under the Network Project.

Genomic selection

Many DNA level variations have been detected differentially in high and low yielding buffaloes. Similarly, genotypic differentiation for buffaloes with varying conception and service period has also been demonstrated. However any of such markers have yet to be utilised under breeding programmes due to very little contributions of any individual marker on the quantitative traits like milk productivity. To make further progress, QTLs were identified, yet a practical utility could not be established due to various reasons. Buffalo genomic work has been initiated for identification of molecular markers associated with performance traits. It has been proven on cattle that genomic selection can be successfully used to aid in selection of high genetic merit animals at the earliest of their life with increasing accuracy thereby improving genetic gain per unit time to the extent that could not have been achievable through conventional breeding schemes. The genomic selection however demands for setting up of reference population and accurate recording system as a prerequisite of its adoption. Thus priority now should be to make the buffalo herds ready for genomic selection by keeping records of essential parameters such as pedigree, production and reproduction parameters, so that in near future genomic selection can be applied flawlessly.

Artificial insemination

The artificial insemination (AI) envisages collection of semen from the male and its introduction in the female system at the most appropriate time. The technique involves care and rearing of males from birth to maturity; collecting, grading, preserving and transporting of the semen, and inseminating semen into females. The spread of AI brought in focus the concept of identifying good sires both in terms of fertility and milk yield. It is noteworthy that without the advent and broad spread adaption of AI techniques, implementation of any of the abovementioned breeding programmes may have not been possible.

Conclusion

Although conventional breeding technologies viz. selection and mating systems have contributed significantly in genetic improvement of livestock in developed countries, the pace in developing countries was slow due to poor spread of AI and non-availability of genetically superior males in requisite numbers. Infrastructure for recording of data in the field conditions is negligible. Progeny testing, being a very long process cannot deliver fast genetic gains despite being accurate. Further, herd size with the farmers is small (1-4 cows/buffalo per household). In view of above limitations genomic selection presents a promising scope of further genetic improvement in buffaloes. The successful implementation of genomic selection on a broad scale however will require ample preparations at the administrative, financial, veterinary services and farmers end.

BODY CONDITION SCORE (BCS) — A TOOL FOR DAIRY HERD MANAGEMENT

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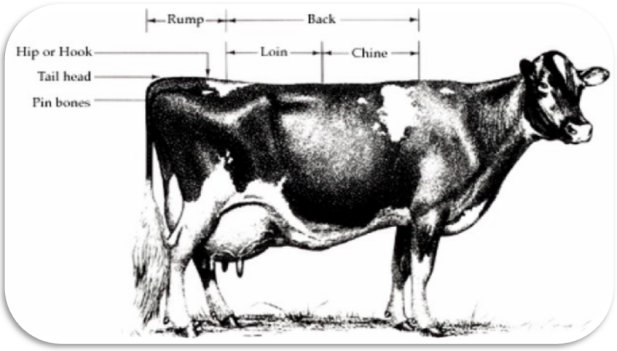
Body Condition Scoring (BCS) refers to the relative amount of subcutaneous body fat or energy reserve in the cow. It is an important management tool for maximizing milk production and reproductive efficiency while reducing the incidence of metabolic and other peripartum diseases. Body condition scoring help to ensure that the cow is in the correct condition for each stage of her annual cycle and accordingly appropriate dietary changes can be made in order to correct any deficiencies. For dairy animals, the crucial periods are at calving and during early lactation. Achieving correct body condition at calving is important in order to avoid calving difficulties and losses. While in early lactation it is important to prevent excessive weight loss when meeting the extra nutritional demands of high yielding cows. Body condition scoring is also useful in dairy heifer feeding management. Thin heifer may not grow rapidly enough to reach puberty by 13 to 15 months of age. They may also be too small to calve at 23 to 25 months or to carry enough weight to maintain a normal first lactation. On the other hand, fat heifers have been shown to produce less milk when they enter the milking herd, especially if they have been fat at puberty. Research and field experiments have shown that body condition influences productivity, reproduction, health, and longevity. Thinness or fatness of animal can give a clue to underlying nutritional deficiencies, health problems, or improper herd management. Regular body condition scoring can be used to troubleshoot problems and improve the health and productivity of the dairy herd. The energy reserved in the form of subcutaneous fat can be used by the cow in periods when she is unable to eat enough to satisfy her energy needs. In high producing cows this is normally happens during early lactation, but it may also happen when cow is ill, fed poor quality feed or when feed intake is restricted. After a period of weight loss, cows should be fed more than their requirements to restore normal body condition. The main principle left behind the body condition scoring is to achieve a balance between economic feeding, good production and good welfare of dairy animals.

How to assess the body condition score

A 5 – point (1 to 5) scoring system is used to evaluate body condition score for dairy animals. On the 5 – point scale, a score of 1- point denotes a very thin cow, while 5 – point denotes an excessively fat cow. These are extreme scores and should be avoided. The average 3 – points is the most desirable for the majority of the herd. A score with a plus or minus indicates a borderline body condition. For accurate scoring, both visual and tactile appraisals are necessary. The main anatomical areas to be observed for determination of body condition scoring are:

- **Pelvic area**
- **Loin area**
- **Hook and pin bones**
- **Tail head and sacral ligaments and**
- **Short ribs**

The following diagram illustrates the dairy cow's major bone and muscle groups and shows the areas of concern in scoring.



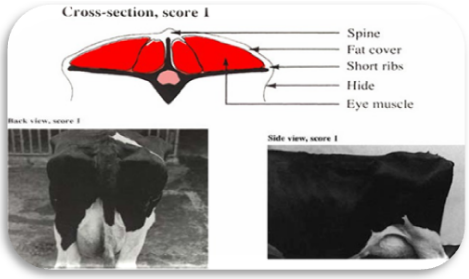
Scoring consistently requires handling cattle in order to assess body reserves but an overall visual inspection is also important. The scoring system is designed to cover all dairy animals (cattle and buffalos) but some allowances should be made for different breeds or indigenous non-descript dairy animals. The scoring method involves a manual assessment of the thickness of fat cover and prominence of bone at the tail head and loin area. One should stand directly behind the animal to score both the areas and always handle the animal quietly and carefully using the hand. The tail head is scored by feeling for the amount of fat around the tail head and the prominence of the pelvic bones. The loin is scored by feeling the horizontal and vertical projections of the vertebrae and the amount of fat in between.

Score of 1

Body Condition: Very poor

- Individual short ribs have a thin covering of flesh.
- Bones of the chine, loin, and rump regions are prominent.

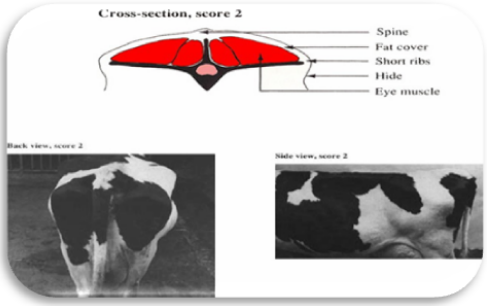
- Hook and pin bones protrude sharply, with a very thin covering of flesh and deep depressions between bones.
- Severe depression below tail head and between pin bones. Bony structure protrudes sharply, and ligaments and vulva are prominent.



Score 2

Body Condition: Poor

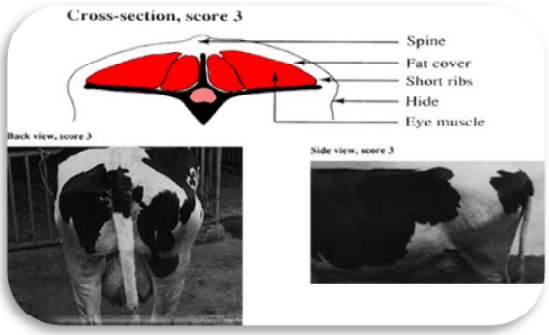
- Individual short ribs can be felt but are not prominent.
- Ends of ribs are sharp to the touch but have a thicker covering of flesh.
- Short ribs do not have as distinct an “overhanging shelf” effect.
- Individual bones in the chine, loin, and rump regions are not visually distinct but are easily distinguished by touch.
- Hook and pin bones are prominent, but the depression between them is less severe.
- Area below tail head and between pin bones is somewhat depressed, but the bony structure has some covering of flesh.



Score 3

Body Condition: Good

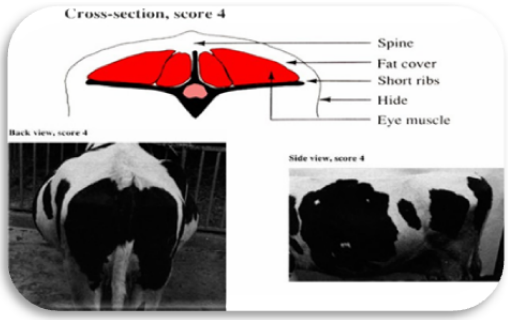
- Short ribs can be felt by applying slight pressure.
- Altogether, short ribs appear smooth and the overhanging shelf effect is not so noticeable.
- The backbone appears as a rounded ridge; firm pressure is necessary to feel individual bones.
- Hook and pin bones are rounded and smooth.
- Area between pin bones and around tail head appears smooth, without signs of fat deposit.



Score 4

Body Condition: Fat

- Individual short ribs are distinguishable only by firm palpation.
- Short ribs appear flat or rounded, with no overhanging shelf effect.
- Ridge formed by backbone in chine region is rounded and smooth.
- Loin and rump regions appear flat.
- Hooks are rounded and the span between them is flat.
- Area of tail head and pin bones is rounded, with evidence of fat deposit.

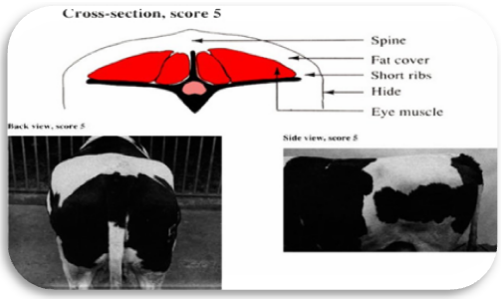


Score: 5

Body Condition: Grossly fat

- Bony structures of backbone, short ribs, and hook and pin bones are not apparent; subcutaneous fat deposits are very evident.

- Tail head appears to be buried in fatty tissue. The following table no.1, shows the ranges of ideal body condition scores along with the nutritional assessment of a dairy animal at her different physiological stages.



Conclusion

Body condition scoring is an easy technique to judge a group of animals in the field. Researches demonstrate that body condition scoring of animals of a dairy herd is an important manage mental tool. Body condition scoring of an animal cannot be altered rapidly. Specialist advice should be obtained whenever there is concern about the general condition of the herd. In excessive condition, cows should be kept on bare pasture with straw to maintain rumen function and should be closely monitored. If done on a regular basis, body condition scoring can improve dairy herd nutrition, health and production.

Table No. 1: NUTRITIONAL ASSESSMENT THROUGH BODY CONDITION SCORE

Physiological stages	Recommended BCS Score	Nutritional Assessment
Drying off	3.75 – 4.25	Scores below 3.75 a) Increase energy intake. Inadequate body fat reserves, can decrease milk production in upcoming lactation b) Increase energy content of late-lactation ration. Body fat reserves should be replaced at that time.
Cow at Calving	3.75 – 4.25	Scores below 3.75 indicate cows received inadequate energy during late lactation and/or dry period
Early Lactation	3.0 – 3.5	Scores below 3.0 a) Very high producers may drop to 2.75 and not become a problem. b) Thin cows that are not high producers are not getting enough energy. c) Cows have good body condition (3.5 – 3.75), but production is not as high as expected. Check for inadequate intake of protein, mineral or water
Mid lactation	3.5	Scores below 3.5 indicate that cows are receiving inadequate energy.
Late lactation	3.75	Scores below 3.75 at dry off mean cows are receiving inadequate energy.
Heifers	3.25 – 3.75	Scores below 3.25 may indicate a nutritional problem. If heifers are allowed to become too thin, they will not grow at the proper rate and may have reproductive problem later on.

LIVESTOCK RECORD KEEPING: A KEY TO EFFICIENT GENETIC IMPROVEMENT

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Record Keeping plays a pivotal role in improving any practice on the livestock farms. However it may require the farmer to put time and efforts into faithfully maintaining a recordkeeping program, the benefit observed in terms of improvement in aspects like management, production, reproduction, and marketing planning are so enormous that they make the efforts as equally rewarding. The record keeping may be as detailed or as simple as one desires. Decisions like purchase, culling, replacement, breeding, housing, health management and marketing of the animals and at farm resources can be more efficient, if they are based on the records.

Collection of the farm records must be done purposefully. Many records are not difficult to collect but all should be easily accessible. This is particularly important with financial records because they are routinely used for book keeping purpose. Benchmarking or comparative farm performance is a useful way to become more aware of the important performance indicators that are more relevant to each livestock keeping system. Some records are compulsory such as data for taxation purposes, whereas most are advisory. Records provide the farm manager with relevant data, information and knowledge. There are few uses of farm records

1. The most vital component of improving in productivity of the farm animals by aiding in decisions like appropriate breeding, feeding, weeding and heeding.
2. Frequently used as a tool for income tax calculations, estate planning, business arrangement, reconciliation and obtaining and managing credits/ loans.
3. Can be used to provide data for financial analysis and other diagnostic instruments and can be used as an indicator to monitor progress.
4. They are a good forward planning tools. Past records can be used to project future cash flows for current and modified farm practices.

Temporary and permanent records

Events of importance should be recorded immediately in the registers with all pertinent information. All note should be dated with correct animal identification and other data pertinent to the situation. The records can later be transferred to permanent records. Each animal in the herd should have a unique identification and individual permanent record that is initiated at birth or at purchase. Format of sections may vary as per convenience but the contents are of importance.

Records to keep

All livestock record keeping systems should incorporate some basic elements. Recording of the performances of the animals can be done easily if animals have some identifications / numberings. Keeping records on individual animal is very important as it is essential in preparing realistic budgets for the future. Rather than depending on generic estimates of the farm performance. Some of the key records to keep include:

1. **Expenditure and Profit**: Sales, purchase, labor, equipment and other investments must be kept in records properly to ensure economic viability of the livestock keeping.

2. **Herd Status and Pedigree**: Recording of the category wise herd strength helps in determining the actual performance level of the herd. In a good herd 70 of the breedable animals should be lactating or be pregnant. Records of total number of animals, calves and their sex, yearlings, heifers, lactating, pregnant and dry cows should be kept. The date of calving/birth and all other important events must also be maintained for each animal. Recording the sire and the dam of the animals, their breed composition and production details may help fetching good prices while selling surplus animals

3. **Feeding**: Routine monitoring of the feed offered and actually consumed amount can indicate that if the cows are in proper appetite or sick, it can also help in tuning up the feed composition of the animals as per the requirements.

4. **Growth**: Birth weights followed by monthly body weights of the calvers helps to monitor the feeding management, required to achieve the growth targets. Live weight and body condition of the heifers and adult cows at important events like at insemination, drying, calving and 15 days post calving facilitate milking performance monitoring during the entire lactation and better planning of the feeding regime. The growth records may further be supported by body condition scoring.

5. **Health**: Records of the vaccinations, diseases, veterinary visits and drug treatments aid a veterinary professional to follow through the history of the animals, correct diagnosis, proper line of treatment and animals' response to treatment. It goes without saying that a better diagnosis leads to better treatment and a healthier herd leads to better profits.

6. **Reproduction**: Recording date of heat in cows is of utmost importance, because it indicates the cyclicity status of the cows and enables the farmers for planning timely inseminations of the animals leading to better conception, thus cutting the cost of rearing the animals at unproductive state. The calving date is of similar importance because, it indicates the start of the next reproductive cycle. If a cow does not come in heat within 50 days after calving, a veterinarian should examine the reproductive system of the animal to be sure of animals' proper cycling or presence of any reproductive disorder, infection etc.

Accurate recording of breeding (Insemination) date is essential for successful pregnancy checks by a veterinarian. This helps to determine conception date that further helps to decide the suitable time for drying off that is 60 days earlier to the expected date of calving, assigning housing to advance pregnant animals and stage specific fulfillment of nutritional requirements and allowances of theirs. Recording the service bull (of which the semen has been used for the insemination) ma help in keeping the pedigree records of the animals, which is a must in genetic evaluation of the animals.

7. **Production**: Daily milk yield helps to checkup on milk payment and to optimize feeding. Regular milk composition data that can be provided by the cooperative or milk processing units can be used to monitor the effects of the diet. The recording of daily milk yields of individual animals, however may prove to be cumbersome for the farmers, especially to those who maintain a substantial numbers of animals and / or depend on the hired labors to manage the animals.

Thus a viable practice in milk recording is for milk and milk fat to be estimated from fewer measures made at regular intervals throughout the lactation. However, the longer interval between these measurements, increases error of the estimates. I n practice a monthly recording at 5, 35, 95…305 days of lactation is widely accepted for balance between the needs of accuracy and economy. While introducing a milk recording scheme, to encourage farmers to cooperate certain incentives may be provided, such as free veterinary care, advice on management and feeding, low cost AI.

Utilization of Records for Genetic Improvement

Besides for a better management of the farm, performance recording of individual animals is a very precious resource that can be utilized for selection and culling decisions for genetic improvement. For the records to be utilized for breed improvement purpose, the data needs to be validated and reliable. Cooperation between the farmer and the field recorder is a basic requirement for the successful operation of any recording scheme. This cooperation can only come through an understanding of the use of records and the uniformity of recording system.

A reasonably accurate progeny test of bull could be obtained from test day records if large progeny groups are available. For example, a progeny test based on a single test day's record of 100–150 daughters would be as accurate as a progeny test based on about 35 daughters with complete records. These test day records can also be used to estimate total lactation yields. The centering method of calculating yields is easier to other methods in monthly recording. In this procedure, the test day yield is multiplied by the number of days in the period of which it is the center, and these products are summed to give an estimated lactation yield. Other method is to use the suitable lactation curve model to predict the production.

These records may be used by breeders for genetic evaluation of the animals at the farms, progeny testing of the breeding bulls used at the farms, and prediction of the genetic production potential of the calves born at the farms, which will further aid in the overall genetic improvement of the animals under recording. It is important here to understand that the genetic evaluation of the animals is not based on the raw records of the animals' performance, as it contains influences of the various external factors like seasons, parity of the animal, age, body condition, nutrition, management practices, breed composition etc. besides the genetic worth collectively transmitted through sire and dam. These predicted / estimated genetic worth (breeding value) can be used as a reference for selection of breeding stock, identification of elite animals, decision of replacement heifers and voluntary culling.

Currently genomic selection is the most efficient selection tool with fastest genetic gains, which will in near future be applied alongside field progeny testing programs. These performance records become further crucial for the successful application of the genomic selection as it requires a pedigreed and well recorded base population as reference on which the entire accuracy and efficiency of the genomic estimated breeding value lies.

Conclusion

Record keeping is a necessary element of good livestock business management. With no written records, farmers have to depend on their memory while making decisions regarding their farm practices. But, memories can become unreliable after a few days, months or years. If farmers maintain records, they can be sure of the farms present status and progress. They can also ascertain strengths and weaknesses in their farm operations and thus have better chances at improving farm practices and profitability alongside enjoying the benefits brought by genetic improvement of their herds.

MEASURES TO IMPROVE POST PARTUM REPRODUCTION IN DAIRY ANIMALS

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Reproduction is a vital factor in determining the efficiency of animal production. Reproductive efficiency can be described as a measure of the ability of a cow to become pregnant and produce viable calf. To achieve the goal of calf a year or a 365 day calving interval, the calving to conception interval (CCI) should not exceed 80-85 days. The CCI comprises of interval from calving to first service and the first service to conception interval.The calving to first service interval further depends upon the re-establishment of ovarian cycles after calving, occurrence and detection of estrus and planned start of services date. Hence, re-establishment of ovarian cycles after calving is of utmost importance and is influenced by various factors viz milk yield, suckling, nutritional status, seasonal influences, uterine health etc.

In order to maximize reproductive efficiency in dairy animals it becomes essential to adopt management tools to achieve reproductive targets. Therefore measure to improve post partum reproduction efficiency are aimed at early restoration of ovarian cyclicity, detection of estrus and timely insemination and pregnancy diagnosis, provision of balanced nutrition, control of post-partum uterine infection, hormonal interventions and avoiding undue stress.

Uterine Health

During pregnancy, the uterus is sterile, but after parturition the uterine lumen is almost always contaminated with a wide range of bacteria. However, development of clinical disease is dependent on the balance between host immunity and the pathogenicity of the bacteria. This balance can be tipped in favor of disease by risk factors such as retained placenta, dystocia, twins, and stillbirth.

Uterine disease within a week of parturition (metritis) is present in up to 40% of dairy cows. Subsequently, 15%–20% of cattle have clinical disease that persists beyond 3 wk postpartum (endometritis), and about 30% have chronic inflammation of the uterus without clinical signs of uterine disease (subclinical endometritis). Clinical endometritis is characterized by the presence of a purulent or mucopurulent uterine discharge detectable in the vagina 21-26 days or more postpartum. Subclinical endometritis is characterized by inflammation of the endometrium that results in a significant reduction in reproductive performance in the absence of signs of clinical endometritis. Subclinical disease is defined by polymorphonuclear neutrophils (PMNs) exceeding between 5.5% of cells and 10% of cells in samples collected by flushing the uterine lumen or by endometrial cytobrush, in the absence of clinical endometritis.

The placenta should be expelled within a few hours of parturition in cattle. During the first week postpartum, the uterus contracts rapidly, and lochia is discharged containing remnants of fetal membranes and fluids. During the second to fourth weeks, any damaged endometrial tissue regenerates, a wave of ovarian follicles develop, a dominant follicle is selected, and estradiol secretion leads to ovulation and formation of a corpus luteum to recommence ovarian cycles. The genital tract should have little evidence of the previous pregnancy by 6 wk after calving and be capable of establishing the next pregnancy. However, about 50% of dairy cows have irregular ovarian cycles during the postpartum period, and animals with abnormal vaginal discharge are more likely than normal animals to have delayed resumption of ovarian cycles after calving.

It is therefore essential to cure any infectious problem by way of antimicrobial therapy before attempting to improve reproductive performance by other means. Incorporation of an injection of PGF2á increases the efficacy of treatment for cows with a functional CL that have metritis or other uterineinfections.Prostaglandin F2á administered to cows on days 12 and 26 postpartum that had either dystocia and/or retained placenta improved their subsequent reproductive performance.

Ovarian Cysts

Ovarian cysts, follicular or thin-walled, and luteal or thick-walled, are found inabout 12% of cows, mostly in the second month of lactation.Ovarian cysts results in poor reproductive performance more likely.Endocrine imbalance seems to explain the occurrence of most cysts, and theirtreatment can be resolved by administering gonadotropin-releasing hormone(GnRH) for follicular cysts orPGF2á forluteal cysts or their combination for both type of cysts.

Nutrition

Nutritional status of dairy animal is of vital importance to maintain a high rate of reproductive performance. The technique of body condition score (BCS) allows to monitor the body reserves in dairy animal. The dairy cows should be fed to calve at a BCS of 3-3.5 and should then loose minimum condition until conception. High milk production in dairy animals in early lactation results in negative energy balance depleting the body reserves. The conception is likely to occur when the peak of lactation is passed and the animal's current energy intake is greater than the output. A poor body condition score at calving adversely affects fertility, characterized by prolonged post-partum intervals, reduced conception rates, and more services per conception. Hence, care of nutritional requirements of the animal during transitional phase of pregnancy helps in earlier restoration of ovarian cyclicity and conception postpartum.

Feed supplementation of Urea Molasses Multinutrient Block (UMMB) and Monensin,an ionophore, has been shown to influence reproductive performance during the postpartum period. Supplemented dairy animals exhibit a shorter postpartum interval provided adequate energy is supplied in the ration. This effect appears to be more evident in

less intensely managed herds that generally have a moderate (60-85d) or longer postpartum interval.

Management Practices

The suckling stimulus from the calf has a negative effect on cyclic activity during the postpartum period; however, animals on a positive energy balance and in adequate body condition generally overcome this negative stimulus prior to the breeding season. Calf removal, either temporary or permanent can increase the number of cows that return to estrus during the breeding season, however, the response can be variable and management of this option can be difficult.

Bull presence postcalving has been shown to cause cows to cycle earlier, this may be accomplished with an altered/vasectomized teaser bull that isn't capable of breeding if this practice is used prior to the breeding season.

Estrus induction or synchronization with progesterone or GnRH or PG based protocols separately or in combination followed by AI at detected estrus or at fixed timeenhances reproductive efficiency in dairy animals. These products may shorten the postpartum interval provided all other management practices such as nutrition and body condition are optimum.

Detection of estrus at appropriate time of ovarian cycle is vital for getting the dairy animals serviced at right time. It is important to frequently observe the animals for estrus, 3-4 times a day for 20-30 min each and particularly late evening and early morning when the animals are not being fed or milked. Maintenance of records is important to improve efficiency of estrus detection. Failure to detect estrus is a major cause of poor reproductive performance.

In conclusion, maintaining healthy cows is essential to maximize fertility and milk yield.Prevention of periparturient disordersby sound herd health practices will reduce the incidence of many healthproblems. Good management practices and somehormonal treatments/interventions given to early postpartum cows preclude further ill health and poor fertility and improvetheir chances for conception.

FOLDSCOPE AS A DIAGNOSTIC TOOL IN VETERINARY SCIENCE

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Disease diagnosis is one of the most important and most difficult aspects of Veterinary Science when compared to Medical Science. It requires exceptional skill and profound knowledge for diagnosing an ailment in a patient (i.e. animal) who unlike humans, cannot express its agony on its own. Just listening to the owner's way of describing the indisposition and comprehending symptoms accurately is a tough job for veterinarians. Also non-availability of proper diagnostic labs in the far flung areas adds fuel to the fire. As it is already known that among various diagnostic equipments, microscope is a significant tool, providing an essential, visual connection between the recognizable macro-world and the incredible underlying micro-world. But the availability of these expensive scientific equipments in each and every nook and corner of the world is somewhat a difficult approach especially in developing countries like India. As part of the "frugal science" movement which aims to make cheap and easy tools available for scientific use in the developing world, an origami based highly affordable paper microscope called as foldscope was developed by Dr. Manu Prakash and Jim Cybulski from University of Stanford, U.S.A. (Cybulski *et al.*, 2014). Another related invention from the same laboratory is paperfuge i.e. a paper centrifuge (Bhamla et al 2017).

Foldscope is the ultra-affordable paper microscope which is designed to be extremely portable, durable and to give optical quality similar to conventional research microscopes. It is designed in such a manner that it costs less than US$1. It is an optical microscope that can be assembled from a punched sheet of cardstock, a spherical glass lens, a light emitting diode and a diffuser panel, along with a watch battery that powers the LED. The foldscope weighs 8 grams and comes in a kit with multiple lenses that provide magnification from 140X to 2180X (Cybulski et al., 2014). The foldscope kit also includes magnets that can be stuck onto the foldscope to attach it to a smartphone, allowing the user to view and take pictures of the magnification.

Foldscope is a very useful invention of the present time especially helpful in the expeditious diagnosis of the diseases. Moreover in the developing countries, the field areas/ rural hospitals are not well equipped with diagnostic machinery which leads to delay in the disease diagnostic process. So in those areas foldscope can serve the purpose. Not only this, if there is no procrastination in the disease diagnosis then this can help in proper treatment of the ailments with specific drugs at the right dosage.

Assembling of foldscope

The unfolded foldscope is comprised of three stages cut from paper; illumination, sample-mounting, and optics. Other primary components include a spherical ball lens (or other micro-lenses), lens-holder apertures, an LED with diffuser or condenser lens, a battery, and an electrical switch. The three stages are weaved together to form an assembled working folded foldscope with magnification of 140x. It is attached with smartphone with help of magnetic couplers provided in the foldscope kit to view parasitic specimens/ samples.

Foldscope as diagnostic tool

Foldscope can be used as a diagnostic tool for animal diseases. Due to the availability of various range of magnification powers from 140 X to 2180 X, it can be used to identify a range of causative agents viz; hemoprotozoan, helminthes, arthropods, fungi, bacteria etc.

Foldscope is highly useful in identification of parasites of veterinary importance because of magnification equivalent to conventional microscope. Foldscope with magnification 140X can be used for diagnosis of helminthic and arthropod diseases. Bal et al (2019) used foldscope (magnification of 140x) attached with smartphone as a cheap and reliable diagnostic tool to identify helminth and arthropod parasites with comparable efficacy to that of expensive light microscope. Same was also used for faecal examinations for parasitic eggs/ova and skin scraping examination for mites. However, low grade parasitic infections and intracellular haemoparsites were not detected by foldscope with magnification 140x. Another problem encountered while using foldscope is the time consumed in focusing of the slides whether it is paper slide or glass slide. *Richard et al (2015) used a foldscope attached with smartphone for diagnosis of Schistosoma haematobium infection in people of Ghana.* However, for diagnosis of haemoparasites, larger magnification lens(greater than 400) is required.

Foldscope may also be used for examination of various secretions and excretions collected from diseased animals. Urine examination may be done conveniently by using foldscope with magnification 140X. Haematological analysis viz; Differential leukocyte count (DLC) may be performed by using lens of higher magnification. Foldscope can also be used for histopathological examination of tissue sections prepared from tissues/biopsies collected from infected/diseased/ dead animals. Wangdi et al (2019) used foldscope as a diagnostic tool for diagnosis of fungal pathogens of tea leaves in Sikkim, India.

On the- spot sample preparation and its visualization with the help of foldscope can prevent the delay and help in spontaneous treatment of the ailment thereby proving highly beneficial in the field areas. Attachment with smartphone is pre requisite for effective use of foldscope. Almost all the field veterinarians are using smart phone and internet these days. Hence, it is easier to acquaint them with use of foldscope attached with smart phone.

The first and foremost advantage of this technology is its cost effectiveness. A

microscope costing less than a dollar is worth imagining. The conventional microscopes are very expensive due to which in developing countries it becomes difficult to make them available everywhere especially at the grass root levels. Moreover the conventional microscopes are heavy, not easily portable and also demand extra care for their maintenance. But as compared to them, the foldscope is origami based microscope so it can be very easily prepared by folding of the paper sheet and carried very easily in our pocket from one place to other place. As it is made of cardboard- like paper sheet so it is very robust and sturdy to use and does not require any special maintenance. Another additional advantage of using foldscope attached with smart phone based that clicked pictures can be sent to a subject expert for further confirmation in case of any suspicion.

Smartphone assisted microscopy has immense potential to bring diagnostic testing to areas most in need, and to support animal disease diagnosis especially in the under-resourced regions of the world.

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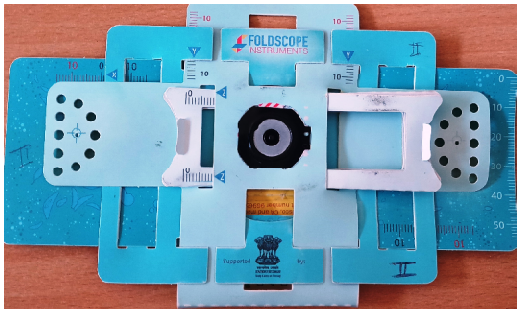


Figure 1: Folded Foldscope

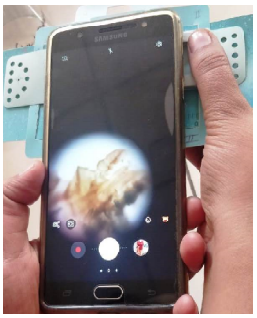


Figure 2: Foldscope attached with smartphone to visualize and click pictures of parasitic specimens.

FROM SYNTHETICS TO NATURAL: NEWER WAY FOR EXTENDED SHELF LIFE

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In the era of awaken awareness and consciousness towards health, a trend has been set up towards acceptance of more and more natural products and products with good shelf life. In this context, novel technologies like Modified Atmosphere Packaging and natural preservatives like bacteriocins are becoming choice of modern consumer as well as manufacturer. Extensive work has been done and many review papers witnesses such promising effects. A brief review of various researches has been outline in this paper.

Milk and milk products constitute the second largest gross agricultural produce in the country and conversion of raw milk into wide variety of milk products has been practiced in our country since pre-historic times. It is estimated that about fifty per cent of total milk produced in India is converted into a variety of traditional milk products (Chowdhury et al 2017). Traditional dairy foods have an essential role in preservation of precious milk nutrients and promotion of its consumption. Also, these are an integral part of Indian heritage and have great social, religious, cultural, medicinal and economic importance. These have been developed over a long period with the culinary skills of homemakers and *halwais* (sweetmeat makers). Manufacture of traditional dairy products also adds value to milk and provides considerable employment opportunity. Indian dairy products naturally contain different healthy components that have therapeutic properties present, owing to inherent components such as e.g. antiallergenic qualities, osteoporosis prevention, and reduced risk of heart disease, antimicrobial qualities, immune enhancement, anti-diarrhoeal aspects, and alleviation of lactose intolerance etc.

Delicacies prepared from milk are as perishable as the milk is, and is dedicated as an ideal food for microorganisms being high in moisture content and neutral pH. At ambient temperature shelf life of traditional dairy foods is only few days. Also, processing temperature is not able to completely undertake the destruction of microorganisms. Therefore, certain permitted chemical preservatives may be used for inhibition of growth and activity of microorganisms. Preservative is a substance which when added to food, is capable of inhibiting, retarding or arresting the process of fermentation, acidification or other decomposition of food (FSSAI, 2006). Also, direct addition of these preservative agents in food can reduce the acceptance of food quality by changing the organoleptic and textural properties of traditional dairy foods along with the fear of consuming chemicals in the form of these preservatives. However, increasing awareness of health risks associated with these chemical preservatives has led examining safe alternatives, and the possibility of using antimicrobial agents. Antimicrobial agents play an important role in enhancing the shelf life of perishable food products by inhibiting the growth of targeted bacteria. One of the tradi-

tional ways of controlling microbial growth using antimicrobial is by dipping or spraying antimicrobial agents on the surface of the product (Kolsarici and Candogan 1995; Keryy and Hogani 2006). However, the efficiency of the antimicrobial substances is restricted because of its uncontrolled migration into the food and partial inactivation caused by its interaction with the food components (Quintavalla and Vincini 2002). To overcome these limitations, antimicrobial packaging technique is an emerging approach in this perspective. In antimicrobial packaging, antimicrobial agents can be incorporated into the packaging material, may be coated on the surface of packaging film or a sachet containing antimicrobial compound can be added into the package (Devlieghere et al 2004). Also, these agents are gaining popularity over synthetic preservatives, being safe and more effective against spoilage microorganisms.

ANTIMICROBIAL AGENTS

Antimicrobial agents from natural or synthetic sources have been explored with satisfactory results regarding the growth inhibition of spoilage and pathogenic microorganisms. Among the most studied, natural antimicrobial agents are bacteriocins (nisin, natamycin and pediocin) and natural plant extracts (essential oils).

A Bacteriocins

Bacteriocins are generally defined as peptides produced by bacteria that inhibit or kill other related and unrelated microorganisms. Bacteriocin was firstly identified by Gratia (1925) as an antimicrobial protein produced by *Escherichia coli* and named colicin. The bacteriocins produced by lactic acid bacteria (LAB) are generally recognised as safe (GRAS) and are suitable for food preservation & can reduce the use of chemical preservatives along with intensity of heat treatments which otherwise alone as a treatment, destroys the organoleptic and nutritional properties of food. These are non-toxic on eukaryotic cells and is pH and heat tolerant. Bacteriocin destroys the bacteria by acting on its cytoplasmic membrane. These can be broadly classified as from the source from where these have been derived like gram negative bacteria and gram positive bacteria. Also, further categorization can be seen with respect to their size as class I, II (a/b/c), and III. The commonly used bacteriocins are nisin and pediocin.

i Nisin

Nisin is an antibacterial peptide produced by *Lactococcus lactis* that effectively inhibits Gram-positive bacteria and also the outgrowth spores of Bacilli and Clostridia (Cleveland, et al., 2001; Hurst,1981; Hurst & Hoover, 1993). The antimicrobial effect of nisin includes disruption of the cytoplasmic membrane, either resulting in leakage of essential cellular material such as adenosine triphosphate (ATP) from the cell or, in more severe cases, lysis. Studies have also indicated that nisin inactivates sulphydryl groups in the cytoplasmic membrane, thereby acting as an inhibitor of both spore outgrowth and vegetative cells (Morris et al.1984). Nisin is one of the bacteriocin approved for food applications by Food and Agriculture Organization and World Health Organization in 1969 (Arauz et al

2009). Therefore, its use in various food products is allowed in several countries (Delves-Broughton, 1990).

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Several studies have been reported to provide effective results with the incorporation of antimicrobial agents into the polymeric films. The possible reason behind this is the inactivation of antimicrobial activity when it comes in contact with food matrix and components or dilution below effective concentration due to migration into the bulk food. Therefore, the attachment of antimicrobial agents to films enables slow release of antimicrobial agents function over longer time period (Appendini and Hotchkiss, 2002; Muriel–Galet et al., 2012). In a similar study, Coma *et al*. (2001) prepared edible cellulosic films with hydroxypropyl methyl cellulose (HPMC) along with nisin as an antimicrobial agent against gram positive species and tested the same against *L. innocua*and *S. aureus*. To this film, further addition of stearic acid improved water migration properties and thus results demonstrated significant effect on reducing the inhibitory activity of microbes.

Though many dairy products have been considered for shelf life enhancement using these novel approaches. However, studies considering composite dairy foods are still lacking and would be an innovative choice to prolong the life of such products. Numerous studies of nisin have been reported. However keeping in consideration the length of the article only few have been listed herein.

ii Pediocin

Pediocin is a bacteriocin produced by *Pediococcus* species and is categorized in class IIa of bacteriocin from lactic acid bacteria, with known antilisterial activity. It inhibits the growth of microorganisms by binding to cytoplasmic membranes, forming poration complexes. This process finally causes the cell death with cell lysis (Rodriguez et al. 2002). The use of pediocin has been extensively studied in meat products and few in dairy products (Ennahar et al. 1998). Jagannath et al. (2001) studied the effect of pediocin in controlling the growth of *L. monocytogenes* in *shrikhand* wherein pediocin was used at different concentrations and kept at different temperatures for various length of time. The results showed that 23% level of pediocin inhibited the growth even at higher temperature and longer storage period. The use of pediocin as biopreservative in dairy products is limited, where as in some studies pediocin was used as an antimicrobial agent in antimicrobial

packaging (Silva et al. 2018).

B. Essential Oils

Essential oils (EO's) are also known as volatile oils or simply as the oil of the plant from which they were extracted, such as oil of clove. Therefore these can be defined as oils being a concentrated liquid containing volatile aroma compounds from plants. These can be extracted by expression, fermentation, or extraction. Amongst various methods, though method of steam distillation is most commonly used for commercially production of essential oils. The essential oils are mostly used as flavouring agents, perfumes and pharmaceuticals (Braak and Leijten, 1999). Owing to its antimicrobial properties, currently essential oils are used as antibacterial agents and as food preservatives. A large variety of EO's from different plants such as basil (*Ocimumbasilicum L.*), chamomile flowers (*Matricaria chamomilla L.*), cardamom seeds (*Elettariacardamomum (L.) Maton*) and rosemary (*Rosmarinus officinalis* L.), has been applied to food or food packaging as antimicrobial and antioxidant and are considered as GRAS (Food and Drug Administration (FDA), 2016). Generally, essential oils containing higher concentrations of phenolic compounds such as carvacrol, eugenol, and thymol bears strongest antibacterial properties against foodborne pathogens. Essential oils from oregano, clove, sage, rosemary, nutmeg, mint and thyme have shown to inhibit *Listeria monocytogenes* at concentrations @ 0.7 to 2.7% (Tassou et al. 1995). These oils inhibit the growth by disturbing the cytoplasmic membrane, disrupting the proton motive force, electron flow and coagulation of cell contents (Burt, 2004). The preservative action helps in enhancing the shelf life of foods, reducing or eliminating pathogenic microorganisms and increasing the overall quality of food products (Dussault et al., 2014; Echegoyen and Nerin, 2015). Several studies have been undertaken using essential oils as biopreservative. Govaris et al., (2010) investigated the usage of *Lamiaceae* essential oil as food preservative applied alone @0.6% or 0.9% and in combination with nisin to check the antimicrobial activity against *S. enteritidis*. Results indicated when used @ 0.9 %, showed quite high activity against *S. enteritidis*.

Seydim and Sarikus (2006) produced antimicrobial film by incorporating different ratios of oregano, rosemary and garlic essential oils into whey protein isolate films and tested the antimicrobial activity against *Escherichia coli* O157:H7 (ATCC 35218), *Staphylococcus aureus* (ATCC 43300), *Salmonella enteritidis* (ATCC 13076), *Listeria monocytogenes* (NCTC 2167) and *Lactobacillus plantarum* (DSM 20174). Results demonstrated the use of garlic essential oils into whey protein films showed maximum inhibition against the selected organisms than oregano and rosemary essential oils. In a similar kind of study, Emiroglu et al., 2010 evaluated antimicrobial activity of soy protein edible film incorporated with 1, 2, 3, 4 and 5% oregano and thyme essential oils against*E. coli O157:H7*, *Staphylococcus aureus, Pseudomonas aeruginosa* and *Lactobacillus plantarum* by inhibition zone test. The results showed that prepared films had antimicrobial activity against E*. coli, E coli O157:H7* and *S. aureus* whereas *L. plantarum* and *P. aeruginosa* appeared to be more resistant bacteria.

MODIFIED ATMOSPHERE PACKAGING FOR TRADITIONAL DAIRY FOODS

The modified atmosphere packaging is sealing the product in modified air or by altering the chemical composition of air. It can be done by either ways by decreasing oxygen level and increasing carbon dioxide and nitrogen level. The low level of oxygen prevents the fat oxidation, pigment and browning oxidation and growth of aerobic bacteria (Sandhya 2010). As dairy products provide nutrients and favourable environment for growth of microorganisms and microbiological deterioration of dairy products is caused by growth of psychrotrophic gram negative bacteria species (*Pseudomonas, Acinetobacter, Flavobacterium, Aerobacter, Serratia, Proteus*), yeast and mold (*Geotrichum, Mucor, Alternaria and Penicillium*) (Chambers 2002). Therefore, addition of high carbon dioxide retard the growth of microorganisms by displacing oxygen, lowering the pH or forming carbonic acid (Butler 1982) and directly affecting on the metabolism of microorganisms (Daniels et al 1985). For packaging of dairy products, the CO_2 composition may vary from 10 to 100 % and balanced with nitrogen preventing package collapse (Singh et al 2012). Nitrogen is inert gas, tasteless, used as filler gas and preserves the food products by replacing the oxygen gas. The modified atmosphere is done by modifying the atmosphere surrounding a food product by vacuum, gas flushing or controlled permeability of the pack. The change in atmosphere causes no growth of microbes and doesn't allow biochemical and enzymatic reactions without using any chemical preservatives.

SYNERGISTIC EFFECT OF MODIFIED ATMOSPHERE PACKAGING AND ANTI-MICROBIAL PACKAGING

Several studies are published related to the modified atmosphere packaging for shelf life extension. Whereas antimicrobial packaging is also used by various researchers to extend the shelf life. However, the synergistic use of modified atmosphere packaging and antimicrobial packaging can give a new approach. The antimicrobial packaging inhibits the growth of various microorganisms along with the potential of modified-atmosphere packaging (**MAP**) which can further extend the shelf life of different dairy products. Studies pertaining to MAP have been demonstrated in various researches (Floros et al., 2000; Pantaleao et al., 2007; Papaioannou et al., 2007). The combined use of both packaging will give more inhibitory action against microorganisms. The various studies has been extended the shelf life of traditional dairy foods by Modified atmosphere packaging (Londhe et al 2012, Chowdhury et al 2017, Jha et al 2015, Ghayal et al 2015, Jain et al 2015 and Sharma et al 2001) and limited studies used antimicrobial packaging whereas study related to combined use of both packaging is not present without one researchers i.e. Andhare et al 2016 who packed the lalpeda in polyethylene bags coated with nisin and modified atmosphere by increasing carbon dioxide and nitrogen levels and life was extended upto 10 days. Other studies of combined effect are present on different products rather than traditional dairy foods like Conte et al 2009 and Mastromatteo et al 2014 where the authors used the active and modified atmosphere packaging for extending the shelf life of Fior d Latte cheese and low moisture mozzarella cheese respectively.

Conclusion:

Application of these technologies has made the favourable choice of consumers and helped manufacturers to meet their demands towards healthful products. Also, not only natural but extended shelf life is another salient feature of products prepared either with bacteriocins or with the incorporation of natural entities such as essential oils and use of novel techniques like MAP. Synergistic effect of either of these two can further helps in improving product shelf life without impairing its sensory, microbiogical and physic-chemical properties. In further time approaching there will be more and more researches will be carried out to yield the potential of hurdle technology to harness more benefits.

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DIAGNOSIS OF PREGNANCY IN DAIRY ANIMALS: IMPORTANCE AND PROBLEMS ASSOCIATED

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Pregnancy is a normal physiological condition of female from the time of fertilization until the birth of fetus. To achieve this goal, it is important to successfully inseminate the animal at right time and diagnose their pregnancy as early as possible. The average gestation period in buffalo and cow is 310 ± 10 days and 280 ± 10 days, respectively (Dobson and Kamonpatana 1986). During the whole life span, a dairy animal may deliver about 8-10 times. This current manuscript gives an overview of the diagnosis of pregnancy in dairy animals, importance and problems associated with it.

Pregnancy diagnosis in dairy animals: Diagnosis of pregnancy is termed as cyseiognosis in cattle and buffalo. There are several external and internal indications of pregnancy in animals.

External indicators of pregnancy: These are not confirmatory but are just indicators.

- **Breeding history:** The animal should have been mated either by natural service or by artificial insemination.
- **Cessation of estrus:** It is the first indication of conception following service. An animal may be pregnant if not coming in heat during next 21 days after mating (Youngquist 1997). However, it is not always reliable because:
  - Sometimes the owner may not see signs of estrus.
  - Cessation of estrus may be due to pathology of uterus and ovaries.
  - Increase in abdominal size and body weight.
  - Comparatively, about 3-6% pregnant cows may exhibit estrus signs during first trimester which is termed as ‘Gestational Heat’.
- **Development of udder:** This is evident usually at 4-5 months of gestation in heifers and at 7-8 months of gestation in pluriparous animals when a little yellowish thick fluid can be pressed from the teats.
- **Change in temperament:** During pregnancy the animals become docile and quiet which are otherwise vicious and very excited. Especially during the last fortnight before delivery, the activity of the pregnant animals is very much reduced; they prefer segregation and show a desire to rest as much as possi

ble.

- **Enlargement of the Abdomen:** The increase in the size of abdomen occurs at about same rate as the rate of development of the fetus. Towards the end of pregnancy, the flanks appear hollow and the abdomen appears dropped down.
- **Relaxation of pelvic ligaments:** This occurs just towards parturition.
- **Abdominal ballottement of fetus:** Fetal movement can be felt in lower right flank by pushing fist. This can be appreciated from 6 months onward.
- **Fetal heart auscultation:** This can be done after 6-7 months of gestation from right flank

Internal indicators of pregnancy: These are as follows:

- **Vaginal examination:** In this method, vaginal speculum is used to see accu mulation of thick mucus discharge which covers the external-Os and forms pregnancy seal. During pregnancy, the vaginal mucus membrane will be dry and pale and cervix will be closed. However, this method is not so reliable.
- **Rectal examination of genitalia:** It is the most practical, conventional, inex pensive, immediate method of pregnancy diagnosis in large animals (Balhara et al 2013).
- **Time for pregnancy diagnosis by rectal palpation:** The pregnancy can be diagnosed at 35 days after conception by an experienced veterinarian. However, it should be avoided as there are chances of rupture of amniotic vesicle and early embryonic death by digital/hand pressure during manipula tion. Therefore it should be performed at 55-60 days of gestation.
- **Changes in ovaries and uterus during pregnancy:** Following changes are observed in ovaries and uterus during pregnancy:
- **In ovaries:** One of the ovaries bears a CL which ipsilateral to the pregnant horn. The ovaries can be palpated up to 4 month of gestation and after that they are pulled ventrally and cranially along with pregnant horn.

In uterus: These are as follows:

- Asymmetry of uterine horn and thinning of the uterine wall.
- Distension of pregnant horn due to the presence of amniotic vesicle, fetal fluids and membranes and the conceptus.
- Slipping of fetal membranes (Fincher's technique)

- **Location of uterus:** It depends upon the length of gestation. The uterus remains in pelvic cavity only upto 4 months and descends down in the abdominal cavity from 5-6 months onwards.
- **Palpation of fetus at various stages of pregnancy:** It is not done before 60 days of gestation due to small size of fetus and distended amniotic vesicle.
- **Palpation of placentomes:** The placentomes start forming by 60-70 days but can be palpated 80 days onwards at the level of intercornual ligaments. At day 120 these are fully developed.
- **Fremitus palpation:** It is the palpation of pulsation of middle uterine artery which is branch of internal iliac artery. Due to advancement of pregnancy the diameter of this artery increases and arterial wall becomes thin. Instead of regular pulse the artery gives thrill/whirr/gush sensation (like rushing of water in a pipe). It can be felt at 80-120 days of gestation. The prominence increases as pregnancy advances. In non-pregnant animals the diameter of artery is 3-4 mm only whereas, in pregnant animal it varies between 1-1.5 cm. The middle uterine artery is located in the fold of broad ligament.

Ultrasonography: It is highly confirmative and requires expertise. By ultrasonography, the embryonic vesicle and heart beat can be observed as early as 20-30 days of pregnancy in cattle and buffalo (Fricke 2002; Romano et al 2007).

Importance of pregnancy diagnosis: An accurate and early pregnancy diagnosis is essential because:

- It helps in identification of non-pregnant animals which can be treated or rebred at the earliest.
- It is required for certifying the animals for sale purpose.
- It helps in good management and economic feeding especially to avoid peripartum complications.
- To prevent lapse of one season for breeding in seasonal breeders.
- To reduce waste in breeding program using expensive hormonal techniques.

Problems encountered during pregnancy: Following problems and diseases may be encountered during pregnancy:

a **Resorption of fetus:** This condition is suspected during early pregnancy. The animal may fail to show symptoms of abortion following death of the fetus. The fetal tissues and fetal fluids are dried up and fetus shrinks as a contorted

mass around which the uterus contracts. Therefore, it is very important to have repeated pregnancy diagnostic check-ups following preliminary exami nation.

b **Accumulation of fluid in uterus:** This condition is more commonly encoun tered in the second trimester of pregnancy due to defective circulation or fetal deformity. During this condition there is excessive accumulation of water inside the fetal membranes which may be upto 100-200 liters. The abdomen becomes too much distended leading to respiratory distress. Such animals should be got treated as early as possible otherwise, the death becomes evident.

c **Torsion of uterus:** This condition mostly occurs during late pregnancy. It is more commonly encountered in buffaloes than in cows during late pregnancy. During this condition, the animal feels abdominal pain and strains to deliver but no part of fetus and/or water bag comes out due to obstruction in the passage This condition warrants prompt diagnosis and treatment to save future reprod uctive capacity of the animal.

d **Prolapse of vagina:** It can occur at any stage of pregnancy. Amongst the various pre-disposing factors, deficiency of calcium, hereditary disposition and feeding of estrogen rich diet are most important. This condition can also occur due to accidental feeding of mouldy feed to the animals. The severity of the problem can extend from a mild degree to complete exposure of vaginal tissue through the vulva. If not treated properly and timely, it can lead to lacerations, maggot formation and wounds on the vaginal tissue resulting in severe hemorrhage. Abortion can also occur due to stress in affected ani mals. With proper management and treatment, such cases can be treated successfully.

e. **Abortion:** This occurs mostly during early stages of pregnancy when the uterus has not descended into the abdominal cavity. It can occur if the genital organs of a pregnant animal are not palpated carefully which can cause rupture of fetal heart, fetal membranes or corpus luteum. This can lead to lacerations, rupture of rectum, develop-ment of peritonitis and subsequent death of the animal.

Key points:

- Always get the animals checked for pregnancy by a qualified doctor (twice or thrice during gestation) to know the progress of pregnancy.
- Keep a record of estrus cycle and date of insemination to ensure the delivery date.
- Feed balanced diet to pregnant animals to avoid weak calves and difficulties at the time of delivery.

- Treat the non-pregnant animals as early as possible to reduce their maintenance cost.
- Keep the pregnant animals segregated so as to prevent any injury to them.
- If suspected for any problem get the pregnant animal examined and treated quickly.

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CURRENT APPROACHES IN THE DIAGNOSIS OF BRUCELLOSIS IN ANIMALS

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Bovine brucellosis is an economically important infectious disease with public health significance characterized by abortions and reduced fertility in bovines. Owing to the immense economic and public health concerns, various assays have been developed for the diagnosis of brucellosis in animals. Direct detection methods like isolation and identification of *Brucella* from clinical samples, molecular diagnostic assays like PCR, multiplex PCR, Real time PCR, serological detection of antibodies to *Brucella* by RBPT, STAT, ELISA and advanced diagnostic assays like Fluorescence polarisation assay (FPA) can be used for diagnosis of brucellosis. Though many diagnostic tests with improved sensitivity and specificity have been developed , but each test has its own disadvantage. So, the solution to the problem with accurate diagnosis of brucellosis will involve a combination of different tests for testing a single sample/ animal.

Brucellosis in animals is an economically important, infectious disease with public health significance causing abortions and reduced fertility in bovines. Depending upon the affinity for their preferred hosts, six classical *Brucella* spps., namely *B. abortus* (cattle and buffaloes), *B. melitensis* (goats), *B. ovis* (sheep), *B. suis* (pigs), *B. canis* (dogs) and *B. neotomae* (desert wood rats) and have been identified (Osterman and Moriyon 2006). In addition, the genus *Brucella* has recently been expanded to include marine isolates, *B. ceti* and *B. pinnipedialis* respectively (Foster *et al* 2007). *B. abortus*, *B. melitensis* and *B. suis* are highly pathogenic for humans. *Brucella* spps. are gram negative coccobacilli arranged singly or in pairs or short chains. Clinical signs like abortion, retained placenta, orchitis, epididymitis and rarely, arthritis, with excretion of the organism in uterine discharges and in milk can be seen in animals suffering from brucellosis. In the control and eradication programmes for brucellosis, vaccination of animals is an important part, and usually *B. abortus* strain 19 vaccine is used. In addition to vaccination, detection of the causative agent in clinical samples is also very important. A number of biochemical, serological and molecular techniques for disease diagnosis and identification of *Brucella* have been developed. Diagnosis can be carried out by lab testing of milk or blood for the presence of antibodies to *Brucella* spp. or by isolation of the organism from clinical samples obtained from affected animals or aborted foetuses like vaginal discharges, uterine discharges, placenta, foetal stomach contents or milk followed by identification of the organism with different diagnostic assays. Discussed below are some of the assays that can be used for diagnosis of brucellosis in animals:

Different methods for diagnosis of brucellosis in animals

1. Isolation and Biochemical identification:

Brucella can be isolated from clinical samples like vaginal discharges, uterine discharges, placental cotyledons, foetal stomach contents and milk obtained from animals suffering from abortions or other reproductive disorders and from aborted foetuses. The samples are streaked on Brucella agar base and the inoculated plates are kept at 37^0C for 3-5 days with and without 5-10% CO_2 tension in the dessicator. Growth of the colonies is examined for 4-6 days. Colonies typical of *Brucella* spp. can be stained by Gram's staining and identification of the organism can be done by catalase, oxidase and other biochemical tests according to the OIE Manual (2016). *B abortus* can be recovered from the placenta but pure culture can be obtained from the stomach and lungs of an aborted fetus. Isolation of *Brucella* is the "gold standard" in diagnosis of brucellosis and is the confirmative test (Godfroid *et al* 2010). Though isolation has the advantage of detecting the organisms directly, but this method takes long time, is associated with a high risk of lab acquired infections, requires level 3 bio-containement facilities and highly skilled technicians for handling the samples (Hinic *et al* 2008). Also, sensitivity of isolation is less in chronic infections and this is unsuitable when large animal populations have to be tested. In order to overcome these difficulties, nucleic acid based assays have been developed and explored for the rapid detection of *Brucella* spp.

2. Molecular tests

- **Conventional PCR:** The molecular biological techniques, often based on the polymerase chain reaction (PCR) amplification, are successfully used for *Brucella* identification and typing (Yu and Nielsen 2010). DNA is extracted from the cultures or directly from the clinical samples using conventional methods or with commercially available DNA extraction kits and subjected to PCR. Amplification of the desired gene sequences is then visualised with the help of gel electrophoresis. A number of genus- or species-specific conventional PCR assays using primers derived from different gene sequences from the *Brucella* genome, such as 16S rRNA, the 16S-23S intergenic spacer region, *mp2* and *bcsp31* have been established.

- **Multiplex PCR:** Since diagnosis by monoplex PCR allows the detection of a single bacterium or single species of the bacterium at a time, hence, monoplex PCR is relatively costly and time consuming. Identification of different species of Brucella is necessary for studying the epidemiological patterns of the organism and for the control and successful eradication of brucellosis. Multiplex PCR is a kind of PCR technique where multiple target DNA sequences can be detected in a single tube reaction (Richtzenhain et al, 2002). Therefore, by application of this assay, molecular typing of all Brucella spp. including the vaccine strains can be done in a single reaction (Goni et al, 2008).

- **Real time PCR:** Real-time PCR is a technique based on the polymerase chain

reaction, which is used to amplify and simultaneously detect or quantify a targeted DNA molecule. In Real time PCR, the general principle of polymerase chain reaction is followed except that the amplified DNA is detected as the reaction progresses in "real time" and there is no need to analyze the PCR products by agarose gel electrophoresis. The introduction of Real-time PCR offers improved sensitivity, specificity and speed of performance as compared to conventional PCR. Real-time PCR assay based on *Brucella* spp. specific multiple insertion sequence IS*711* has been described by Hinic *et al* (2009) for detection of *Brucella* spp.

3. Serological tests

Serum agglutination tests like RBPT, STAT have been the standard diagnostic methods for brucellosis diagnosis. Other tests that may be used are complement fixation, rivanol precipitation, and acidified antigen procedures (Merck Veterinary Manual). RBPT is a broad simple method of brucellosis diagnostics (Alton *et al*, 1988) in which drops of stained antigen and serum is mixed on a plate and any resulting agglutination signifies a positive reaction. RBPT is an excellent screening test but may be oversensitive for especially the vaccinated individual animals. Complement fixation test for detection of antibodies to *Brucella* consists of a complex series of proteins. These proteins if activated by antigen antibody complexes react in a cascade sequential manner to cause lysis of the cell. The drawback of the complement fixation test is that it is difficult to standardise it, so, is progressively being replaced by primary Enzyme linked immunosorbent assays (ELISA) (Poester *et al,* 2010).

a **I-ELISA:** Indirect ELISA (iELISA) is based on the specific binding of antibodies present in the sample to be tested with the antigen that is immobilised on the surface of ELISA plate. The antigen antibody binding is visualized using chemically or enzymatically derived fluorescent, luminescent or colorimetric reactions. iELISA for diagnosis of brucellosis has been used by many researchers and many commercially available iELISA kits for brucellosis diagnosis are available. For ELISA, very low quantities of antigen and antibody are required and it can detect very low concentration of either reagent. Other advantages include high degree of sensitivity and potential for being used as both qualitative and quantitative assay.

b **C-ELISA:** Competitive enzyme immunoassays are based on selecting a monoclonal antibody with higher affinity for the antigen as compared to vaccinal antibody. Competitive ELISA for detection of bovine serum antibodies to *B.abortus* field strains generally do not react with sera containing residual antibody from vaccination with *B.abortus* S-19. So C-ELISA is capable of eliminating problems due to residual antibodies produced in response to vaccination with *B. abortus* S19 and from cross reacting antibodies but with lower affinity than antibodies arising from infection (Nielsen *et al* 1995). Many commercial c-ELISA kits for brucellosis diagnosis are available.

c **MRT:** Milk ring test is an agglutination test used for screening dairy herds for brucellosis. The test is conducted on fresh milk collected from dairy cattle but does not

work on pasteurized or homogenized milk (Fleischhauer, 1937). IgM and IgA antibodies bound to fat globules are detected in this test. Though MRT is cost effective, easy to perfom and can cover a large population in a short time (Cadmus *et al*, 2008) but the sensitivity of the test becomes less reliable in large herds with more than 100 lactating cows (FAO). Another disadvantage is that false-positive reactions may occur in recently vaccinated cattle or in samples containing abnormal milk, such as colostrum or in mastitic milk (FAO).

4. Advanced diagnostic tests

a. Peptide Nucleic Acid Fluorescent In-situ Hybridisation assay Fluorescence in situ hybridization (FISH) technique is a novel diagnostic technique in which the traditional staining procedures are combined with the unique performance of PNA probes for rapid and accurate diagnosis of infectious diseases (Lehtola *et al,* 2006). PNA FISH is mainly based upon 16S rRNA as a target probe. The probes can be either deoxyribonucleic acid (DNA) oligo probes or Peptide nucleic acid (PNA) probes. These have been used to identify organisms from cultures. The neutral characteristic of PNA molecule is responsible for a higher thermal stability (high Tm) between PNA/DNA or PNA/RNA bonding, compared with the traditional DNA probes and specific hybridization between the PNA sequences and nucleic acid complementary sequences occur according to the Watson-Crick rules (Cerqueira *et al,* 2011). PNA probes normally have sequences relatively smaller (13-18 nucleotides) than DNA sequences (at least 18 nucleotides) (Cerqueira *et al,* 2011). Due to uncharged backbone of PNA, these probes have superior hybridization characteristics as compared to traditional DNA probes (Perry O' Keefe *et al* 2001).

b. Fluorescence Polarisation Assay: Serological test like the Fluorescence polarization assay (FPA) directly measures the binding of an antigen with antibody makes use of molecular rotational properties, measuring directly the binding of an antigen with antibody. The principle of the method relies on a fluorescent dye attached to a small antigen (or antibody fragment) that is excited by plane polarized light at the appropriate wave length. FPA is based upon the differences between a small soluble antigen molecule in solution (labelled with a flurochrome) and the antigen molecule complexed with its antibody. The rate of rotation of the antigen molecule is reduced when its molecular size is increased by its binding to antibody (or antigen) (Nielsen *et al* 1996). FPA for brucellosis diagnosis has been used by many researchers (Gall *et al* 2000, 2001, 2002; Lucero *et al* 2003; Trangadia *et al* 2012; Nielsen *et al* 1996, 1998).

Conclusions: It can be concluded that though molecular assays like PCR have been developed with increased sensitivity and specificity and used in labs with promising results but in resource limited labs where PCR cannot be performed in routine due to the high running cost, lack of technical expertise or lack of instrument; serological testing can be carried out. Serological tests can be carried out in any lab with basic facilities and are

much less expensive. But for accurate diagnosis of brucellosis, a combination of different tests for a single sample/ animal can be carried out.

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SELENIUM TOXICITY IN ANIMALS

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Selenium is an essential element with narrow margin of safety having difference between adequate and potentially toxic concentrations in the diet being approximately 10 to 20 fold. Selenium is an important component of many selenoenzymes and proteins like glutathione peroxidase which acts as an antioxidant in the body. So, in order to prevent deficiency and resulting diseases like white muscle disease in sheep and cattle, exertional myopathy in horses, exudative diathesis in poultry and hepatosis dietetica in pigs, supplements with selenium content of 0.2–0.3 ppm are added to their diets. The maximum tolerable concentrations for selenium in most livestock feed is considered to be 2–5 ppm.

Etiology

Although all animal species are susceptible to the toxic effects of Selenium poisoning but it is more common in forage eating animals such as cattle, sheep, horses and other herbivores that may graze selenium containing plants. Plants accumulate selenium if the element is available at high concentrations in the soil but pH and moisture content of the soil have greater influence on the relative bioavailability of selenium to plants. Generally selenium is mostly bioavailable to plants when they grow on more alkaline soils with low rainfall (<50 cm). The alkalinity and low moisture content of the soil tend to allow more of the selenium to be retained as the oxidized form of selenate for plant uptake. Because low moisture in the soil decreases the anaerobic environments to greater depths, drought conditions could allow for more selenium in the soil to be oxidized into forms which are readily available for plant uptake

1 Based on their relative requirements and ability to accumulate selenium, Selenium accumulating plants have been classified as :

2 Obligate indicator plants require large amount of selenium for growth and contain high selenium concentrations open more than 1000 to 10000 ppm and include species of *Astragalus*, *Stanley*, *Oonopsis*.

3 Facultative indicator plants absorb and tolerate higher concentrations of soil selenium, with accumulations ranging from trace amounts to a few thousand ppm, but they do not require selenium for growth and include species of *Aster*, *Castilleja*, *Grindelia*, *Atriplex*, *Gatierreaia*, and *Comandra*.

4 Non-accumulator plants, such as most grasses, passively absorb much lower amounts of selenium from the soil, resulting in trace amounts to a few hundred ppm.

In Punjab, the districts which are most prone to Selenium toxicity are Hoshiarpur

and Nawanshahr. All the affected villages of these districts lie in the foothills of the Shivalik range. As per a study, it has been observed that for the past several years, selenium has been transported through floodwaters from the Shivalik mountain to these areas. Also the paths of seasonal rivulets in the region, which originate in the hills and end in the vicinity of these villages have been traced which may account for the high selenium content of the soil. For soil, the safe limit arrived at by PAU is 0.5 ppm and any amount above this would lead to plants containing more than 5 ppm of the element. It has been evaluated that when selenium levels in a plant go beyond 5 ppm, it becomes toxic for consumption. If the amounts are in excess of 100 ppm, white patches start to appear on the plants (the condition is described as snow-white chlorosis) which are common in crops grown in these villages. Another factors that seem to have aggravated the problem is the cropping pattern of the region. Significantly, though crops such as maize, sorghum and oat are relatively safe, certain others are known to attract high amounts of selenium. Over the past 10-12 years, areas which have switched from the maize-wheat pattern to that of rice and wheat are the worst-hit.

Toxicity

Excess selenium produces three general toxic effects :

1 The direct inhibition of cellular oxidation reduction reactions by depleting glutathione and S-adenosyl methionine reserves.

2 The production of free radicals that cause oxidative tissue damage.

3 The replacement of sulphur containing amino acids in the body with selenium or seleno- amino acids.

Loss of these disulfide bonds can alter the three-dimensional configuration of proteins potentially resulting in loss off or diminished enzyme activity. The most commonly altered sulphur containing amino acids are methionine and cysteine, which are replaced with selenomethionine and selenocysteine respectively. Replacement of these amino acids with selenium containing amino acids also effects cell division and growth especially susceptible are the keratinocytes and the sulphur containing keratin molecule itself. Thus Selenium weakens the hooves and hair which tend to fracture when subjected to mechanical stress.

Acute Selenium Poisoning

Acute oral selenium poisoning due to consumption of plants or diets with concentrations >50 ppm is not common but if occurs can result in large losses in cattle, sheep, and pigs. It occurs rarely because animals usually avoid plants with high selenium content because of their offensive odor but during drought conditions or when pasture is limited, accumulator plants may be the only food available. Young animals are most susceptible to acute parenteral selenium toxicosis with dosages of 0.2–0.5 mg/kg. Clinical signs are characterized by abnormal behavior, respiratory difficulty, GI upset, and sudden death. Abnor-

mal posture and depression, anorexia, unsteady gait, diarrhea, colic, increased pulse and respiration rates, frothy nasal discharge, moist rales, and cyanosis may be noted. Sheep usually show these signs to a much lesser degree or just become depressed and die suddenly.

Most deaths usually follow within a few hours to 2 days after an acutely toxic consumption or injection of selenium. The major lesions are pulmonary edema, pulmonary congestion, pulmonary hemorrhage, hepatic necrosis, myocardial necrosis, myocardial hemorrhage, and potentially renal necrosis.

Treatment consists of symptomatic and supportive care. Acetyl cysteine to boost systemic glutathione concentrations may be beneficial.

Subchronic Selenium Toxicosis

In pigs that are fed a diet supplemented with selenium >20–50 ppm for >3 days develop a subchronic selenium toxicosis characterized by neurologic abnormalities. Animals are initially ataxic and uncoordinated, followed by anterior paresis, then quadriplegia. Even though neurologic impairment is occurring, the pigs continue to eat, which would indicate neurologic damage that is not centrally mediated. The hooves develop cracks and impaired growth similar to those seen in cattle. In sows, conception rate decreases and the number of stillborn births increases. Lesions of subchronic toxicosis include focal symmetric poliomyelomalacia, which is most prominent in the cervical and thoracic spinal cord. Death may result from complications of permanent paralysis. Hoof and hair damage is similar to but in most cases less severe than that seen in chronic selenium toxicosis.

Chronic Selenium Toxicosis

(Alkali disease)

Chronic selenium poisoning usually develops when livestock consume seleniferous forages and grains containing 5–50 ppm of selenium for many weeks or months, although chronic exposure to high concentrations of inorganic selenium can also produce chronic selenosis. Naturally occurring seleno-amino acids in plants are readily absorbed and inserted into proteins in place of their corresponding sulfur-containing amino acids (ie, selenomethionine in place of methionine or selenocysteine in place of cysteine). Hitherto, two types of chronic selenium poisoning were discussed in the literature: alkali disease and blind staggers. Blind staggers is no longer believed to be caused by selenium but by sulfate toxicity due to consumption of high-sulfate alkali water and/or high sulfur-containing forages. Excess sulfate (>1% of diet) leads to polioencephalomalacia and the classical signs of blind staggers.

Alkali disease has been reported in cattle, sheep, and horses and animals become inactive, weak, anorexic, lame, emaciated, anemic, and lack vitality. The most important and distinctive lesions are those produced by damage of the keratin of the hair and hooves. For horses, the predominant clinical manifestation is lameness due to founder.

The animal has a rough hair coat, and the long hairs of the mane and tail break off, giving a "bob" tail and "roached" mane appearance. Abnormal growth and structure of horns and hooves result in circular ridges and cracking of the hoof wall at the coronary band. Extremely long, deformed hooves that turn upward at the ends leading to subsequent lameness which is compounded by degeneration of joint cartilage and bone. Reduced fertility and reproductive performance occurs, especially in sheep and cattle. Reproductive performance may be impaired with a dietary selenium content lower than that required to produce the other typical signs of alkali disease. Other lesions may include liver cirrhosis, ascites and myocardial necrosis.

Birds also may be affected with chronic selenium toxicosis. Eggs with >2.5 ppm selenium from birds in high selenium areas have low hatchability and embryos that are usually deformed. Developmental and teratological effects including underdeveloped feet and legs, malformed eyes, crooked beaks and ropy feathers are also observed.

In selenium-poisoned animals, some alterations in blood chemistries occur like decreased prothrombin activity, fibrinogen, and glutathione, as well as increased serum alkaline phosphatase, ALT, AST, and succinic dehydrogenase.

Treatment and Control

There is no specific treatment for selenium toxicosis. Eliminating the source and exposure, as well as symptomatic and supportive care of the animal, should be started as soon as possible. Addition of substances that antagonize or inhibit the toxic effects of selenium in the diet may help reduce the risk of selenium toxicosis. A high-protein diet, linseed oil meal, sulfur, arsenic, silver, copper, cadmium, and mercury have reduced selenium toxicity in laboratory animals, but their use under field conditions is limited. However, some of the poor reproductive performance associated with selenium poisoning can be decreased by copper supplementation. Addition of arsenic salt at 0.00375% to enhance biliary excretion of selenium or a high-protein diet to bind free selenium has historically been used to reduce incidence of selenium poisoning in cattle. However, this has minimal to poor overall efficacy. Chronically selenium-poisoned animals are less likely to thrive even after exposure has been stopped.

Forages should be tested regularly in high-selenium areas to evaluate year-to-year risk. Also in high-selenium zones, farmers should be recommended to apply one tonne of gypsum per hectare every alternate year which may slow the selenium absorption by crops by up to 70 per cent.

AN OVERVIEW ON REPRODUCTIVE MANAGEMENT PRACTICES IN SWINE

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Management techniques, nutrient requirements and reproductive technologies, which affect gilt development and sow longevity, require continuous updating. Failure to detect estrus accurately has the greatest impact on farrowing rate and litter size. Even accurate estrus detection will not compensate for the variability in the interval between onset of estrus and actual time of ovulation. Moreover, seasonal infertility mediated by temperature and photoperiod, is a persistent problem in swine. Real-time ultrasonography should be used to determine pregnancy 3-5 weeks post-service. Farrowing is usually induced by administration of prostaglandin. Assistance at farrowing is important especially to ensure adequate colostrum consumption by piglets immediately after birth. Furthermore, prostaglandin is also used for induction of estrus in pre-pubertal gilts to overcome seasonal anestrous. Ovulation synchronization, artificial insemination and induced parturition may lead to farrowing synchronization, which facilitates supervision and reduces stillbirths and piglet mortality. The current manuscript is to review the literature and existing industry practices employed for reproductive management of swine.

Management remains a critical step in governing reproductive efficiency of swine and is subsequently related to profitable/lossmaking pig farming. Adoption of scientific management practices and technologies, provided the foundation for development of highly prolific females which have significantly increased efficiency of reproduction in the breeding herd. Eventually, obtaining maximum farrowing rate, litter size, and number of pigs weaned is essential to achieving maximum profits in a swine enterprise. Pig farmers generally appreciate time and input costs required to grow animals from birth to market weight. Numerous factors viz. season, nutrition, disease, embryo mortality affect reproductive performance in breeding sow (Foxcroft et al 2006). Nutritional deficit during lactation increased weaning to estrus interval in sow with lower conception rate and reduced litter size (Campos et al 2012). Refining management practices of gilts/sows improved their lifetime reproduction and production traits (Foxcroft et al 2010). Further, Oliviero (2013) also showed that appropriate management of piglet before and after weaning affected its livability and future reproduction. Moreover, accurate monitoring of management practices and technologies along with past performance is essential to identify problems quickly and to initiate solutions for development of highly prolific females in a swine enterprise. Although, some causes of variation in reproductive measures can be attributed to single sources, most are complex and multi-factorial. The heritability of such reproductive traits is generally low. Therefore, much of the phenotypic variation of reproductive performance is due to environmental effects, of which a major portion would be considered management. In addition,

artificial insemination (AI) in swine is a tool to obtain a high conception rate and good litter size. AI requires a higher level of management as compared to natural service mating systems. The purpose of this paper is to summarize results from basic and applied research that may be applied to optimize management of gilts and sows in the breeding herd.

Development and management of gilt/sow: Sow longevity refers to the total number of offspring produced in the lifetime of sow and is important because litter size and piglet weight increase until fourth or fifth parity, and number of pigs weaned per sow per year increase till sixth or seventh parity. Breeding and selection of gilts is generally based on growth rate, body composition, disease status, sexual development and dam's reproductive history (Gill 2007). The ability to express estrus and continue to cycle should be the key reproductive trait for selection of replacement gilts (Table 1). Sterning et al (1998) reported that heritability of the ability to display estrus at puberty and ovulate within 10 days after weaning a litter is 0.31. Average sow replacement rate is about 45% (PigChamp 2012). Since large number of piglets per litter are farrowed by sows, often there are not enough functional nipples for all piglets. Therefore, number (14 or more teats) and functionality of mammary glands are critical for survival of piglets. Feet and legs are important because sows live on solid concrete floors (Stalder 2009). Lameness due to incorrect structure of feet and legs hinder sows from getting up and down which results in reduced feed intake and poor reproductive performance. In general, selected gilts are moved from a growing and finishing facility to a development facility at 150-180 days of age when daily boar exposure begins (Filha et al 2009).

Table 1: Goals for reproductive management in swine

Sr. No.	Parameter	Target
1	Weaning to estrus (Days)	< 7
2	Non-productive sow (Days)	< 50
3	Age at first mating (Months)	< 7.5
4	Farrowing rate (%)	> 85
5	Sow mortality (%)	< 2
6	Post-weaning loss (%)	< 2
7	Finishing loss (%)	< 1.5
8	Piglets weaned/sow/year	> 22
9	Piglets weaned/litter	> 9.5
10	Litters/sow/year	> 2.4
11	Piglets born live/litter	>10.9
12	Stillborn piglets (%)	< 5
13	Mummified piglets (%)	< 0.5
14	Pre-weaning mortality (%)	< 8

Generally, age at puberty is positively associated with age at onset of boar exposure (Singh et al 2019). Exposure of peripubertal gilts to boars for 20 minutes/day stimulates expression of estrus. The boars must be mature (>10 months of age) and express full complement of male mating characteristics. For best results, gilts are brought to boars where they experience sight, sound and odor of boar with fence line contact. However, constant exposure to boar sound and scent causes habituation and hinders heat detection, but not necessarily onset of sexual maturity. Moving, mixing, transport and boar exposure induces first estrus in a high percentage of gilts within 10-20 days. Gilts that respond to boar exposure at an early age tend to remain in production longer than gilts that respond at a later age (Hoge and Bates 2011). After the first estrus, gilts should be acclimated to stalls or breeding and gestation housing at least 16 d prior to breeding. Stimulating gilts to cycle and breed on second or third estrus is a well-established practice. It is important at first mating that adequate fat stores are available for good lactation which is determined by back fat measurement of 12-18 mm (Wiedmann 2010).

Gilt/sow nutrition: For sustained herd fertility adequate and balanced feed intake is essential. Diet for replacement gilts should contain higher concentrations of vitamin A and E, selenium, chromium and zinc. Concentrations of calcium and phosphorus must be high enough for maximum bone mineralization, which is mobilized for fetal growth and lactation (Whitney and Masker 2010). Nutritional deficit during early growth period is associated with delayed puberty. Replacement gilts are typically fed ad lib a diet lower in energy to avoid excessive body fat. This also allows for slightly slower growth, which limits mature body size, thereby preventing feet and leg problems and excessive fat gain. Highly prolific gilts reach puberty with limited reserves of protein and body fat and they continue to grow during their first gestation. Therefore, lean tissue mass is a key consideration for correct management of the gilt (Foxcroft et al 2005). Gill (2007) proposed that a nutrition program should result in a body condition score of three at first service.

Sows should be fed based on an objective measure of individual body weight, body condition and measurement of back fat depth. Feeding high energy sources for 10-14 days before first service, increases ovulation rate and litter size (Young et al 2004). Feed intake during the last 2 to 3 weeks should be adjusted to at least avoid a negative energy balance prior to farrowing and to promote higher feed intake in early lactation, easier farrowing and adequate birth weight of newborn piglets. Restriction of feeding prior to parturition significantly reduces the risk of postpartum dysgalactia syndrome. Peltoniemi et al (2007) reported that feeding low energy and high fiber diets during peripartum period appeared to improve intestinal function and initiation of lactation. They further noticed that sows with back fat depths of 23 mm or more at farrowing have depressed appetite during lactation. Eventually, highly prolific sows of today produce large litters of fast growing piglets. Thus, lactation puts a great nutritional demand on sows. Adequate feed intake, especially during the first 7 to 10 days of lactation is important to replenish body reserves, and re-establish secretion of hormones which control subsequent reproductive performance (Kauffold et al 2008). Most lactation feeders today include a reservoir that hold a minimum of 9 kg of feed. Ensuring sows have access to full feed 24 h/d results in optimum return to estrus and piglet weight at weaning. Getting sows up 2-3 times per day stimulates sows to urinate and defecate, resulting in drinking and eating, thus optimizing feed intake, lactation performance and return to estrus. Fat as a high density energy source is incorporated into lactation

diets to compensate for depressed appetite during heat stress. It is essential to have good quality water (Leibbrandt et al 2001). Lack of water limits milk production. High performing sows have a water intake of up to 40 liters/d when milk production is at its highest three weeks after farrowing. Sows experience the stress of piglet removal, change of location, transition of mammary tissue into dry period and follicular development and subsequent ovulation all within 4-5 days. These events require a high level of energy and nutrients. Maintaining *ad lib* feed and water consumption optimizes these events as measured by consequent fertility. Boar exposure of sows should start on the day of weaning for at least 10 minutes/d. Weaned sows are typically exposed to boars within two days; most commonly once per day (Knox et al 2013).

Housing and environment: Purchased gilts should be quarantined for at least four weeks, during which time they should be observed for and serologically tested for infectious diseases. Both purchased gilts following quarantine and internally selected gilts should be acclimated in small groups in the breeding barn to allow them to build immunity to organisms present in the breeding herd. Gilts reared in individual pens have more silent heats and irregular estrous cycles and reach puberty later than gilts reared in group pens (Knox 2014). Breeding and gestation sows should be kept in standard gestation stalls. Well-designed farrowing crates, floors and ergonomic feeders and water nipples, gut fill and lying comfort are important for sow health, performance and longevity. Any stress in the first three weeks of gestation may result in loss of pregnancy or reduced litter size. Moving sows early in gestation should be done gently in small groups (Knox et al 2013).

Estrus detection and time of insemination: Failure to detect estrus accurately has the greatest impact on farrowing rate and litter size. Estrus normally lasts 24 to 48 h in gilts and up to 72 h in sows. Nearly, 90% of sows express estrus 3-6 days after weaning (Soede et al 2011). Sows which are mated at estrus 4-6 days after weaning have greater farrowing rates and litter sizes. Ovulation occurs approximately 36-48 h after onset of estrus and optimum time of insemination is 6-12 h prior to ovulation (Soede et al 1995). If the female still accepts the boar and/or is still showing a positive (standing) response to back pressure test, mate 24 h after initiation of standing heat and rebreed 8-16 hours later. Farrowing rate and litter size will be lower if insemination occurs more than 24 h before ovulation because sperm live approximately 24 h after insemination and eggs can be fertilized for only 12 h after ovulation (Soede et al 1995). The best way to predict ovulation is to detect estrus frequently. Generally, sows are inseminated on the day of detected estrus and the morning of following day. Less time is required to elicit standing response and a greater percentage of females are detected when gilts are moved to the boar area. Some general recommendations viz. checking estrus after feeding, removing all distractions from the area, detecting estrus in same place and same way each time, keeping animals calm and allowing sufficient time for interaction can improve efficiency of estrus detection.

Tips for detecting estrus

- Swelling and reddening of vulva
- Ears erect
- Change boar regularly
- Group housing is preferred for breeding females

- Allow vigorous courtship of 15-20 seconds
- Characteristic grunt
- Reduce feed intake after breeding
- Introduce the sexually mature boar directly into pen containing females to be tested
- Keep accurate record of mating dates
- Standing reflex (response to pressure on back)
- Keep animals calm

Use of current management technologies: Impact of reproductive technologies on pig production have dramatically changed the way pigs are raised and made the pig the most efficient livestock species for food production in the world. Many of the technologies developed during the past 2–4 decades have been incorporated into modern pork production systems. In most cases, producers have adapted and are utilizing the technologies for applications or objectives that differ from the original or approved use or claim.

Artificial insemination technology: Artificial insemination is potentially a very hygienic means of fertilizing a gilt/sow to improve genetics, reduce labor, breed more sows with semen from superior sires and fewer sires needed to produce that semen (Wilson 2012). It eliminates the possible transfer of infection from direct contact with boar which improves time management compared to natural service. Prominent procedures during AI are back pressure, boar exposure, flank rubbing and gravity semen flow. During the past few years, interest in and implementation of AI technology has experienced a dramatic increase with a high success rate and may soon become the most prevalent assisted reproductive technique in swine.

Pregnancy detection using ultrasound scanning: The most common strategy for identifying non-pregnant females is detection of estrus by daily boar exposure from 17 to 23 d after breeding followed by examination through ultrasonography between days 28 and 35 of gestation (Knox 2014). Real-time (B-mode) ultrasonography is accurate when used after the first three weeks of gestation (Knox et al 2013).

Farrowing management: Farrowing is usually induced by administration of prostaglandin analog (250 ìg). High prolific females commonly have 14-16 piglets born alive with piglet pre-weaning mortality ranging from 11 to 24% during first five days of age (Foxcroft 2012). A larger litter generally means smaller and weaker pigs. The rate of stillborn piglets increases as duration of farrowing and interval between births increases. Generally, farrowing supervision/birth assistance includes following practices:

- Thoroughly clean and disinfect all farrowing crates.
- Treat females with anthelmintic about 3-4 weeks before farrowing.
- Feed a laxative diet for a week before moving into farrowing pen.
- Manually deliver piglets when birth interval becomes longer than 30 minutes.
- Remove placenta around piglets and clear airways to prevent suffocation.
- Ligate the umbilical cord.

- Keep piglets under heat lamp immediately after birth to prevent chilling.
- Place low-viable piglets in a heated box away from sow.
- Prevent savaging of piglets by sow.
- Feed colostrum or milk replacer orally to low-viable piglets.
- Split suckling or cross-fostering to ensure piglets from large litter consuming adequate colostrum.

The most important factor for ensuring piglet survival is adequate colostrum consumption immediately after birth since colostrum production by sow occurs for only 24 h after farrowing.

Seasonal infertility: Most farms experience seasonal infertility caused by estrus failure in gilts and weaned sows which is mediated by temperature and photoperiod. Puberty is delayed in summer months and ovulation rate, conception rate and litter size are lower in summer than in winter. First parity sows have reduced reproductive performance than older sows. Photoperiod is the only environmental factor which is highly repeatable from year to year. Pigs may not be able to respond to sudden changes in photoperiod (Peltoniemi and Virolainen 2005). High environmental temperature decreases feed intake, delays puberty, disrupts behavioral estrus, lowers ovulation and conception rate, increases embryonic mortality and decreases milk production in sows. Heat stress is most detrimental to reproductive performance during the first 30 days due to increased embryonic death and last 30 days of gestation due to increased stillborn piglets (Peltoniemi and Virolainen 2005). Strategies to reduce heat stress are:

- Feed high energy diets with lower fiber and crude protein content
- Decrease group size to 15 or less in gestation
- Use air cooling or water dripping equipment
- Feed multiple times a day
- Use individual gestation stalls to reduce social stress

Decreasing photoperiod and high temperatures generally occur at same seasonal time frame. To optimize sow production producers should minimize heat stress and adapt light and dark cycles to avoid either excessive light or dark periods. Additionally, prostaglandin can effectively be used for induction of estrus in pre-pubertal gilts and as a treatment to overcome seasonal anestrous (Knox 2014).

Conclusion

Genetics, nutrition, housing, age at first mating, assistance at farrowing, growth rate, body condition, performance of parity, adequate colostrum consumption by piglets immediately after birth and adoption of artificial insemination technology impact sow longevity which will enhance reproductive performance of herd and subsequently improve overall pork production.

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CHEMOTHERAPEUTIC INTERVENTIONS FOR CANCER PATIENTS

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Cancer is a class of diseases characterized by out-of-control cell growth. There are over 100 different types of cancer, and each is classified by the type of cell that is initially affected. The main lines of cancer treatment are surgery, radiation and chemotherapy either solo or in combination.

1 Chemotherapy is appropriate when:

2 Disease is wide spread

3 The risk of undetectable diagnosis is high

4 The tumor can't be resected and is resistant to radiation

5 Neoadjuvant: shrink a large tumor and lower the stage of the tumor so it can be surgically removed or cured.

6 Adjuvant: given to prevent growth of stray cancer cells remaining after surgery or radiation.

The primary focus of chemotherapy is to prevent cancer cells from multiplying, invading adjacent tissue or developing metastasis.Thus the main goal of chemotherapy must be realistic so as to destroy all malignant cells without excessive destruction of normal cells.Factors to consider when choosing patient's chemotherapy treatment include

1 Type of cancer

2 Stage of Cancer (TNM System)

3 Patient's Age

4 General State of Health

5 Other health problems (liver, renal)

6 Types of anticancer treatments in the past

Determination of dose

Dose of antineoplastic agents is determined on the basis of body surface and can be calculated from the following formula:

$$\text{Surface area} = \text{Body weight}^{0.67} \times K/10^4$$

Where surface area is given in square metres (m^2) and body weight in grams. For cats and dogs, K is constant with value of 10.0 and 10.1, respectively.

Chemotherapeutic Agents

- Cell Cycle Specific: mostly affect the S phase & some the M phase. *Administered in minimal concentrations by continuous dosing routes.*
- Cell Cycle Non-Specific: affects dividing and resting cells in all phases of the cell cycle. *Administered in single bolus injection.*
- Combination: agents that differ in both cell cycle specificity and their toxicities are combined to maximize tumor cell kill with minimal toxicity.*Administered in repeated courses*

There are three major Groups of Antineoplasticdrugs:

1. Cytotoxic Drugs (largest group)

a **Alkylating agents -** Nitrogen mustards, Alkyl sulphonates, Nitrosoureas, Triazenes

b **Antimetabolites -** methotrexate, 6-mercaptopurine, 6-thioguanine, 5-fluorouracil, floxuridine

c **Antitumor antibiotics -** Actinomycins, doxorubicin, daunorubicin, bleomycin, mitomycin

d **Plant alkaloids -** vincristine, vinblastine

e **Miscellaneous cytotoxic drugs –** mitotane, bexarotene, tretinoin, demecolcine

2. Hormones and hormone antagonists:

These are among the besttolerated chemotherapeutics because they target specific receptors.

- diethylstilboestrol, tamoxifen, testosterone, flutamide, leuprolide

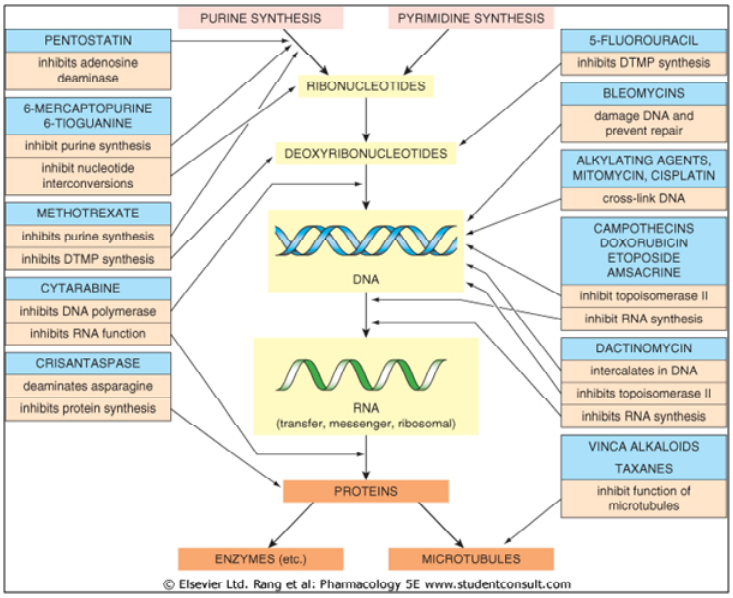
3. Immunomodulators

a **Immunostimulants-** interferons and interleukins

b **Immunosuppressant -** corticosteroids, azathioprine

Cell Kill hypothesis – only a percentage of cancer cells are killed with each course of chemo so repeated doses or cycles are used. The length of the cycle is determined by the recovery of the patient's healthy cells as well as the characteristics of the agents. Myelosuppression is a common dose-limiting toxicity and determines the length of

the chemo cycles. It generally takes 21-28 days for neutrophils to recover after treatment with amyelosuppressive chemotherapy.



Schematic diagram showing the site of action of antineoplastic drugs

Problems Associated with Chemotherapy

Several problems associated with clinical use of antineoplastic drugs may result in treatment failure. These include generally drug resistance and toxicity.

1. Drug resistance

Failure of a tumour to respond to a drug or development of acquired drug resistance is a major problem with antineoplastic chemotherapy. Some neoplastic cells, for example melanoma are inherently resistant (natural resistance) to most anticancer drugs. Acquired drug resistance is common and may occur due to a variety of reasons including altered biochemical mechanisms, increased drug biotransformation, etc. The development of drug resistance may be minimised by short-term, intensive intermittent therapy with combination drugs.

2. Toxicity

Toxicity is the major treatment-limiting factor in antineoplastic chemotherapy. Important adverse effects of cancer therapy may include direct tissue/organ toxicity, hypersensitivity, drug induced tumours and superinfection.

Chemotherapeutic agents are apt to impair or damage cells in the marrow than other normal cells in the body (myelosuppression).Myelosuppression decreases the number of WBCs (leukopenia), red blood cells (anemia), and platelets (thrombocytopenia) and increases the risk for infection and bleeding. Only actively dividing cells in the bone marrow are affected (i.e. stem cells). Cells with shorter life span are more affected (white vs. red blood cell). The damage to the bone marrow is directly proportional to the drug dosage. Depression of these cells is the usual reason for limiting the dose of the chemotherapeutic agents. Monitoring blood cell counts frequently is essential, as is protecting the

patient from infection and injury, particularly while the blood cell counts are depressed. However, low count doesn't occur immediately after administration of an antineoplastic agent because these drugs donot destroy cells already in the blood stream. Drugs temporarily prevent formation of new blood cells in the marrow.

Contraindications and Precautions

Many antineoplastic drugs, particularly cytotoxic drugs, are potentially toxic agents with narrow margins of safety. Several drugs are irritant to skin and mucous membranes and are reported to have teratogenic, carcinogenic or mutagenic effects. Therefore, extreme care should be exercised during handling, preparation and administration of these drugs. Injectable preparations should always be prepared by trained staff wearing protective clothing and gloves. Tablets must not be broken or crushed. Animals must be properly restrained before administration of cytotoxic drugs. Pregnant women are advised not to handle these drugs. Peripheral blood counts should be monitored periodically to assess myelosuppression and other blood abnormalities. The dosage of drug should be reduced or therapy withheld if blood counts are drastically reduced. Appropriate supportive and nursing therapy must be instituted to support vital body systems, if required.

The potential benefit to the patient of treatment as an option must always outweigh the toxic effects.

AN UPDATE ON THE CANINE UROLITHIASIS

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Urinary obstruction due to urolithiasis is a common medical emergency is dogs. Various factors play an important role in the pathogenesis of urolithiasis which are considered while making a decision of medicinal dissolution or surgical removal of uroliths. International recommendations on the treatment and prevention of uroliths are published from time to time. This article discusses updates on the canine urolithiasis with particular reference to pathophysiology of various types of uroliths, their prevention and treatment.

Urolithiasis is defined as the presence of urinary calculi anywhere in the urinary system starting from the kidney, ureter, urinary bladder or urethra (Tion *et al* 2015). When urine becomes supersaturated with dissolved salts, the salts may precipitate to form crystals (crystalluria). If the crystals are not excreted, they may aggregate into solid concretions known as urinary calculi or urolith. Various factors play an important role in the pathogenesis of urolithiasis which are considered while making a decision of medicinal dissolution or surgical removal of uroliths. International recommendations on the treatment and prevention of uroliths are published from time to time (Lulich *et al* 2016). This article discusses updates on the canine urolithiasis with particular reference to pathophysiology of various types of uroliths, their prevention and treatment.

General Considerations and Clinically Relevant Pathophysiology:

- Most canine uroliths are found in the urinary bladder or urethra (Tion *et al* 2015).
- Struvite (magnesium ammonium phosphate) and calcium oxalate calculi are the most common canine uroliths, followed by urate, silicate, cystine, and mixed types.
- **Struvite:-**
  - Urinary tract infections with urease-producing bacteria are an important cause in the formation of struvite calculi in dogs (Lulich *et al* 2016).
  - Bacterial cystitis also increases organic debris, which can serve as a nidus for crystallization and calculi formation.
  - Female dogs tend to have more struvite-containing calculi than male dogs. Shorter, more dilatable and straight urethra in female dogs makes them more vulnerable to urinary tract infection.

- Alkaline urine favors struvite calculi formation.

- **Calcium oxalate calculi:-**
  - It occurs most commonly in dogs with transient, postprandial hypercalcemia and hypercalciuria.
  - Many affected dogs have low-to-normal serum parathormone concentrations. Although rare, these calculi may also occur in dogs with defective tubular resorption of calcium, primary hyperparathyroidism, lymphoma, vitamin D intoxication, decreased urine concentrations of citrate, or increased dietary oxalate (Tion *et al* 2015).
  - Concurrent urinary tract infection, in cases of calcium oxalate calculi, is rare.
  - Acidic urine favors calcium oxalate crystal formation.
  - Dogs eating canned diets with a high amount of carbohydrate were found to be at increased risk for calcium oxalate urolith formation; whereas, dogs fed dry diets formulated to contain high concentrations of protein, calcium, phosphorus, magnesium, sodium, potassium, and chloride appeared to have fewer calcium oxalate calculi.

- **Urate calculi:-**
  - Dalmatians have defective hepatic transport of uric acid, resulting in decreased production of allantoin and increased urinary excretion of uric acid and also have decreased proximal tubular resorption and distal tubular secretion of uric acid, making urate urolithiasis common in this breed (Tion *et al* 2015).
  - Dogs with hepatic insufficiency (e.g., congenital portosystemic shunts) are also predisposed to form ammonium acid urate calculi as the result of increased renal excretion of ammonium urates.
  - Secondary urinary tract infection may occur as a result of mucosal irritation.

- **Silicate uroliths:-**
  - They are often jack shaped and probably are related to increased dietary intake of silicates, silicic acid, or magnesium silicate .
  - Male German Shepherd dogs are at increased risk for formation of

silica-containing urinary calculi.

- **Cystine uroliths:-**
  - Cystine uroliths form because of an inherited disorder of decreased proximal renal tubular reabsorption of cysteine, consequently, cystine crystalluria.
  - Cystine stones usually occur in acidic urine.

Although dissolution of some stones is possible but surgical removal is often necessary initially to allow a diagnosis of stone type. Appropriate medical management may help decrease the recurrence of canine uroliths. Supersaturation of urine with salts appears to be the primary factor favoring calculi formation. Other factors include presence of a nidus on which the stone can form, decreased concentrations of urine crystallization inhibitors also appear to contribute to stone formation.

As struvite calculi in dogs are frequently associated with infection; it is advised to culture the urine, bladder wall, and/or stone. Mucosal cultures may be positive in some patients when urine cultures are negative.

DIAGNOSIS

Clinical Presentation and Signalment:-

- Struvite calculi are more common in female than in male dogs because females more commonly have urinary tract infection; however, urethral obstruction from stones is more common in males.
- Calculi in dogs younger than 1 year of age are often struvite secondary to urinary tract infection. Calcium oxalate uroliths are more common in male dogs.
- Middle-aged to older dogs are most commonly affected with urolithiasis.
- In cats, calcium oxalate uroliths occur nearly as frequently as struvite uroliths. Approximately one-third of cats with calcium oxalate uroliths also have increased total serum calcium concentrations.
- Urate uroliths most commonly occur in Dalmatians.
- Middle aged, male German Shepherds seem to be at increased risk for silicate urolithiasis, although these stones occur in small-breed dogs as well.
- Cystine uroliths most frequently occur in middle-aged male Dachshunds.

History:-

- Clinical signs of urinary tract infection (i.e. hematuria, pollakiuria, and stranguria) are common in dogs with cystic or urethral calculi.
- Small stones lodging in the urethra of male dogs may cause partial or complete obstruction.
- Bladder distention, abdominal pain, stranguria, perceived incontinence due to partial obstruction, and/or signs due to postrenal azotemia (i.e., anorexia, vomiting, and depression) may develop.
- Rupture of urinary bladder associated with urolithiasis is extremely rare in dogs.

Physical Examination Findings

- The bladder wall is often thickened, and stones are occasionally palpable.
- Signs consistent with urinary tract infection may be noted.
- Abdominal pain, anorexia, vomiting, and/or depression may be noted if urinary tract obstruction occurs.

Diagnostic Imaging

- Survey abdominal radiographs or ultrasonography is indicated in all animal with urolithiasis. These procedures are required to localize the calculi in the kidney, ureter, bladder and/or ureter.
- Calcium-containing uroliths (i.e., calcium phosphate and calcium oxalate) are the most radio-opaque calculi in dogs and cats.
- Cystine and urate uroliths are the least radio-opaque, so are likely to be missed, radiographically.
- Struvite calculi are normally radio-opaque and usually are observed with survey radiography.
- Double contrast cystography and/or retrograde urethrography may identify radiolucent stones in the bladder or urethra; however, ultrasonography can detect all types of calculi and can evaluate the kidneys and ureters for concurrent abnormalities.

Laboratory Findings

- Complete blood count, serum chemistry profile (including electrolytes), urinalysis, and urine culture should be performed to assess the health status and severity of the condition.

DIFFERENTIAL DIAGNOSIS

- Uroliths should be considered in any animal presenting with chronic urinary tract infection, hematuria, stranguria, pollakiuria, obstructive uropathy, or urinary incontinence.
- Other differentials include neoplasia and granulomatous inflammation.

MEDICAL MANAGEMENT

- **Bladder decompression**: Using a finger inserted into the rectum and massaging a urethral urolith toward the vagina may dislodge the urolith in female dogs.
- **Retrohydropropulsion**: It may be used to propel urethral stones back into the bladder in both male and female dogs. A catheter is placed in the urethra distal to the stone, and sterile saline or a combination of sterile saline and a 1 : 1 mixture of aqueous lubricant (e.g., Liquid paraffin) is injected while the urethra between the stone and the bladder is occluded by a finger in the rectum (or the vagina in females). Once the urethra is dilated, digital pressure is removed in the hope of flushing the stone into the bladder. A urethral catheter is left in place until the animal can be taken to surgery for a cystotomy. Stones that cannot be hydropropulsed into the bladder are removed via urethrotomy (Bojrab *et al* 2014).
- **Voiding urohydropropulsion**: It may remove small cystoliths in male or female dogs. Under general anesthesia, a urethral catheter is placed and the bladder filled with sterile saline. The dog is then held upright for several minutes to allow stones to settle in the trigone and the proximal urethra. The bladder is then forcefully expressed.
- **Cystoscopic retrieval**: By using a flexible endoscope and basket can be performed for small stones in male and female dogs, but its use is dependent on the size of the animal and the availability of equipment. Laparoscopically assisted cystotomy allows removal of stones with a smaller skin incision than occurs in traditional cystotomy (Lulich *et al* 2016).
- It is always preferred to flush the urethral calculi into the bladder so that cystotomy (rather than urethrotomy) can be performed.

TREATMENT AND PREVENTION

S. No.	Urolith Type	Treatment Options	Prevention
1.	Struvite	• Surgical removal (control infection first, if possible) • Voiding hydropropulsion if stones are small enough	• Monitor urine pH and urine sediment • Must prevent and eliminate urinary tract infection. • Keep urine pH <6.5, BUN <10 mg/dl, and urine specific gravity <1.020
2.	Calcium oxalate	• Surgical removal • Voiding hydropropulsion if stones are small enough • Resistant to dissolution	• Administer potassium citrate to achieve urine pH ≥7.0; do not supplement vitamins C or D • Increase water consumption Reduce protein intake
3.	Urate	• Surgical removal • Voiding hydropropulsion if stones are small enough • Dissolve stones using alkalinization with sodium bicarbonate or potassium citrate; administer allopurinol	• Allopurinol if necessary • Correct congenital Porto Systemic Shunt or lower blood ammonia concentrations
4.	Silicate	• Surgical removal	• Prevent consumption of dirt
5.	Cystine	• Surgical removal Dissolve cysteine stones by administering D-penicillamine or *N*-(2-mercaptopropionyl)-glycine.	• Reducing protein intake with urine alkalization, pH > 7.5 (using potassium citrate or other alkalizing drugs) helps in increasing cysteine solubility in urine.

In conclusions, obstructive urolithiaisis is an emergency clinical entity. History, clinical signs, hemato-biochemical alteration, radiography and ultrasonography helps in making the diagnosis. Depending upon the type and site of urolith, medicinal or surgical intervention is recommended.

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A SIMPLE METHOD OF PRESERVING RUMINANT STOMACH OF GOAT FOR TEACHING AND DEMONSTRATION

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Teaching of anatomy requires fresh specimen, teaching models and visual aids. A simple method was developed for preparation of air-dried inflated three-dimensional model of rumen. Stomach was fixed, washed and dehydrated. Dehydrated samples were inflated using bicycle pump and air-dried. A rectangular-shaped area was removed to make windows in rumen, reticulum, omasum and abomasum. The prepared specimen was similar to the fresh specimen with respect to external surface features and internal surface structures. The method involved few chemicals. Dried specimen can be stored for longer period of time without any change in their appearance. This method is very easy and also cost effective.

Introduction

Anatomy is one of the most important and core subjects of veterinary curriculum because understanding the structure and function of anatomical structures form the foundation of the veterinary science. To be a qualified veterinarian, it is essential to know the anatomical structures at various developmental stages of the animals. Knowledge of gross anatomy forms the basis of physical examination, age determination, collection of blood samples, *per rectal* examination, artificial insemination, pregnancy diagnosis, and various surgical procedures. However, it has always been a difficult subject to teach and understand anatomy, as it includes study of organs and systems with lot of descriptive terminologies. The use of appropriate models, visual aids, or samples in the classroom may be very valuable in teaching. With respect to the ruminantstomach, fresh specimens are quite useful,but those of some species such as goats or With respect to the ruminant stomach, fresh specimens are quite useful,but those of some species such as goats or deer may be difficult to obtain orthe desired the normal shape is not alwayseasy to visualize after fresh specimens have been partially dissected. Present method aimed at developing a simple method of preserving stomach of goat for teaching and demonstration.

Materials and methods

Fresh stomach of goat along with part of oesophageal tube and duodenal tubewas collectedfrom slaughterhouse. It was cleaned properly both from outside and inside using tap water. After cleaning stomach samples were fixed in 10 percent formalin solution for four days. Fixed stomach was again washed with tap water to remove adhered formalin. Stomach specimen was dehydrated with alcohol two changes for two hours each. The oesophageal end of the tube was tied with valve which is used for bicycle wheel tyre. The

duodenal end of the digestive tube was tightly tied to ensure no leakage of the air. The bicycle pump was used to inflate the stomach through the valve tied toward the oesophageal end.The inflated stomach was left on the dissection table to get air-dried. The specimen became dried in five to seven days. A regular examination was made to the drying specimen and the any deflation due to slow leakage of air was compensated with further pumping of air. Air-dried specimen was ready for making opening in all the four compartments to make it enable to visualize the internal structures. A layer of varnish was applied over the surface to make it durable. A rectangular-shaped area was removed to make windows in rumen, reticulum, omasum, and abomasum.

Results and discussion

The present method resulted in a three-dimensional model of ruminant stomach of goat with all the four compartments (Fig.1a). External surface features and counters of rumen were clearly visible. The rumen papillae were seen similar to normal fresh ruminal internal surface (Fig.1b). The honeycomb pattern of the reticulum was exactly similar to the fresh specimen (Fig.1c). The omasal leaves (Fig.1d) and abomasal folds (Fig.1e) were also seen similar to the original fresh specimen.

The present preparation of model was very simple and required only limited low-cost chemicals. The specimen can be used for the study purpose whenever required. It has an advantage over the formalin-fixed specimen as it is free from any chemical which is toxicant. Similar methods had been reviewed by Church (1968). Updike and Holladay (1986) described the method of preparation of flexible models of hollow gastrointestinal organs by coating air-dried organs with a commercially available clear plastic compound. The plastic infiltrated the full thickness of organ walls to support and protect internal as well as external structures. Models prepared by them were flexible, resistant to fluids, and lightweight. This technique was similar to our but use of plastic compound increases the cost. Our method was similar into the technique described by McKiernan and Kneller (1983) for the preparation of inflated air dried Lung specimens. Slightly modified method was reported by Ramkrishna and Leelavathy (2017) for hollow organs like stomach, intestine and lungs. The method described the use simple balloons to prepare stomach and intestine; and air compressor pump for lung.

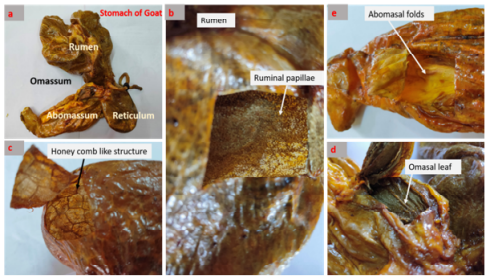


Fig.1. Ruminant stomach model: a. whole stomach depicting all the compartments, b. rumen with ruminal papillae, c. reticulum with honey comb like interior structure, d. Omasum with omassal leaves, e. Abomasum with folds in interior surface.

Many of the anatomists described the plastination method of preserving the hollow gastrointestinal organs. Holladay (1989) described the technique for plastination of large animal hollow gastrointestinal organs in a life-like, inflated position. Pond *et al*., (1992) concluded that preservation by plastic coating or plastinationwill permit permanent documentation of the effectsof experimental treatments or diseases onwhole organs and tissues. In addition, bothtechniques were found to be valuable tools for thesubsequent study of organs and tissues fromresearch specimens.Plastination based preservation technique was also developed by Benevenga*et al*. (1969) for ruminant stomach model preparation and fibreglass technique for preparation of natural models of ruminant stomach was developed by Kitchell*et al.* (1961).

Present method of rumen model was simple, very easy and also cost effective and resulted in a good teaching and demonstration medel.

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MEETING DRINKING WATER REQUIREMENTS OF ANIMALS

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Water is by far most critical of nutrients and an indispensable necessity for body. Animal will succumb to water deprivation sooner than to starvation.Animal can shed almost all fat and about half of its protein and yet live but losing 10 per cent of body water will cause restlessness, trembling, weakness, and 20 per cent loss will cause death.An adequate drinking water supply is an essential component of cattle production. Producers need to be concerned with the amount of water supplied and the quality of that water. The water needs of livestock are filled from three major sources:

1 Free drinking water

2 Water contained in feed

3 Metabolic water produced by oxidation of organic nutrients

The catabolism of 1 kg of fat, carbohydrate, or protein produces 1190, 560, or 450 g of water, respectively. Metabolic water is important to all animals, particularly those residing in dry environments. The first two sources are of major concern in the management of livestock, although in periods of negative energy balance, i.e., when depot fat and tissue protein are being utilized, metabolic water would be important. Water contained in the feed is extremely variable. It may range from a low of 5 percent in dry grains to about 90 percent in young, fast-growing grasses/fodders. In addition, the amount of dew or precipitation on the grass at the time of grazing is subject to wide fluctuations. In the case of swine and poultry, diets are blended from dry ingredients and intake of water in a feed accounts for about 10 percent of the total feed intake.

Factors Affecting Water Intake

There are numerous factors that influence the intake of free water, such as animal species, physiological condition of the animal, level of dry matter intake, physical form of the diet, water availability, quality of water, temperature of the water offered, and ambient temperature.Zebu cattle may have a lower intake of water than European breeds. Water intake per kilogram of dry matter consumed may be as much as 40 percent less for sheep than cattle. Young calves generally have higher intakes of water per kilogram of DM consumed than the older cattle . During the last 4 months of pregnancy, cows may consume 30 percent more water than when dry and open. When cattle on grazing have water available free choice, they drink 2 to 5 times per 24 h. Physical form of the diet influences water consumption. When the same forage crop was made into both hay and silage, Holstein heifers on the silage diet had higher total water intake (free + feed) and secreted

more urine than heifers on hay alone. Protein and salt levels in the diet will also influence water consumption.

Factors Affecting Water Quality

Some of the most common factors that reduce water quality are described below:

1 Bacteria, Viruses and Parasites

Bacteria, viruses and parasites are common in reservoirs that collect runoff from a manure source to which livestock have direct access. There is a large variety of these organisms that can cause a number of different symptoms and production losses. Calves are provided some immunity through their mother's milk, but are still susceptible to high concentrations of pathogens. Mature cattle often have built-in resistance to many of these contaminants, but the introduction of an uncommon pathogen can rapidly spread through the herd causing very serious diseases. Water contaminated by feces can transmit many disease-causing organisms such as *E. coli*, *Cryptosporidia*, *Salmonella*, and *Leptospira* The easiest way to minimize pathogens in water is to prevent inflow from manure sources and prevent direct entry of animals. The sun's ultraviolet rays are effective in killing pathogens in water that is relatively clear.

2 Total Dissolved Solids

Total dissolved solids (TDS), or salinity, refers to the mineral quantities in water. TDS includes common salts such as sodium chloride, calcium, magnesium, sulphates and bicarbonates. Livestock have an ability to adapt to saline water to some extent, but abrupt changes may cause harm. The main symptom from ingesting saline water is diarrhea. If TDS is high enough, cattle may avoid drinking the water for several days, followed by a period of high consumption, which causes illness or even death. Water with TDS higher than 5,000 milligrams/litre should not be used for lactating or pregnant cows. Most animals will reduce intake at this level. Water with TDS greater than 7,000 mg/L is unsuitable for cattle.

3 Nitrates

Nitrates are occasionally found in groundwater that has been contaminated by manure or fertilizer. Nitrates themselves are not very toxic, but bacteria in ruminant animals convert the nitrates to nitrite which reduces the blood's ability to metabolize oxygen and effectively causes shortness of breath and eventual suffocation. Nitrate toxicity resulting exclusively from water is rare, but is primarily of concern when combined with forages having high nitrate levels. A combination of nitrates in feed and water can reach toxic levels and result in death as quickly as three to five hours after consumption. Recommended limits of total nitrates plus nitrites in water for cattle is 100 mg/L as nitrogen (N) or 450 mg/L as nitrates (NO_3).

Water Requirements

Water requirements are influenced by the species, dietary and environmental factors. Water consumption is related to dry matter intake. The larger the proportion of indigestedmatter the greater is the loss of faces and water along with faces. Water requirements increase with the level of roughage. In general, water requirement in the tropics varies between 3.0 to 6.0 litres for each kg of dry matter consumed by the non-lactating animals, depending upon the ambient temperature varying from 5°C to 42°C. These amounts are higher in pregnant and lactating animals. Water consumption increases due to the presence of mineral salts, particularly sodium chloride in the feed and ingestion of high protein feed because of increased urinary excretion. Demand for water intake increases with increasing air temperature to counteract the respiratory and sweat losses.

Voluntary intake of drinking water includes following purposes:

i Maintenance :28 kg approx..

ii For milk production: 3.0 liter water for every litre of milk.

Washing, cleaning of barn, animal and utensils requires 50-70 litre/day. Total need of water per cow is about 110 litre/day. Total need of water per buffalo is about 130 to 150 litre/day. Some researchers speculate that cattle are sensitive to certain taste and odour. Manure in the water will impact its taste and odour. Cattle have shown a preference to drink at clean water sources over contaminated ones. Cattle will not reduce consumption of contaminated water until manure exceeds 0.25 per cent in the water. Iron and manganese can also affect the odour and taste of water. Thus, it is crucial to maintain a clean, fresh water supply to maintain health and performance of animals.

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GENDER MAINSTREAMING IN LIVESTOCK FARMING: A KEY STRATEGY FOR SUSTAINABLE LIVESTOCK DEVELOPMENT

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"If you want something said, ask a man; if you want something done, ask a woman."

Margaret Thatcher

FAO (1998) defines gender as the relation between men and women, both perceptual and material. Gender is not determined biologically as a result of sexual characteristics of either women or men, but it is constructed socially. It is a central organising principle of societies, and often governs the processes of production and reproduction, consumption and distribution. India is an agriculture based country and livestock sector is an integral component of it. It is a source of food, income, employment and foreign exchange. For small income producers, it provides draught power and organic fertilizer for crop production; serves as store of wealth and means of transportation as well (Garcia, et al., 2006). About 90% of livestock is owned by small farmers and landless rural households. These small holders, especially the landless livestock holders, are extensively dependent on income from the sale of milk an d animals to meet their daily household expenses. Even in the mixed farming systems, livestock is the main source of income for rural households and a source of productive employment for the poor.

The livestock production is largely in the hands of women and they are performing phenomenal work in the rural areas (Waters Bayers, 1985). Most of the livestock activities are incomplete without the assistance of women. Economic Survey 2017-18 says that with growing rural to urban migration by men, there is 'feminisation' of agriculture sector, with increasing number of women in multiple roles as cultivators, entrepreneurs, and labourers. In fact animal husbandry is becoming feminized and they contribute 60 to 80% of labour in the animal husbandry (Younas *et al.*, 2007). They undertake various activities of livestock management such as fodder collection, grazing of animals, care of animals, feeding, watering, and health care, management, milking, cleaning of animal sheds etc. Their involvement in the post-harvest operations like household-level processing, value addition is the exclusive responsibilities of women. They also prepare cooking fuel by mixing dung with twigs and crop residues. So one can say rural women remain busy from dawn to dusk in various agricultural activities and livestock management.

Women constitute around 50% of the global population. A large number of women around the world are unwaged. The world economy suffers a lot because of a disproportionate opportunity for women at work places. In India, concept of gender sensitization is of recent origin. Women have become aware about their rights and situations and entered in

different fields of business. They have established their own successful business empires. They are contributing towards the growth of economy and improvement of their socio economic conditions. Government of India has given due importance to gender sensitization and women empowerment in the country *(Borkar et al. 2017)*

Concept of Gender Mainstreaming and Women Empowerment

Gender mainstreaming is an approach to policy-making that takes into account both women's and men's interests and concerns. The concept of gender mainstreaming was first introduced at the 1985 Nairobi World Conference on Women. Women have undergone a radical transformation from merely a homemaker to a dynamic multifaceted personality contributing to the socio-economic growth worldwide. As per NSSO, the present share of workforce in agriculture, livestock, forestry and fishery is more than 50 % in all states. Despite considerable involvement and contribution of women in the society, their contribution has not been duly acknowledged. Significant gender inequalities also exist in access to technologies, credit, information, inputs and services probably because of inequities in ownership of productive assets including land and livestock. The process of creating this knowledge and awareness 'of' and responsibility 'for' gender among professionals enabling them to address gender issues in appropriate and most effective ways is called 'gender mainstreaming'. Mainstreaming is not about adding a "woman's component" or even a "gender equality component" into an existing activity. It goes beyond increasing women's participation; it means bringing the experience, knowledge, and interests of women and men in any policy, programme, reform or activity or any developmental agenda.

Similarly, women empowerment refers to the creation of an environment for women where they can take decisions of their own for their personal benefits as well as society. It is an active, multidimensional process which enables women to realize their potential and powers in all spheres of life including economic empowerment. Economic empowerment is nothing but making women aware about their role /importance in economic development and provide them space for attaining financial independence and account their significant contributions in an enterprise.

Livestock & Rural Women

In India, women in animal husbandry and livestock sector constitute 69 percent of the labor force as against 35 percent in crop farming *(Economic Survey 2002-03).*They form the backbone of agriculture & allied activities, comprising the majority of agricultural labourers and play a significant & crucial role in agriculture and livestock developmental activities. Livestock production is largely in the hands of women. In fact animal husbandry is becoming feminized Women do a bulk of livestock related activities like fodder collection, feeding, health care of animals, watering, milking and household level processing *(Planning Commission, 2012).* Women accounted for 93% of total employment in dairy production *(Qureshi et al. 2016).* Depending upon the economic status, women perform the tasks Such as fodder collection, feeding, watering, and health care, management, milking and household-level processing, value addition and marketing etc. are performed by women.

Despite of their significant role & considerable involvement and contribution in livestock management & production, women's control over livestock and its products is negligible and there is significant gender inequalities exist in access to technologies, credit, information, inputs and services probably because of inequities in ownership of productive assets including land and livestock. Therefore, there is a need to correct gender bias in livestock sector, veterinary education, research and service delivery systems as to enhance the effectiveness of women-oriented livestock development programs.

How to develop women entrepreneurs through livestock sector?

Right efforts on from all areas are required in the development of women entrepreneurs and their greater participation in the livestock based entrepreneurial activities. Following efforts can be taken into account for effective development of women entrepreneurs in livestock sector.

- Consider women as specific target group for livestock based developmental programmers.
- Vocational training to be extended to women community that enables them to understand the production process and production management.
- Adequate training programmed on management skills to be provided to women community.
- Encourage women's participation in decision-making.
- Training on professional competence and leadership skills should be given to women entrepreneurs.
- Training and counselling on a large scale of existing livestock related women entrepreneurs to remove psychological causes like lack of self-confidence and fear of success.
- Better educational facilities and schemes should be extended to women folk from government part.
- Continuous monitoring and improvement of animal husbandry related training programmers.
- Activities in which women are trained should focus on their marketability and profitability.
- To encourage more passive women entrepreneurs the women training programs should be organized.
- Counselling through the aid of committed NGOs, psychologists, managerial experts and technical personnel should be provided to existing and emerging livestock women entrepreneurs.

Gender Mainstreaming through Livestock Entrepreneurship

Entrepreneur associated to livestock farming /business, production of livestock related raw materials and livestock related processing industries is considered as livestock entrepreneur. In other terms, a person who is linked directly or indirectly to the animal husbandry or livestock sector is referred as livestock entrepreneur.

1 Dairy Sector

Since the dairy industry has become more consumer oriented due to health consciousness and increase in purchasing power leads to development of innovative practices of organized retailing, supply chain management, balanced product portfolio, product development. It leads to increase demand for milk and milk products in recent years. Dairy farming is one of the important enterprises which dominate the economic activities of the woman in the rural areas of India. Women accounted for 93% of total employment in dairy production. Depending upon the economic status, women perform the tasks of collecting fodder, watering, feeding and other animal management activities. Therefore, it serves as a profitable enterprise for rural women as they are well aware about animal behaviour and production characteristics.

Women can be guided for small scale dairy farming and commercial dairy business. They can start their own dairy farms by rearing small number of animals and with proper business plan, scientific management and care can ensure maximum production and profit from dairy farming business. If woman has to expand her dairy enterprise on a commercial basis successfully, she has to adopt new and modern dairy farming tools, time and energy saving tools/ drudgery reducing technologies, etc. As there is more than 60% fodder deficit in India, they can also start seed /fodder banks in the potential areas. Women can combine together, purchase fertile land and produce quality fodder and supply them to the nearby livestock farmers. For this they need to undergo specialized trainings from various organisations.

2 Goat Rearing

High demand for goat and its products with potential of good economic returns have been deriving many progressive farmers to take up the goat enterprise on a commercial scale. Goat is mainly reared for milk, meat, sale of breeding stock as an income source. This versatility allows the producer to plan and operate a more stable economic production unit. In many parts of the India, some of the goat breeds are raised for fiber, meat, and milk and cheese production. In general, the role of women in goat keeping is very significant in the rural families and goat is the most important means through which rural women are able to contribute meaningfully to the cash needs for her and their family members. Most of the activities like sale/purchase of goat, grazing of goats, feeding and watering, care of kids, cleaning of pen and household maintenance, milking of goats, health management and breeding management of goats were performed mainly by women. Thus, goat rearing is the most useful way of women's earning those who stay at home. Among the livestock livelihood, goats are more economical than cattle as they are less investment

oriented. An increased level of adoption of technologies and availability of good quality breeding stock would be essential to make the commercial goat farming more successful. Simultaneously, emerging favourable market conditions and easy accessibility to improved goat technologies are also making this enterprise a profitable venture for these women.

3 Poultry Sector

Poultry farming is an important livestock activity for rural women as it generates cash income and provides employment opportunities and improves household nutrition. Rural women are primarily responsible for the care and management of the bird under backyard poultry systems. Poultry rearing has significant advantages over other livestock activities to rural women, because: it is easy to manage and can be taken up under diversified agro-climatic conditions. It can provide quick returns and constant source of income throughout the year, as it enjoys good market demand and prices. Backyard Poultry Farming (BYPF) enhances women's social status and decision-making power in the household by increasing women's income and can be used as a tool to reduce poverty in rural areas. The BYPF rearing had shown a remarkable impact on women's livelihoods across the country. Since women got to deal with different people while purchasing and marketing birds or eggs, these women slowly gained confidence. Various centrally and state government sponsored schemes are promoted for empowering the BPL families mainly the women farmers e.g National Livestock Mission (NLM), Rural Backyard Poultry Development (RBPD) which covers beneficiaries from BPL families to enable them to gain supplementary income and nutritional

4 Aquaculture

The Indian aquaculture is mainly male-dominated and that is largely because it involves fieldwork, travel and living in remote areas. But it has increased significantly with the emergence of fish processing as a growth area within the manufacturing sector in the past years. A recent FAO study found that women's involvement in rural aquaculture had led to a 10- 20% increase in fish production and almost all women fish farmers shown a significant improvement in their socioeconomic conditions. Women play a major role in aquaculture production as labourers and managers of the production process: fishing, processing and marketing. Women form the core of the industrial fisheries labour force through their involvement in postharvest or processing activities. The involvement of women in these activities generates supplemental income to support their families. Some of the government agencies, NGOS, NABARD, NFDB have identified several fisheries technologies, which could facilitate women to become entrepreneurs and enhance their incomes. The various fields that can be chosen by women entrepreurs in this sector are mainly composite fish culture prawn culture, integrated fish culture along with horticulture and animal husbandry, backyard hatcheries, fish-feed manufacturing, fish marketing (wholesale/retail), fish processing and packaging, value addition, net mending/repairs, ornamental fish farming etc. Financial support to these enterprises is provided by NABARD through a rural credit system which provides capital for short-term production/marketing activities, and medium term and long-term loans for technically feasible and financially viable projects

through State Cooperative Banks, State Cooperative Agriculture, and Rural Development Banks, Regional Rural Banks and Commercial Banks.

Approaches and Strategies for Gender Mainstreaming through Livestock Sector

1 Access to financial services and financial literacy

Lack of access to credit was a major constraint for poor women workers to develop any economic activity. Public banks were not adapted to these women who were mainly illiterate, had no collateral and little knowledge about how to use or manage credit efficiently. Rural Bank or cooperative-type bank are the right choice that targets poor women from the informal sector. Its main objective is to help women come out of poverty by providing them with financial services adapted to their situation and capacities. These Bank designed financial products to meet the women's needs and the bank created a door-to-door service so that savings could be collected regularly without requiring the women to travel to the bank. The services provided by the bank help women avoid exploitative moneylenders build their own savings, assets and learn about financial and business management. Along with this awareness should be created about various credit facilities, financial incentives and subsidies through various channels. Government and NGOs offered various schemes and opportunity to the rural entrepreneurs. But, they are unaware of these schemes and opportunities due to their illiteracy. So they should to be educated by the conducting workshops and seminars related to their business. Financial institutions like ICICI, SIDBI, IDBI, IFCI, and SFC should also be encouraged to provide finance to rural entrepreneurs with low rate of interest and limited collateral security with liberal terms and conditions. Simulteously, rural women could be motivated to avail finances from these kinds of institutions for starting the entrepreneurial activities.

2 Promotion of Livestock based Self Help Groups (SHGs)

The SHGs are voluntary associations of people formed to attain some common goals. Members in SHG agree to save regularly and convert their savings into a common fund and to use this common fund for management and business activities. The biggest problem with the SHGs is increasing substantially in rural areas as majority of them are unorganized. These groups are mobilizing thrift deposits, but unable to receive timely, matching and revolving funds to generate employment activities to earn their livelihood. To overcome these constrains SHGs are being actively promoted by government of India through Ministry of Rural Development and Employment, RBI, NABARD, DRDA, Line Departments of State Governments, NGOs, etc at various capacities. NABARD has been working as a catalyst in promoting and linking more and more SHGs to the banking system. Simultaneously the SHG should be promoted to adopt latest technologies to thrive in various market and that could be only possible if they are provided with extension and training support on a sustained manner. Therefore, there is a need for the extension workers, researchers and technologists to provide a helping hand to them.

3 Establishing milk cooperative societies for women at village level

Women dairy Cooperatives (WDC) may serve as good option for rural women to become more empower as they are authorised to make their own decision outside the home. Most of the women dairy co-operatives in India are based on the principle of

maximization of farmer profit and productivity through cooperative effort. This pattern, known as the Anand Pattern, is an integrated cooperative structure that procures, processes, and markets produce. (Datta and Ganguly, 2002). The dairy activity is now largely based upon a three tier system under which, the primary village cooperative societies of women are linked with district union and state federation which are guided by the national co-operative dairy federation in India. For eg. Gujarat Co-Operative Milk Marketing Federation – AMUL, Karnataka Milk Federation – NANDINI, Rajasthan Co-Operative Dairy Federation– SARAS, Bihar Milk Federation– SUDHA, Tamilnadu Co-operative Milk Producers' Federation Limited–Aavin.

4. Women based Producer's Organizations

A Producer Organisation (PO) is a legal entity formed by primary producers, viz. farmers, milk producers, fishermen, weavers etc. A PO can be a producer company, a cooperative society or any other legal form which provides sharing of benefits among the members. As small producers are not able to harness the benefit of economies of scale. Besides in livestock marketing, there is a long chain of intermediaries who very often work non-transparently leading to the situation where the producer receives only a small part of the value that the ultimate consumer pays. Therefore, through aggregation the groups of women producer can avail the benefit of economies of scale. They will also have better bargaining power vis-à-vis the bulk buyers of produce and bulk suppliers of inputs. Promoting Livestock based producers organization run by women ensures investment of various stake holders involved in animal husbandry sector to improve the production and profitability. Creation of a separate label for women's products which can give women greater recognition for their work, and develop a sense of pride and ownership of their products. Similarly, Promotion of value addition to the livestock products such as milk, egg, meat, and fish has huge profit potential. Value of the products get increased many folds during processing, and thereby provide excellent returns. Women can start their own milk parlour, where they can sell processed milk and milk products like flavoured milk, khoa, ice cream, paneer, shrikhnad, curd, gulabjamun, whey milk, ghee etc. or meat centre where fried chicken, chicken, mutton keema, etc. could be sold. Marketing of these values added products could be done in their own brand name and they can start chain of parlours/hotels thereafter. Women may also opt for converting farm wastes (dung, urine, wasted fodder etc.) especially of local or deshi cows to produce biogas, vermicompost plant elixirs and pesticides etc. and sold as products that have higher market values. NABARD provides financial support to these POs through "Producers Organisation Development Fund". Government of India provides budgetary support to these POs for its Equity Grant and Credit Guarantee Fund Scheme for the Farmer Producer Company. For creation of storage and other agricultural marketing infrastructure under the Integrated Scheme for Agricultural Marketing (Ministry of Agriculture, Government of India), FPOs are eligible to get higher subsidies. CAPART, Ministry of Rural Development also operates schemes through which support for some activities can be obtained by the PO.

5 Promotion of organized farm and dairy/meat/egg market

Understanding the market and preparing it to respond to emerging market trends would be the prime instrument for enhancing the women livelihood opportunities in the livestock sector. Rural women entrepreneurs are facing tough competition from the large scale organizations and urban entrepreneurs. The women producers are not collective in their approach for marketing their products because they are to widely scattered and mostly uneducated. The women entrepreneurs are heavily dependent on middlemen for marketing of their products who pocket large amount of profit. Government should take steps to provide market information of different products and finance to the rural entrepreneurs at concessional rates. They should be encouraged to have a regular income by providing market-related and technical support and identifying local and national marketing opportunities. Innovative technology should be publicly announced in order to get its acceptance among the rural entrepreneurs. Assess to infrastructural and storage facilities and means of transport are other means of marketing to be supported to these women in rural areas. Integrated marketing services should be provided to the rural producers through exploring, developing and establishing first the internal (local market) and then the national market for their products. Various models like rural haat, trade fairs, livestock fairs etc facilitate linkages with markets and private companies should be promoted for showcasing their products. The promotion, protection and branding of women products is an important strategy to increase female participation and benefits within an organization. The various market charges recovered from livestock dealers were registration fee, sales tax, toll tax and certificate charges are to be made at concessional rates.

6 Support services

Information about support system is a must for an enterprise. In short-term it is the information which helps in-sound decision making. The information could be on infrastructure facilities, incentives available, financial tie-ups, availability of raw materials, tax concessions, etc. Innovative institutional and operational mechanisms and business models need to be developed to enable small-scale producers, especially women, to seize market opportunities along agricultural value chains, while taking into account issues of gender-based power inequalities and access to choices and resources. As livestock products are intrinsically difficult to trade because they are perishable, so require freezing, canning, drying, or processing of some sort to allow adequate shelf life to send to distant markets. Provision of State of Art- Abattoir cum meat processing plants and cold storage facilities at field level, establishment of custom hiring centres for the women, availability of quality inputs in bulk through authenticated sources can promote more women entrepreneur in this sector. Regional feed-fodder banks needs to be encouraged for milk production in summer months when most Indian cattle and buffaloes go dry.

7 Strengthening women's capacity and leadership skills

One of the most significant barriers faced by Indian women is their low level of literacy as education is key to achieving self-reliance and fighting poverty. Building women's capacity, especially leadership skills, is crucial to build women's self-confidence. Vari-

ous organization have been developing tools and methodologies for strengthening the capacity of women to ensure that gender goals can be achieved and sustained in the long run. Capacity development enables women to access information about various organizations and to become members, and to participate more actively in their activities as well as decision making processes. On-farm technical trainings and extension services including trainings on veterinary health care, clean milk production, improved feeding practices involving local feed resources, better breeding and animal husbandry integrating the helpful traditional practices. In addition they also need the skills to run their own business. These include accounting skills, managerial skills and, marketing skills. Marketing management skills should be improved among the rural entrepreneurs to face the problems of entrepreneurship. Entrepreneurship development cell should be established at all the villages level to provide guidance and counselling to motivate the rural entrepreneurs regarding the use of modern technology. Training institutions supported by the Ministry of Agriculture & Farmers' Welfare, Ministry or Rural Development, Government of India (www. rural.nic.in) also impart skill and capacity building training which can be made use by these women entrepreurs.

8 Creating an enabling policy environment

Governments play an important role in creating the enabling environment so that effective, inclusive and gender equitable organizations can flourish and act as important contributors to poverty reduction and the achievement of food security. An enabling environment will be a gender sensitive one when policies and legislation that directly or indirectly recognize that women and men from various social groups have differentiated roles and priorities; and therefore, adopt the appropriate measures so that all rural women and men can participate in, and benefit from emerging opportunities (FAO, 2000). Therefore various schemes and plans of government for the encouragement of women entrepreneurs should be strongly executed at different levels. Policies should be flexible to facilitate local circumstances. The nature of enterprises to be established in rural areas must be conducive to those areas in economic, social and environmental terms. Rural enterprise policy should cover all types of rural enterprise. There should be consistency and co-ordination with respect to the choice of rural enterprise locations.

Strategies and Approaches to Develop Women Entrepreneurs in Livestock Sector

Right efforts on from all areas are required in the development of women entrepreneurs and their greater participation in the livestock based entrepreneurial activities. Following strategies can be taken into account for effective development of women entrepreneurs in livestock sector.

- Consider rural women as specific target group for livestock based developmental programmers.
- Encourage women's participation in decision-making.
- Adequate trainings on management skills, professional competence and leadership skills to be extended to women community that enables them to understand the production

process and production management.

- Activities in which women are trained should focus on their marketability and profitability.
- Counselling through the aid of committed NGOs, psychologists, managerial experts and technical personnel should be provided to existing and emerging livestock women entrepreneurs.
- Helping women farmers to identify their production, processing & market related constraints through awareness, exposure, exchange of information through other women farmers, extension officers and other stakeholders.
- Continuous contact with women farmers shall be established to provide knowledge & information empower & facilitate them to demand & access services; redress their concerns & grievances; and capture ground reality for use in policy making & improving delivery through; Farmers portal, Kisan Call Centers, Common Service Centers, Short message services and Community radio stations etc.
- Assisting women farmers to make best use of livestock technologies and good practices of improving livestock produce through capacity building.
- Establishing linkages through information source on livestock produce, new technologies and market related information such as, demand, supply and prices.
- Knowledge generators (public & private, formal & informal systems) should develop knowledge portals for capturing, collating and disseminating knowledge through all channels including print & electronic media, farm journals, regular meets etc. for the women farmers.
- Reaching out to and connecting women farmers and other stakeholders so that they communicate with each other.
- Test all indigenous technical know-how (ITKs), identify women farmer innovators, recognize their skills and leverage for field extension as farmer consultants.
- Promotion of Livestock based Farmers Field Schools for the women farmers
- Demand-Driven or Farmer-led & Market–Led Extension Approach & Farmer to Farmer Extension
- Introduction of ICT in delivery of extension messages and market information to the women farmers/entrepreneurs.
- Establishment of proper Research-Extension-Farmer-Market-Linkage for the existing and emerging livestock women entrepreneurs.

- A mechanism may be put in place to provide weekly/ daily personalized information (thru SMS/MMS) to the women farmers through Veterinary Universities/ Departments of Animal Husbandry/ KVKs.
- A stakeholder directory of Institutions/ Agencies, Experts / Livestock Magazines/ Journals/ Newspapers / channels shall be prepared and linked on to Farmers Portal.
- A comprehensive livestock-knowledge portal may be designed and developed to host information about the happenings/innovations in Livestock sector.
- The e-procurement of inputs and services required by the women farmers may be promoted to give them negotiating power to get the livestock inputs at the most competitive rates without transaction costs.
- Path-breaking methods such as Kala Jathas, Extension Buses can be tried successfully to deliver the message effectively on a large scale.
- Promotion of group approach
- Focus on nutritional value and new or unknown products
- The technical skills and ability of the women entrepreneurs should be evaluated
- Extension Agencies and Women Farmers Organizations should give wider publicity
- Encourage the women entrepreneurs by introducing various concessions and incentives.
- Networks of women entrepreneurs may be established
- Promotion of direct marketing by establishing close interaction between producers and consumers
- Promote organized road side display models milk and meat products for the existing and emerging livestock women entrepreneurs.

Conclusion

Gender mainstreaming and gender sensitization is a challenge but through livestock based enterprises /ventures in rural area can help to meet these challenges. These enterprises not only enhance national productivity, generate employment but also help to develop economic independence, personal and social capabilities like; economic empowerment, improved standard of living, improvement in leadership qualities, involvement in solving problems related to women, decision making capacity in family and community, build-up self confidence, increased social relations, political participation, increased participation in various developmental programs and enhance awareness etc. amongst rural women.

Livestock women entrepreneurs may contribute significantly in rural and economic development in India. However, lacks of suitable gender mainstreaming and gender sensitization policies, supportive network, financial and marketing prospects may hamper their entrepreneurial activities. National policies should be resolute in tackling this issue and local bodies should ensure the implementation of these policies at the community level and at last but not the least the rural women needs to be motivated to take up entrepreneurship as a career, with training and sustaining support systems providing all necessary assistance.

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