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Dos and Don'ts during Snake Bite

Fish Feed Ingredients and Their Classification

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Overview of Oligo-Directed Mutagenesis (ODM)

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ODM is exploiting the finding that oligonucleotides of short or medium sized sequence length, can be used to induce mutations at genomic DNA sequences, which are complementary to the oligonucleotide sequence except for single or very few positions. Upon introduction of the respective oligonucleotides into target cells they associate with complementary genomic sequences, thereby creating sites of sequence mismatch (es). During subsequent steps of DNA replication mutations can be introduced at the mismatched positions. By this process intentional sequence changes at specific nucleotide positions can be introduced into the genomic target sequences, which are directed by the nucleotide sequence of the synthetic oligonucleotides used in ODM (Breyer *et al.* 2009). This technique is applicable to introduce targeted mutations into the genomes of microorganisms, animal and plant species using a similar general approach as depicted below.

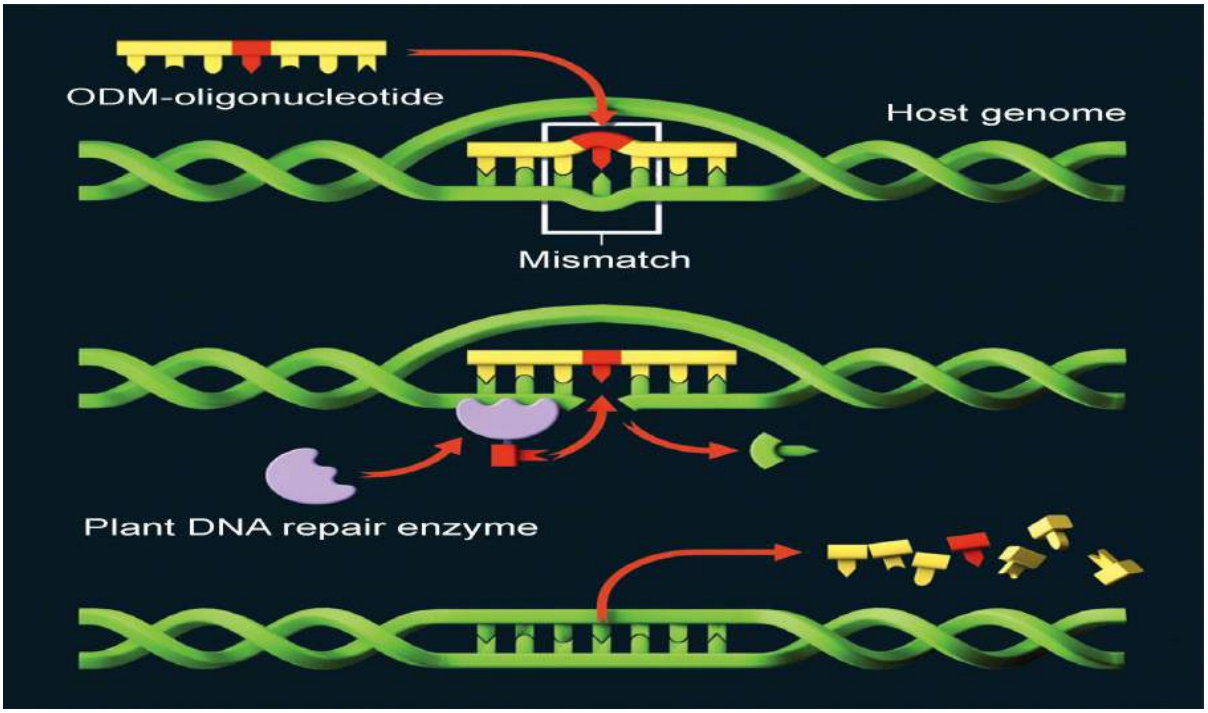

Figure 1: Schematic diagram of ODM (adaped from **http://cibus.com/**)

Technical Details of ODM

ODM employs different types of oligonucleotides for a targeted induction of point mutations at specific sites in the DNA sequence. Such oligonucleotides can either be in vitro synthesized single stranded DNA oligonucleotides or chimeric oligonucleotides including DNA and RNA bases, RNA-oligonucleotides or oligonucleotides consisting of nucleic acid analogues (Ntwg 2011). These oligonucleotides are designed to share sequence homology with certain target sequences with the exception of one or a few base pairs thus intentionally creating sites of sequence mismatch. Due to their sequence homology they associate with the genomic target sequences and induce site-specific mutations via the natural DNA repair mechanisms operating in the targeted cells. These repair mechanisms are triggered by the sequence mismatches between the oligonucleotide- and genomic sequences. Commonly mismatches of a length of 1-4 nucleotides are used in ODM (Lusser *et al.* 2011). ODM is intended to modify either the DNA sequence of a specific gene which may lead to changes in the function of the gene product or to modify the expression of a specific plant gene present in the genome of the target crop (Ntwg 2011).

The success of an ODM experiment (intended targeting, sufficient efficacy) is dependent on a number of factors, like:

- Design of the oligonucleotide sequence used for ODM (Length and sequence of ligonucleotide selected for ODM, number and location of target sequence mismatches)
- Type of the oligonucleotide used (DNA, RNA, chimeric oligonucleotides, oligonucleotides with chemical modifications)
- Efficiency of transfection procedure and of oligonucleotide uptake into target cell nucleus
- Type of target cell (species, tissue) and developmental status of the targeted cell

Unintended modifications

ODM is generally considered to introduce mutations in a more targeted way than other mutational techniques (random mutation). However certain possibilities to introduce unintended effects are associated with the method:

- Semi-targeted, non-specific mutations were also observed for ODM (Britt & May 2003).
- Knock-out mutations, which result in expression of fusion genes, should be

assessed for potential adverse effects of their products.

- Sufficient partial homologies of off-target genomic sequences with the ODM oligonucleotide can lead to mutations created at other sites in the genome than the targeted site. Off-target effects may also not be easy to anticipate, as single mutations can have relevant effects, e.g. lead to an increase in expressed plant toxins (Kuzma & Kokotovich 2011).
- In comparison with GM technology no vector sequences or other foreign DNA sequences are introduced, however similar transfection methods are used for introduction of the ODM-oligonucleotides into the target cells. These methods (e.g. transfection mediated by chemicals, biolistic bombardement) are themselves associated with a potential to elicit unintended mutations (Wilson *et al.* 2006).
- Extended stability of oligonucleotides used in the transfected cells during ODM can also lead to unintended effects. Chimeric or chemically modified oligonucleotides however are specifically used because of their increased stability leading to better performance. An improved knowledge on the degradation kinetics of ODM-oligonucleotides would be necessary to assess effects due to oligonucleotide stability.
- The frequency of integration is higher for oligonucleotides with increased number of consecutive mismatches as compared to target sequences (Sawitzke 2013).
- Eventually, ODM oligonucleotides may trigger the regulatory RNAi-machinery leading to unexpected regulatory changes in cellular gene expression (Heinemann *et al.* 2013).

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QTL Mapping

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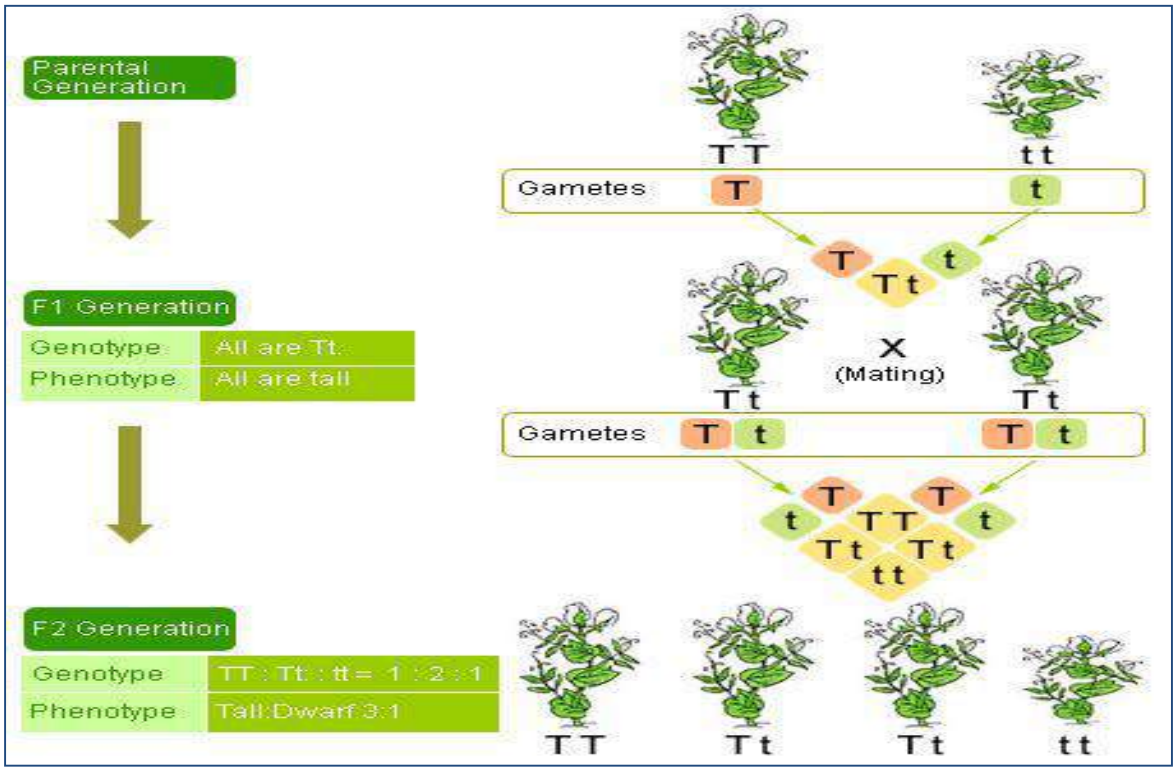
Quantitative traits

Many traits of agronomic and horticultural interest are controlled by a single gene and fall into few distinct phenotypic classes. These classes can be used to predict the genotypes of the individuals. For example, if we cross a tall and short pea plant and look at F2 plants, we know the genotype of short plants, and we can give a generalized genotype for the tall plantphenotype. Furthermore, if we know the genotype we could predict the phenotype of the plant. These types of phenotypes are called *discontinuous traits.*

QTL mapping

Quantitative characters have been a major area of studying in genetics for over a century, as they are common feature of natural variation in populations of all eukaryotes, including crop plants. For most of the period up to 1980, the study of quantitative traits has involved statistical techniques based on means, variances and covariances of relatives. These studied provided a conceptual base for portioning the total phenotypic variance into genetic and environmental variances and further analyzing the genetic variance in terms of



additive, dominance and epistatic effects. From this information, it became feasible to estimate the heritability of the trait and predict the response of the trait to selection. It was also possible to estimate the minimum number of genes that controlled the trait of interest.

Principle of QTL mapping

It is not difficult in populations of most crop plants to identify and map a good number of segregating markers (10 to 50) per chromosome. However, most of these markers would be in non coding regions of the genome and might not affect the trait interest directly; but a few of these markers might be linked to genomic regions (QTLs) that do influence the trait of interest. Where such linkages occur, the marker locus and the QTL will cosegregate. Therefore, the basic principle of determining whether a QTL is linked to a marker is to partition the mapping population into different genotypic classes based on genotypes at the marker locus, and the apply correlative statistics to determine whether the individuals of one genotype differ significantly with the individuals of other genotype with respect to the trait being measured. Situations where genes fail to segregate independently are said to display "linkage disequilibrium". QTL analysis thus depends on linkage disequilibrium.

Objectives of QTL mapping

1. To identify the regions of the genome that affect the trait of interest
2. To analyze the effect of the QTL on the trait
   a. How much of the variation for the trait is caused by a specific region?
   b. What is the gene action associated with the QTL (additive effect? Dominant effect?)
   c. Which allele is associated with the favourable affect?

Salient requirements for QTL mapping

1. A suitable mapping population generated from phenotypically contrasting parents.
2. A saturated linkage map based on molecular markers
3. Reliable phenotypic screening of mapping population
4. Appropriate statistical package to analyze the genotypic information in combination with
5. phenotypic information for QTL detection.

Factors affecting the power of QTL mapping

1. Number of genes controlling the target trait(s) and their genome positions
2. Distribution of genetic effects and existence of genetic interactions

3. Heritability of the trait
4. Number of genes segregating in a mapping population
5. Type and size of mapping population
6. Density and coverage of markers in the linkage map
7. Statistical methodology employed and significance level used for QTL mapping.
8. Replicate progeny analysis, selective genotyping, sample pooling and sequential sampling are some of the suggested approaches for optimization of experimental designs, so as to enhance the power of QTL detection and estimation of QTL effects.

Mapping QTL with Molecular Markers

The improvement of quantitative traits has been an important goal for many plant breeding programs. With a pedigree breeding program, the breeder will cross two parents and practice selection until advanced-generation lines with the best phenotype for the quantitative trait under selection are identified. These lines will then be entered into a series of replicated trials to further evaluate the material with the goal of releasing the best lines as a cultivar. It is assumed that those lines which performed best in these trials have a combination of alleles most favorable for the fullest expression of the trait. This type of program, though, requires a large input of labor, land, and money. Therefore plant breeders are interested in identifying the most promising lines as early as possible in the selection process. Another way to state this point is that the breeder would like to identify as early as possible those lines which contain those QTL alleles that contribute to a high value of the trait under selection. Plant breeders and molecular geneticists have joined efforts to develop the theory and technique for the application of molecular genetics to the identification of QTLs. Molecular makers associated with QTLs are identified by first scoring members of a random segregating population for a quantitative trait. The molecular genotype (homozygous Parent A, heterozygous, or homozygous parent B) of each member of the population is then determined. The next step is to determine if an association exists between any of the markers and the quantitative trait.

The most common method of determining the association is by analyzing phenotypic and genotypic data by one-way analysis of variance and regression analysis. For each marker, each of the genotypes is considered a class, and all of the members of the population with that genotype are considered an

observation for that class. (Data is typically pooled over locations and replications to obtain a single quantitative trait value for the line.) If the variance for the genotype class is significant, then the molecular marker used to define the genotype class is considered to be associated with a QTL. For those loci that are significant, the quantitative trait values are regressed onto the genotype. The R^2 value for the line is considered to be the amount of total genetic variation that is explained by the specific molecular marker. The final step is to take those molecular marker loci that are associated the quantitative trait and perform a multiple regression analysis. From this analysis, you will obtain an R^2 value which gives the percentage of the total genetic variance explained by all of the markers. The two types of populations that have been used to identify markers linked to QTLs are F2*3 families (or F3 families from F2 plants) and recombinant inbred lines. Each population type has advantages and disadvantages. The primary advantage of F2*3 families is the ability to measure the effects of additive and dominance gene actions at specific loci. Because RI lines are essentially homozygous, only additive gene action can be measured. The advantage, though, of the RI lines is the ability to perform larger experiments at several locations and even in multiple years. For many crops, it is not possible to generate enough seed to perform a multilocation experiment with population of F2*3 families.

Fish Feed Ingredients and Their Classification

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Indian aquaculture has demonstrated a six and half fold growth over the last two decades, with freshwater aquaculture contributing over 95 percent of the total aquaculture production. The production of carp in freshwater and shrimps in brackishwater form the major areas of activity. Aquaculture in India, in general, is practiced with the utilisation of low to moderate levels of inputs, especially organic-based fertilisers and feed but to increase the output successfully nutritional manipulations and better feeding managements have to be followed. As in any aquaculture venture, feed forms the major part of the operational cost so feed should be designed scientifically by judiciously formulating the feed composition so that best growth rate can be achieved at minimal possible feed cost. For this a sound knowledge of the nutritional requirements and feed ingredients should be possessed. In the culture systems producing more than 1 tonne/ha/yr feed interventions are usually required. Further, in semi-intensive and intensive culture systems feed becomes more important as it is the major source of nutrition in semi-intensive culture and the only nutritional source in intensive culture.

FEED INGREDIENT CLASSIFICATION

Feed ingredients can be classified on the basis of composition, function and source.

Classification on the basis of composition:

Here we look at the constituents of the ingredients and use them accordingly and in proper proportions in the feed.

(i) **Protein constituents**: Certain ingredients are rich in proteins and are used as per their amino acid profiles. Fish meal, soyabean meals are some of the common

ingredients used as the sources of proteins in fish feed.

(ii) **Lipid constituents**: Ingredients like fish oil, coconut oil are used to increase the fatty acid or triacyglyceride content of the fish feed.

(iii) **Carbohydrate constituents**: Ingredients such as Alginic acid, tapioca flour, are included in the feed as carbohydrate source.

(iv) **Vitamin constituents**: Vitamins are required for effective metabolism of animals as they are indispensable part of many metabolic enzymes. Their deficiency leads to disorders, diseases and cripples the organism. Vitamin mix solutions are added to fish feed to provide fish with a balanced diet.

(v) **Mineral constituents**: Any organism would require minerals for ensuring proper functioning of the body. Requirement of any mineral above 100 milligrams a day is labeled mineral while trace minerals are required in very small quantities (in micrograms).There are about 21 recognised elements which perform essential functions in the body. Minerals provide rigidity to the endoskeleton in finfish and exoskeleton on shellfish. They are required in maintaining acid-base equilibrium and osmotic balance with the environment, they are involved in proper functioning of muscle fibers and neurons, they are involved in endocrine system, they are present as components of red blood cells, enzymes and organic compounds in tissues and cells.

Classification on the basis of function:

On the basis of function, ingredients can be classified as (i) Energy supplements and (ii) Non energy yielding supplements.

(i) **Energy supplements**: These ingredients have more than 20% protein level. They are also called protein supplements. Carbohydrates, fats and protein are included in this category.

(ii) **Non energy yielding supplements:** Ingredients that contain less than 20% protein and 18% fibres are classified as energy yielding supplements. These include vitamins, minerals which have

physiological and biochemical roles and are important in deciding efficiency of the diet

Classification on the basis of source:

Feed ingredients can be of animal origin or can be derived from plants.

(i) **Ingredients of animal origin**: Feed forms the most expensive production function in aquaculture and in feed, protein is the most expensive component that determines the cost of feed and hence, in turn, determines the cost of fish production. Ingredients of plant origin are generally protein contributors. Fish meal, slaughter house waste are widely used to increase the protein composition of fish feed. Fish meal is a very important ingredient in this regard as it is rich in lysine and methionine which are found in deficit quantities in plant derivatives. In addition to this, fish processing by-products, processing house waste can be procured cheaply for incorporating into feed. Certain fishing by-catch like Mantis shrimps (*Squilla* sp.) or market value fish like Anchovies can be used to prepare fish meal which can be added as a protein source in feeds.

But, apart from being very good sources of proteins, animal derivatives have certain disadvantages like high bacterial load, low shelf life of raw material and of the product made from them, hygiene requirements in handling the animal derived raw material and processing it adds up the cost of feed production.

(ii) **Ingredients of plant origin:** Agriculture forms the primary economic sector of India and this country has a wide variety of vegetative flora hence it would be wise to use plant derivatives in feed preparation for they will be abundantly available throughout the length and breadth of the country unlike fish meal which will be a scarce item in North-Indian states like Jammu and Kashmir, Himachal Pradesh, Haryana, Punjab etc. and in North-eastern states. As ingredients of plant origin will be available in almost all the seasons and in large quantities, they will be cheaper. Handling such raw materials is easy, their shelf life is more than that of

the ingredients from animals. Health and hygiene problem in handling plant derivatives is less which in turn will reduce the cost of feed production.

Rice Bran, wheat bran, oil cakes and soya bean meal have been widely used as traditional feed in Indian aquaculture.

The problem with the ingredients of plant origin is that their nutrient composition, especially amino acid profile varies widely from plant to plant. This creates a restriction in their free usage in feed composition. Plant proteins are deficient in lysine and methionine. Digestibility of plant proteins is also less than fish proteins.

There is another general classification of fish feed ingredients, which is as follows:

1. **Dry forages and roughages**: This include hay, straw, hulls and other products with more than 18% crude fibre content. Rice Bran and seed coats are of special mention in this category.
2. **Pastures, range plants and forages fed green**: this includes ingredients that may be slightly cured on the stem, cut and fed fresh. E.g. *Hydrilla*, dried *Azolla, Colocasia* leaves etc.
3. **Silages**: this is a category where feed ingredients are reduced in size and then preserved by reducing their pH. The silage so obtained is added to the feed and not fed directly. Grasses, slaughter house waste, fish, grains, roots, tubers etc are generally preserved in this form.
4. **Energy feeds**: This includes ingredients with protein content below 20% and fibre content less than 18% (on dry weight basis). E.g. Vitamins and minerals mix.
5. **Protein supplements**: This includes ingredients containing protein level above 20% (on dry weight basis). E.g. oil cakes, soya bean meal etc.
6. **Mineral supplements**.
7. **Vitamin supplements**.
8. **Additives**: The ingredients in this category are added in feed to make it more efficient by enhancing its pelletability, palatability, attractiveness. These are antibiotics, colouring materials, flavours, hormones, medicines, binders etc.

Conventional Feed Ingredients:

Aquaculture in India has been a traditional practice in the form of traditional brackishwater 'capture-and-culture' systems like 'Pokkali' in Kerala, 'Bhasabhada fisheries' in West Bengal. This started as extensive type of culture system in India which required only fish seed and some manuring as inputs. But as the demand for the fish rose more fish had to be produced from the same area available. Stocking of the ponds or other suitable water bodies had to be done beyond their carrying capacities and for this feed had to be a new input.

Aquaculture like any other traditional practice tends to utilize locally available inputs. In India, agricultural by-products and waste is abundantly available in one or the other form and our ancestors have learned to use them in aquaculture. These conventional inputs had been used to provide fish mainly with proteins and energy. Though these inputs have been successful in supplementing feed with some nutrient value and producing fish slightly above the natural carrying capacity of the water bodies they have some disadvantages also, the biggest being that their nutrient value is not sufficiently large to produce exceptionally high quantities of fish.

Some of the conventionally used feed ingredients are discussed below:

(i) **Rice bran**: This has been the most popular ingredient of the practical diets for fin fishes especially carps. It has crude protein value of 10-12%, crude fibre 12-18%, total lipid 7-12%, ash 8-12%. It is a good source of energy and B group vitamins. Deoiled rice bran is better in terms of nutritional profile and this also keeps away the problem of rancidity.

(ii) **Wheat flour and wheat bran**: This is a good source of energy having crude protein 10-14%, crude fibre 12-18%, ash 6-18%. It is a good source of phosphorous, potassium, magnesium and zinc. Amongst vitamins, niacin, pantothenic acid and biotin are in good amounts. For prawn feeds, ground whole wheat flour is widely used. Inclusion of this in feeds foments gelatinization hence improving the feed stability.

(iii) **Corn gluten**: Crude protein 20-30%; arginine and lysine levels are low; good source

of iron and zinc, niacin and vitamin E.

(iv) **Sorghum and millet**: Crude protein 8-12%; poor profile of amino acids, minerals and vitamins; can be used as an energy source.

(v) **Oil cakes and meal:** In India oil cakes have been widely used as feed ingredients based upon the type of oil seeds in various regions. Some important ones are:

(a) **Soyabean oil cake**: Among the plant sources soyabean oil cake is considered as the best source of protein, in terms of its protein content and amino acid profile. The energy content varies with the deoiling extent and deoiling process which will have an effect on the fibre content of the meal.

Despite its high protein content, it lack in methionine, lysine and threonine levels are also less as compared to animal protein source. Supplementing it with the deficient amino acids it can be a very good feed ingredient. It also contains protease inhibitors, urease enzyme, haemagglutinins and glycosides like saponin, but all the antinutritional factors can be destroyed by heat treatment which may compromise some amino acids. Phytates, lipoxidase antivitamin A, antivitamin D are some other antinutritional factors present. About 50% of phosphoric acid is present as phytic acid which is rendered unavailable. Among vitamins, choline is found in relatively high amounts. Levels of incorporation in feeds for tilapia, carps, channel catfish is as high as 50%; sea bass, grouper, trout 10-20%, prawns upto40%. Protein level is 46-48% in solvent extracted meals while it is 38-42% in mechanically extracted forms.

(b) **Cotton seed oil cake**: Protein content varies from 29-42% depending upon the amount of hull removed. The content as well as availability of lysine, threonine, and methionine is lower than in soyabean oil meal. It is a good source of thiamine and vitamin E. Presence of phenolic pigment gossypol and cyclopropenoic fatty acids adversely affect the nutritional value value of cotton seed oil cake.

(c**) Groundnut oil cake**: Crude protein ranges from 35-42%. It is lower in lysine, tryptophan, threonine and methionine in soyabean meal cake. It is a good source of magnesium, sulphur and potassium. Good source of vitamins, niacin, pantothenic acid, thiamine, while choline and vitamin E levels are low. Highly prone to fungal growth and mycotoxin (aflatoxin) in humid conditions.

(d) **Sunflower oil cake**: Highly deficient in lysine. Methionine and cystine higher than soyabean. Vitamin B and carotenoids found in good quantities.

(e) **Mustard oil cake**: used in carp diets. Non detoxified cakes contain erucic acid, glucosinolates. Some other oil seed cakes are Safflower oil cake, Rapeseed oil cake, gingely oil cake, linseed oil cake.

Cereal products: Ground broken rice, wheat, soghum, millets and maize can be used considering their cost, availability and carbohydrate content.

Root Crop: Tapioca, sugar beet molasses and meals from potatoes Have been used. Hydrocyanic acid content should be checked in the tapioca before use.

NON CONVENTIONAL FISH FEED INGREDIENTS:

Non-conventional feed resources refer to all those feed ingredients that are not traditionally used in animal feeding and are not normally used in commercially produced rations for livestock.

Characteristics of Non conventional feed resources:

i) They are end products of production and consumption that not have been used, recycled or salvaged.

ii) They are mainly organic and can be in solid, slurry or liquid form.

iii) Their economic value is often less than the cost of their collection and transformation for use and consequently they are discharged as wastes.

1) **Fisheries by-products**: Waste from fish processing industries have found a good use in formulating fish feed. The are procured everyday from the processing industries in bulk and either used immediately after short storage time or can be preserved by ensilage for future use. Some of the by-products are:

i) **Fish meal**: this is perhaps the most abundant animal protein source commercially produced and marketed in several countries. In fact this fish meal industry is sustaining the worlds largest single fish species exploited by man; Peruvian Anchovy (*Engraulis ringens).* Best fish meals are manufactured by steam cooking. In India, fish meal marketed is pulverized fish meal. Though very high in protein levels its cost makes its use sparingly in feed for carp but it can be used in good quantities in shrimp and trout feeds. Protein content is 60-75%, fat ranges from 4-20%, ash content depends on the processing level and varies highly ranging from 11-12% in anchovies to over 23% in white fish meal.

ii) **Fish solubles**: This is the water remaining after the oil is removed from the liquid pressed out during the manufacture of fish meal. The condensed and dried fish solubles when included in small quantities an aqua feed serve as an attractant. It is high in B group vitamin and contains an unidentified growth factor.

iii) **Fish silage**: It is prepared from trash fish, waste fish head, vicera prawn waste small crabs and mixed with a mixture of acids to bring down the pH to 4. This causes liquefaction and prevents bacterial decomposition. Biological fish silage is prepared by introducing lactic acid bacteria into ground fish carbohydrate mixture. The lactic acid bacteria produce the acid necessary to preserve the fish. The resulting liquid product can be used as an ingredient mainly in fish feeds.

iv) **Crustacean meals**: Meals obtained form small prawns, prawn heads, mantis shrimp, crabs and krill are important ingredient for prawn feeds. Fresh crustacean meals are good attractants for prawn. Crude protein level varies between 30-50% depending upon size and species. Ash content ranges from 25- 40% and chitin is as high as 16%. It is good source of cholesterol, carotenoid pigments, chitin, calcium, iron, manganese, choline, niacin, pantothenic acid and cyanocobalamine. Fresh material should be used always. In prawn feeds inclusion rates range from 5-

15% and meals from small prawns up to 25%

2) **Meat meal and meat and bone meal**: These are dried mammalian tissue exclusive of hair, hooves, horns, hide trimmings, manure and stomach content. Protein content is about 51% for meat meal and 50% for meat and bone meal. Fat is about 9.1-9.7% in both. Meat has phosphorus content less than 4.4% while it is above 4.4% in meat and bone meal. Calcium content of meat and bone meal is 8.8-12% and in meat meal is less 3%. Both have ash content of 27-31%
3) **Blood meal**: It is a dry product made from clean fresh animal blood, exclusive of all extraneous matter. It can be prepared by spray drying, flash drying and conventional drying. Its protein content is 85%, lysine is 9-11% with lysine over 80%.
4) **Feather meal**: It is made from poultry feathers, hydrolyzed under pressure in the pressure of $Ca(OH)_2$ and dried. Its protein content is 80-85% and not less than 75% of protein must be digestible by the pepsin digesting method. Its use in fish feed is restricted due to its poor digestibility by fish.
5) **Milk by-products**: Dried whey, dried whey products, casein and dried skim milk. Dried whey is obtained when lactose has been removed. Protein content is relatively low (13-17%), yet are classified a protein supplements. Dried skim milk forms a part of larval diet as it digestibility is high and has good amino acid profile. It has about 34% protein. Casein is the residue obtained by acid or rennet coagulation of defatted milk. It has 80%protein.
6) **Gelatin:** it is obtained by partial hydrolysis of collagen from animal skin, tendons and ligaments. It is hard and brittle when solid but dissolve in hot water and forms gel when cooled. It is 88-92% protein and contains no tryptophan. Used as protein source and binding agent.
7) **Silkworm pupae:** used in feeds at low level. Has high levels of chitin, and lipid which is prone to rancidity, Solvent extraction of lipids may improve the quality.
8) **Chicken eggs:** without shell have crude protein level of about 46%

and has 43% lipid content. Ash contributes to 4%. It is a good source of amino acids, pantothenic acid, cyanocobalamine, riboflavin, iron and zinc. Particularly beneficial in hatcheries and nurseries.

9) **Concentrates:** A concentrate is usually described as a feed or feed mixture which supplies primary nutrients (protein, carbohydrate and fat) at higher level but contains less than 18% crude fibre with low moisture and total ammonia nitrogen over 60% on air dry basis.

Miscellaneous ingredients: Fruit processing waste as from citrus fruits can be incorporated in the diets which act as a source of carotenoids and vitamins.

Single cell protein: This term applies to a wide range of products of microbial origin (Tuse' 1884, Taco & Jacson 1985). The microbes may be of algal (*Spirulina maxima, Scenedesmus obliques, Chlorella vulgaris*), fungal or bacterial origin (*Methamonas methanica*) resulting from fermentation process. Yeast and breweries, sewage, processing waste, wood pulp operation, and petroleum cracking products are some of the substrates which are harmful to the environment but can be utilized to produce single cell protein. Yeast, *Spirulina* are some of the examples of SCP having lot of potential in the fish feed manufacture. Yeast may not be used as such but is fed to *Artemia* in which lipid content is seen to rise. Feeding this *Artemia* provides fish fry with essential fatty acids in the diet (E. H. Lim, T. J. Lam and J. L. Ding 2005*). Spirulina* has crude protein level of 55-65% with good levels of essential amino acids, calcium, and phosphorus.

Azolla as feed ingredient

Recently, the utilization of aquatic plants having high food value are used to supplement fish food has taken a new dimension for producing the much required animal protein at low cost (Lakshmanan et al., 1967). Azolla, which grows in association with the blue green algae *Anabaena azollae*, is perhaps the most promising from the point of view of ease of cultivation productivity and nutritive value (Lumpkin and Plucknett 1982;Van Hove and Lopez 1983). Azolla contains 20-25.5% protein, 3.1%fat, 34.9%carbohydrate, 8.5-11.7% cellulose and essential aminoacids. Grass carp and common carp recorded

a weight gain of 174 and 35.8g / fish respectively and utilized Azolla nitrogen to the extent of 30% (Ayyappan, 1992).

CONCLUSION

With the ever increasing demand of fish it has become very important to turn the fish production from aquaculture for which feed inputs would be required to sustain stocks at higher densities. Traditionally used feeds are cheaper but not nutritionally balanced hence would fail to support high stocking densities. Knowledge about feed formulation has to be spread with a thought towards the acceptance pattern of the Indian farmers. Cost factor is a major deterrent that keeps farmers away from the formulated feeds so techniques should be developed to effectively utilize locally available ingredients.

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Seasonal Influences on Spermatogenesis in Buffalo Bull and Its Amelioration

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The buffalo has been traditionally regarded as a poor breeder with low reproductive efficiency, characterized by late attainment of puberty and maturity, seasonality of calving, long postpartum anestrus, silent heat, low conception rates and long calving intervals. Buffalo usually behave like a short-day breeder but capable of breeding throughout the year becoming sexually active in response to decreasing day length is influenced by photoperiod mediated by melatonin secretion.Season directly affects reproduction through determining macro and micro climatic factors with semen quality being poorer during summer than in winter. Generally winter and spring are the favorable seasons for the semen production and hot and hot- humid are the unfavorable seasons in buffaloes. Hormonal fluctuations of the photo-neuroendocrine circuit may have on reproductive efficiency which may be a result of seasonal variation. An initial rise in Follicle Stimulating Hormone (FSH) is results in a proliferation of Sertoli cells, a lengthening of the seminiferous tubules (ST) and an increase in tubular diameter. At the same time, there is a rise in Luteinizing Hormone (LH) secretion resulting in increased testosterone production by the Leydig cells. Weight of the testis is also one of the markers of a possible alteration in androgen status along with physiological activity. The increase of temperature lead to decreasing the number of the receptors of LH that presents on Leydig cells and then decrease in testosterone and activity of the testes in summer season. The seasonal variation significantly affects the number of spermatogonia of seminiferous tubules in different stages that showed higher in spring and lower in summer. In spite of the seasonal fluctuation in spermatogenesis melatonin operates as a hypothalamic-pituitary gonadal axis modulator, via activation of receptors found on the hypothalamic neurons that release GnRH. Melatonin has strong effect on the regulation of spermatogenesis and blood–testis barrier. In both long and short day breeders. The feeding, housing and better management of the buffalo bulls has an influence on the production and quality of the semen. Existing reports demonstrated that the buffaloes are not seasonal animals. In

buffalo bulls, a significant positive relationship between scrotal circumference and semen volume and concentration. As the buffaloes behave like photoperiodic animals their performances is show negative trend with day length. The receptor for hormones play significant role for efficient physiological performance is mainly stimulated by proper light and vice versa. As well as, the level of nutrition with better managemental practices may effect on the reproductive activity of the buffalo bull.

India reigns globally in terms of largest buffalo population, huge buffalo germplasm diversity (12 recognized plus 14 distinct population groups) and the world renowned buffalo breed - Murrah. Buffalo is a triple purpose animal, being suitable for milk, meat and draught. Buffalo can efficiently utilize the roughages and crop by-products into high quality milk suitable for a wide range of dairy products. Buffaloes in India are spread over almost all parts of the country with varying population density, majority (72%) being concentrated in the north and western states where most of the milch breeds of buffaloes are found viz. in Haryana, Punjab, Uttar Pradesh, Rajasthan, Gujarat and Maharashtra. During the last 10 years there has been continuous growth of this species in this region at the rate of about 2.1% per annum as against the average growth rate of approximately 1.0 % in the country. (CIRB, 2014). The water buffalo is ranked highly in the tropics and subtropics since it thrives in hot conditions. In particular, the genus *Bubalis* surpasses the cattle genus Bos in its ability to adapt to the hot, humid areas of muddy and swampy lands; therefore, water buffaloes have special importance in the swamps of Southeast Asia, the marshes of southern Iraq and the valleys of flooding rivers in the Indian subcontinent, as well as near the River Nile in Egypt. It is because of its morphological and anatomical characteristics that the buffalo is so well suited to hot and humid climates and muddy terrain. With this physical adaptation to the tropical and subtropical hot humid conditions, the water buffalo has acquired a reproductive-productive pattern that conforms to the sequential seasonal changes in climate, terrain and vegetation conditions.

EFFECT OF SEASON

The effect of season is both direct and indirect. It affects the animal directly through macro and micro climatic factors. High heat stress during summer is known to depress the libido, semen quality and fertility of breeding buffalo bulls (Pant, 2000). The buffalo has been traditionally regarded as a poor breeder but even then buffalo bulls are capable of breeding

throughout the year with semen quality being variable during the different season of the year where poorer during summer than in winter (Sengupta *et al.,* 1963). Buffalo is a short-day breeder, becoming sexually active in response to decreasing day length in the late summer to early autumn (Arrighi *et al.,* 2010). Photoperiod is an important environmental factor influencing reproduction and sexual activity of buffalo bulls. It was attributed 40% of the seasonal variation of buffalo fertility to the male (Heuer *et al.,* 1987). This Seasonality is influenced by photoperiod, mediated by melatonin secretion. As hormonal fluctuations of the photo-neuroendocrine circuit may have on reproductive efficiency which may be a result of seasonal variation.

In the tropical regions, the quality of semen was observed to be satisfactory during the rainy season, semen collected during November (winter) produced significantly higher conception rate (40.9%) than semen collected in June (summer) (34.0%). Winter and spring are the favorable season for the semen production and hot and hot- humid are the unfavorable season in buffaloes (Tuli, 1984). While In the temperate regions of the world, it has been found that the semen is of better quality during the winter and spring than in summer and autumn (Galli *et al.,* 1993).Where as in the warm and humid tropical Amazon region, the best time to obtain semen is between January and June.

MORPHOLOGICAL AND HISTOLOGICAL CHANGES

Weight of the testis was one of the markers of a possible alteration in androgen status (Simanainen *et al.,* 2008). An initial rise in Follicle Stimulating Hormone (FSH) is results in a proliferation of Sertoli cells, a lengthening of the seminiferous tubules (ST) and an increase in tubule diameter. The increased of the weight, length and width in these months indicated an increase in the physiological activity, with an increased in activity of ST and sperm production (Zicarelli, 1997). The season's variation significantly affected the number of spermatogonia of seminiferous tubules in different stages that showed higher in spring and lower in summer. The mean testicular weights and the mean diameter of the organ were higher especially in moderate months than in hot and cold months. Smaller testicular volumes, together with minor values of tubular diameters might indicate a decrease in spermatogenesis. At winter it showed moderate spermatogenesis and sperm in the lumina

of seminiferous tubules and moderate proliferation of leydig cells in the interstitial tissues between seminiferous tubules. The increase in activity of testes corresponded with an increased and in histological measurement increased in the spermatogenesis production and sperm concentration. The various changes as per months were shown in fig.1 to 6 by the (Al-Sahaf and Ibrahim, 2013) in of Mature Iraqi Bull Buffaloes.

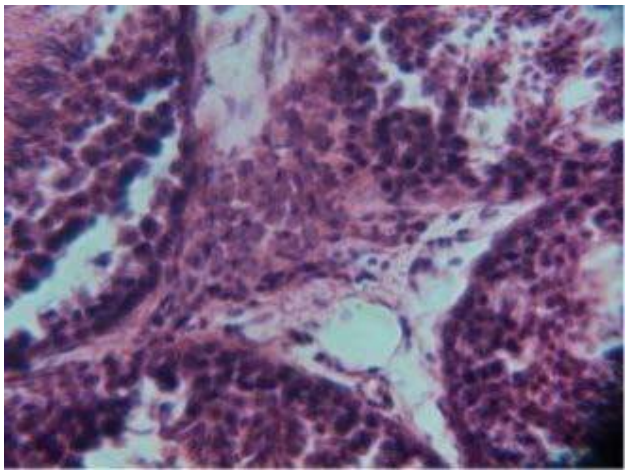


Fig.1: Tests of buffalo in January shows moderate proliferation of leydig cells between seminiferous tubules (⟶) (H and E 40X)

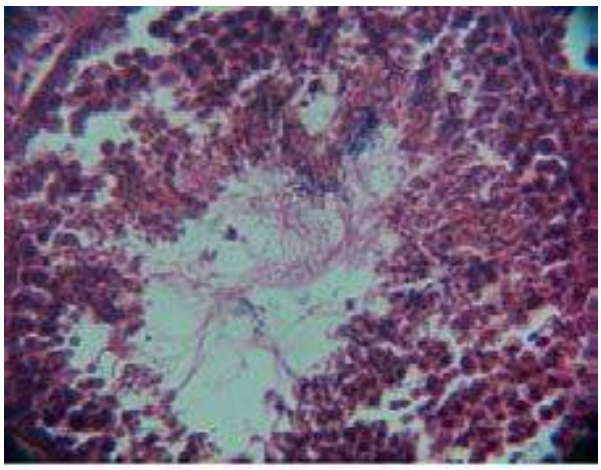


Fig. 2: Tests of buffalo in February shows moderate spermatogenesis and sperm in the lumina of seminiferous tubules (⟶) (H and E 40X)

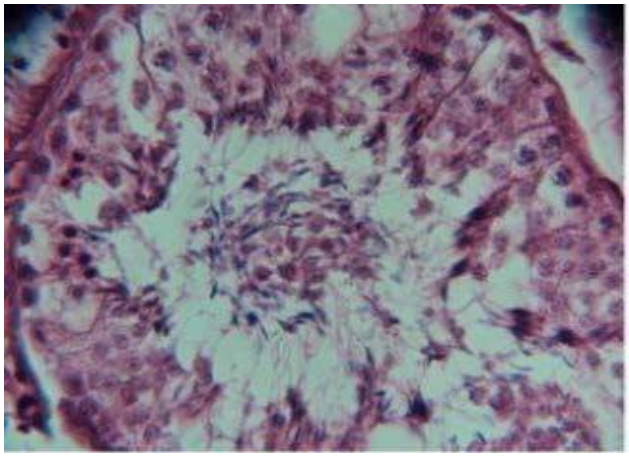


Fig. 3: Testes of buffalo in March shows marked spermatogenesis with spermatogenic cells filled most of seminiferous tubules (H and E 40X)

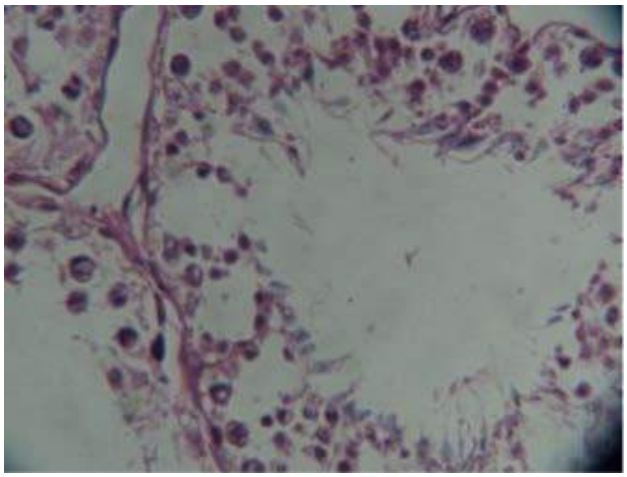


Fig. 4: Testes of buffalo in June shows decreased in spermatogenesis with absence of sperms in the lumina (H and E 40X)

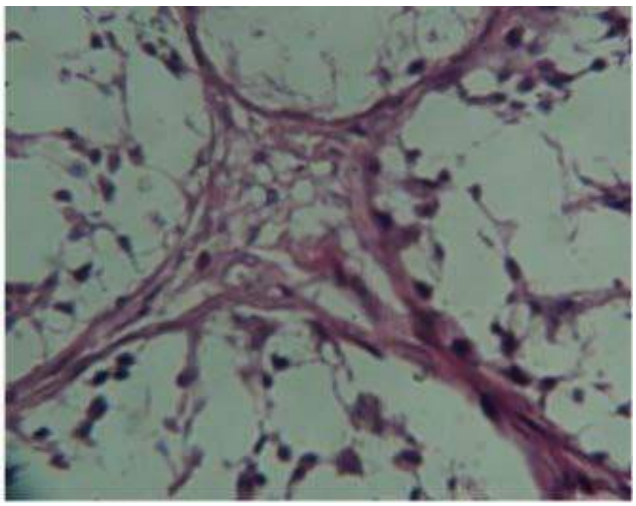


Fig. 5: Testes of buffalo in June shows few leydig cells in the interstitial tissue with decreased in spermatogenesis (H and E 40X)

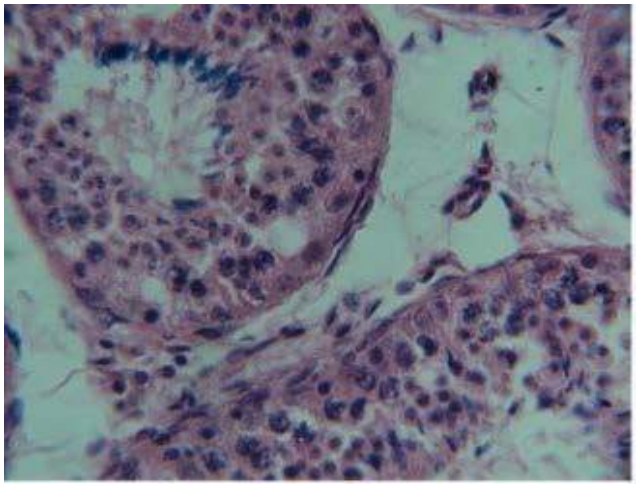


Fig. 6: Testes of buffalo in September complete process of spermatogenesis but moderate number and size of leydig cell (H and E 10X)

Months	Weight (g)	Length (cm)	Width (cm)
Dec	99.32±1.78ab	8.70±0.40b	4.26±0.12b
Jan	106.48±3.86ab	8.88±0.20b	4.17±0.07b
Feb	100.80±1.56ab	9.44±0.23a	4.38±0.12ab
March	98.46±1.43ab	9.17±0.20ab	4.47±0.13ab
April	105.36±1.23a	9.69±0.17a	4.62±0.11a
May	96.08±3.78b	9.38±0.17a	4.53±0.08a
Jun	99.80±0.77ab	9.07±0.14ab	4.43±0.07ab
July	100.16±0.86ab	9.27±0.15ab	4.31±0.07ab
Aug	96.20±1.07b	9.13±0.16ab	4.50±0.06a
Sep	95.20±1.28b	9.28±0.17ab	4.42±0.09ab

Table.1: Monthly changes in the weight in (g), length and width in (cm) of buffalo testis

Months	Diameter of ST X40	Thickness of ST X40
Dec	233.45±4.04c	54.11±1.15c
Jan	235.26±2.30c	56.13±2.31c
Feb	258.24±4.61ab	64.48±3.46b
March	262.68±4.62a	69.13±3.34a
April	270.25±2.88a	75.24±2.89a
May	260.71±5.77a	65.32±1.73b
Jun	253.81±4.04b	57.28±1.70c
July	221.33±5.77d	40.09±2.31d
Aug	219.75±3.46d	38.89±1.74d
Sep	231.17±3.40d	45.12±2.89d

Table.2: Shows diameter and thickness of ST of the testis (milli micron)

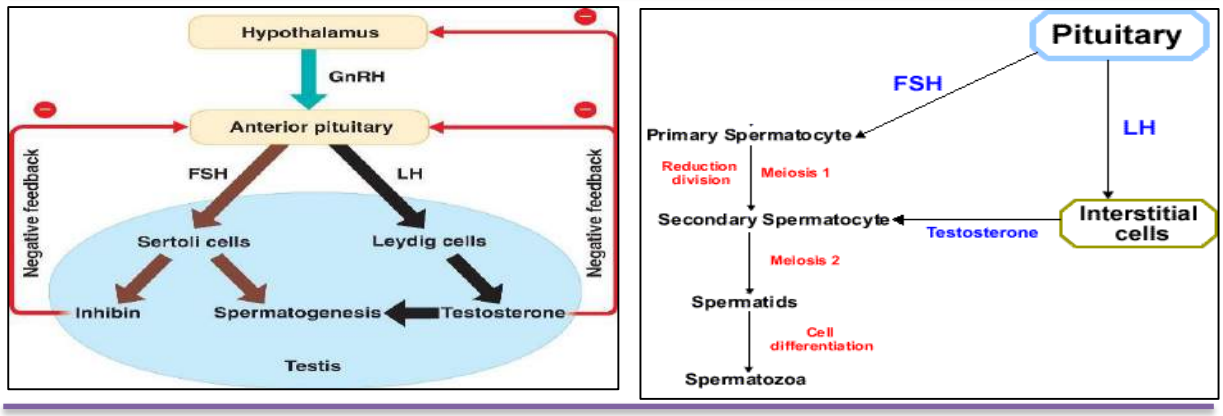
Small different letters that indicated a significant difference between months ($p<0.05$)

The table.1 showed that testicular weight increased ($p<0.05$) significantly during Jan, Apr and March and decreased in Sept and Aug while testicular length and width increased ($p<0.05$) significantly in Apr, Feb and May then decreased in Dec and Jan, respectively. The table.2 Diameter of seminiferous tubules(ST) ($p<0.05$) increased significantly in Apr, Mar and May these increase is a companied by an increase in thickness of ST in the same months. The histometric measures of testes showed that diameter of ST were decreased in hot months, in Aug, July and, Sep.

HORMONAL CONTROL ON SPERMATOGENESIS

Melatonin has strong effect on the regulation of spermatogenesis and blood–testis barrier. Claudin and occludin are the main components of

tight junction proteins, thereby creating an immunologically unique microenvironment for spermatogenesis. Melatonin operates as a hypothalamic-pituitary gonadal axis modulator, via activation of receptors found on the hypothalamic neurons that release GnRH. The increase of temperature lead to decreasing the number of the receptors of (LH) that presents on Leydig cells and then decreasing in testosterone hormone and activity of the testes in hot months (Al- Sahaf and Ibrahim, 2012). An increase in the activity of the testes in moderate and cold months and these activities is regulated by the increases testosterone hormone levels in these months.



NUTRITION

The feeding of the buffalo bulls has an influence on the production and quality of the semen. The feeding management as being followed for growing buffalo calves is followed until they attain a body weight of 350-400 kg. For the growing bulls the diet should contain about 12 (10 to 14) per cent CP and 60 per cent TDN on DM basis up to 15 months of age and attaining 300 to 350 kg weight (Dahiya et al., 2001). DM intake should remain around 3.0 kg per 100 kg body weight as overfeeding may lead to fat deposition and obesity in bulls which reduces libido and vigor. Increase of fat thickness in buffalo males has also been associated with accumulation of fat in the scrotal region which causes an imbalance of temperature exchange and reduction in the semen quality. Moderate to severe nutritional deficiency, especially in rural buffaloes, due to feed shortage and/or poor quality feed leads to delayed puberty in buffalo bulls associated with loss of libido, depressed spermatogenesis and poor semen quality. Significant improvement in semen quality was noticed in mature breeding buffalo bulls given vitamin AD3 and E injection and water splashing at the hotter part of the day in summer season.

MANAGEMENT

Semen quality is affected by vaccination because of immunomodulation in the immunity of bulls (Venkatareddy et al., 1991). The effect of age, body size, body weight, scrotal circumference on the ability of buffalo male to produce semen has long been recognized (Pant et al., 2003). Housing conditions also influence the quality and quantity of semen. Semen collection once a week is an ideal frequency for a young bull. There after two successive ejaculates with a time interval of 30 minutes, twice a week can be collected for harvesting good quality semen. Efforts should be made to create better micro environment around the animal and standardize the shelters. The will include the provision of environmental control devices, increased roof height and provision of shade in open paddocks to protect from radiation effect. The feeding of antioxidants (Zn, Se, Vit. E) during summer can also improve health and fertility of the bull. The increase in feeding frequency and that too in cool hours improves feed intake and production under heat stress. Water intake is closely related to dry matter intake by reducing body temperature through absorbed heat energy.

CONCLUSION

The feeding, housing and better management of the buffalo bulls has an influence on the production and quality of the semen. Existing reports demonstrated that the buffaloes are not seasonal animals. In buffalo bulls, a significant positive relationship between scrotal circumference and semen volume and concentration. As the buffaloes behave like photoperiodic animals their performances is show negative trend with day length. The receptor for hormones play significant role for efficient physiological performance is mainly stimulated by proper light and vice versa. As well as, the level of nutrition with better managemental practices may effect on the reproductive activity of the buffalo bull.

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Dos and Don'ts during Snake Bite

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A bite from a venomous snake can be deadly, and should always be treated as a medical emergency. Even a bite from a harmless snake can be serious, leading to an allergic reaction or an infection. Hence, Snake-bite is an environmental, occupational and climatic hazard in rural and urban areas. Snakes have adapted to a wide range of habitats and prey species. It is therefore a medical problem that has important implications for the nutrition and economy of the countries where it occurs commonly. It is recommended that snake-bite should be formally recognized as an important occupational disease in the South East Asian region. Most of the fatalities are due to the victim not reaching the hospital in time where definite treatment can be administered. In addition people are also not well informed about the occupational risks and simple measures which can prevent the bite. Thus, people need to be educated about the practices to be done

and not done during a snake bite.

Identifying a snake bite

- two puncture wounds
- swelling and redness around the wounds
- pain at the bite site
- difficulty in breathing
- vomiting and nausea
- blurred vision
- sweating and salivating

The bitten area, and immobilization may increase the severity of the damage in this area, but also reduce the total area affected; whether this trade-off is desirable remains a point of controversy. Since the types of snakes vary from region to region, first aid methods also vary.

However, most first aid guidelines agree on the following:

1. Protect the person and others from further bites. While identifying the species is desirable in certain regions, risking further bites or delaying proper medical treatment by attempting to capture or kill the snake is not recommended.
2. Keep the person calm. Acute stress reaction increases blood flow, and endangers the person.
3. Call for help to arrange for transport to the nearest hospital emergency room, where antivenom for snakes common to the area will often be available.
4. Make sure to keep the bitten limb in a functional position and below the person's heart level so as to minimize blood returning to the heart and other organs of the body.
5. Remove any items or clothing which may constrict the bitten limb if it swells (rings, bracelets, watches, footwear, etc.)
6. Keep the person as still as possible.

- numbness in the face and limbs

FIRST AID

Snakebite first aid recommendations vary, in part because different snakes have different types of venom. Some have little local effect, but life-threatening systemic effects, in which case containing the venom in the region of the bite by pressure immobilization is desirable. Other venoms instigate localized tissue damage around

India developed a national snake-bite protocol in 2007 which includes advice to:

- Reassure the victim who may be very anxious Immobilize the whole of the patient's body by laying him/her down in a comfortable and safe position and,

especially, immobilize the bitten limb with a splint or sling.

- Any movement or muscular contraction increases absorption of venom into the blood stream and lymphatics [level of evidence E].
- If the necessary equipment and skills are available, consider pressure-immobilization or pressure pad unless an elapid bite can be excluded (See Annex 4). In Myanmar, the pressure pad method has proved effective in victims of Russell's viper bite (Tun Pe *et al.,* 1995) [level of evidence O].
- Avoid any interference with the bite wound (incisions, rubbing,vigorous cleaning, massage, application of herbs or chemicals) as this may introduce infection, increase absorption of the venom and increase local bleeding (Bhat, 1974) [level of evidence O].

Release of tight bands, bandages and ligatures: Ideally, these should not be released until the patient is under medical care in hospital, resuscitation facilities are available and antivenom treatment has been started (Watt et al., 1988).

DO NOT

- Do not use a tourniquet.
- Do not cut into the snake bite.
- Do not use a cold compress on the bite.
- Do not give the victim any medications unless directed by a doctor.
- Do not raise the area of the bite above the victim's heart.
- Do not attempt to suck the venom out by mouth (CDC, 2012).
- Do not use a pump suction device. While these devices were formerly recommended for pumping out snake venom, it is now believed that they are more likely to do harm than good.
- Do not give the person anything to eat or drink. This is especially important with consumable alcohol, a known vasodilator which will speed up the absorption of venom.

  Do not attempt to kill the snake as far as possible - as this may be dangerous. However, if the snake has already been killed, it should be taken to the dispensary or hospital with the patient in case it can be identified. However, do not handle the snake with your bare hands as even a severed head can bite!

Washing the bite with soap and water is recommended by many organizations. Australian recommendations for snake bite treatment recommend against cleaning the wound. Traces of venom left on the skin/bandages from the strike can be used

in combination with a snake bite identification kit to identify the species of snake. This speeds determination of which antivenom to administer in the emergency room.

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ANTIVENOM

Until the advent of antivenom, bites from some species of snake were almost universally fatal. Despite huge advances in emergency therapy, antivenom is often still the only effective treatment for envenomation. Antivenom is made by injecting a small amount of venom into an animal (usually a horse or sheep) to initiate an immune system response. The resulting antibodies are then harvested from the animal's blood. Antivenom is injected into the person intravenously, and works by binding to and neutralizing venom enzymes. It cannot undo damage already caused by venom, so antivenom treatment should be sought as soon as possible. Modern antivenoms are usually polyvalent, making them effective against the venom of numerous snake species. Pharmaceutical companies which produce antivenom target their products against the species native to a particular area. Although some people may develop serious adverse reactions to antivenom, such

as anaphylaxis, in emergency situations this is usually treatable and hence the benefit outweighs the potential consequences of not using antivenom. Giving adrenaline (epinephrine) to prevent adverse effect to antivenom before they occur might be reasonable where they occur commonly. Antihistamines do not appear to provide any benefit in preventing adverse reactions.

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Oral Drug Delivery System and Their Advancement

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Drug delivery is the method or process of administering a pharmaceutical compound to achieve a desirable therapeutic effect in humans or animals. Drug delivery technologies modify drug release profile, absorption, distribution and elimination for the benefit of improving product efficacy and safety, as well as patient convenience and compliance. Drug Delivery System can be defined as a formulation or a device that enables the introduction of a therapeutic substance in the body and improves its efficiency and safety by controlling the rate, time and place of release of drugs in the body. A drug delivery system comprising of a drug formulation, a carrier (medical device or dosage form/technology to carry the drug inside the body) and a mechanism by which the drug is released into the body. An effective drug delivery system eliminates loss of drug while passing through biological barriers and carries it to the target to achieve the desirable therapeutic effect.

What is the need for the advanced drug delivery system?

The drugs are normally not required or essential for the life of healthy organism, so they are considered as foreign substance (xenobiotic) and ultimately the body tries to eliminate them by various natural passive or active processes. Conventional drug delivery involves the formulation of the drug into a suitable form, such as a compressed tablet for oral administration or a solution for intravenous administration. So the administered drug should face various biological barriors and catabolic enzymes before it reaches its target place. Some orally administered drugs are largely ionized and so absorbed only in a pH specific site or can be destroyed in acidic or alkaline pH (pH sensitive), host enzymes can destroy nearly all the orally administered protein drugs. It increases amount of drug to be administered to reach its therapeutic concentration at its target site. Some drugs are low in their margin of safety and can produce toxic effect well before its

therapeutic effect. A drug may be life saving but poor pharmacokinetic profile will prevent its usage. This necessitates the advanced drug delivery system to improve therapeutic efficacy, targeted action, reduce the loss during transport in the biological system with no or very less adverse effects.

Principles of drug delivery system

A good drug delivery system should aims to produce maximum therapeutic benefits with minimum toxicity, it should not be recognized by the immune system and the drug should be delivered at the targeted site to avoid toxicity to the other normal cells. Controlled release or phased release or sustained release is important for the drugs with low bioavailability and less margin of safety. Such drugs should be released to the target in a controlled manner to get steady state concentration for prolonged period of time. Conventional drug delivery system can be classified into non-invasive and invasive, the former includes oral, sub mucosal, sub lingual, nasal, ocular, otic , pulmonary (inhalation), topical, transdermal, colorectal, vaginal, urethral and the latter includes parenteral routes like intra-venous, intra-muscular, subcutaneous, intra-dermal, intrathecal, epidural, intragastric/intraruminal. Conventional drug delivery system developed to increase bioavailability of the drug but one should consider that, although it is one of the factors which influence the therapeutic efficacy of the drug, it lacks the targeted, sustained drug delivery.

Advanced Drug Delivery System

Advancement in drug delivery system viewed to develop more precised drug delivery system which targets and releases the drug only at the site of requirement. It can be of passive targeting which uses the passive mechanisms like phagoctosis by reticulo endothelial cells, M-cells, endocytosis, micronization for trans or intercellular passage and active targeting which include, Liposome, Microspheres, Drug- Protein conjugates, Erythrocytes, Dendrimers, Nanoparticles, Nanofibers, Nanotubes, Vector based drug delivery etc.

Recent advances in the oral drug delivery system:

1. **Muco adhesive buccal drug delivery (Thin film drug delivery/ dissolving film/oral drug strip)**

In this system the drug formulation adsorbed in to the thin film of polymers which rapidly dissolves when it contacts the mucosa and releases the drug. This is used for the OTC drugs which have the high oral absorption profile. Different buccal delivery products have been marketed or

are proposed for certain diseases like trigeminal neuralgia, Meniere's disease, diabetes, and addiction. This method also having the scope of delivers the oral vaccines.

2. Osmotic Controlled Release Oral Delivery System (reservoir system)

Osmotic controlled drug delivery system, deliver the drug in a large extent and the delivery nature is independent of the physiological factors of the gastrointestinal tract and these systems can be utilized for systemic as well as targeted delivery of drugs. Osmotic Pump Controlled Release Preparation is a novel drug delivery system with eternally drug delivery rate as characteristic and controlled with the osmotic pressure difference between inside and outside of the semipermeable membrane as drug delivery power for controlled delivery of active agents. Basically it consists of an osmogen (osmotic agent), a wicking agent to draw water inside, covered by a rate limiting membrane, coated by a flux regulator and a pore forming agent (after contact with fluid leaches out and forms pore) for the delivery of drug in a controlled manner stated as zero order release of drug. Once the tablet comes in contact with the aqueous environment, the water-soluble component dissolves and an osmotic pumping system can activate. Subsequently, water diffuses into the core through the micro porous membrane, setting up an osmotic gradient and thereby controlling the release of drug. Slight modification on this drug delivery system can make site specific drug delivery. e.g. Enteric coating can be used for the colon targeted drug delivery.

3. Matrix System

In matrix systems the drug homogeneously distributed within the polymer is dissolved, dispersed or dissolved and dispersed in order to achieve controlled drug release or involves the direct compression of blend of drug, retardant material and additives to formulate a tablet in which the drug is embedded in a matrix of the retardant. Alternatively drug and retardant blend may be granulated prior to compression. These systems present several advantages as easy-manufacture and low cost, lower risk of dose dumping and the possibility of improvement of aqueous drug solubility. Besides, drug-polymer interactions can occur and bring benefits in terms of mechanical properties such plasticizing effect. The materials most widely used in preparing matrix systems include both hydrophilic and hydrophobic polymers. Commonly available hydrophilic polymers

include Hydroxypropylmethylcellulose (HPMC), Hydroxypropylcellulose (HPC), Hydroxyethyl cellulose (HEC), Xanthan gum, Sodium alginate, Poly (ethylene oxide) and cross-linked homopolymers and copolymers of Acrylic acid. the matrix drug formulation start releasing the drug when contacts the fluid, drug outside matrix leaves out first by forming pore and it make the channel for the drug in deep layer to come out.

4. Phased Drug Delivery

Matrix system can be a monolayer or multilayer (mixture of different polymers) which explains the time dependant drug delivery (fast and slow release).multi layer matrix system may contain different type of drug formulations which can be released at different time intervals (e.g. Verelan PM ™). Capsules contains the drug mixed with hydrophilic and hydrophobic polymers first one dissolves, releases the drug immediately and hydrophobic polymers start releasing the drug after passing the particular time interval. Conversely it may contain a drug core covered by semi permeable membrane which allows high drug loading this eliminates the disadvantage of conventional matrix system.

4. Gastro Retentive Delivery

Gastro retentive systems can remain in the gastric region for several hours and hence significantly prolong the gastric residence time of drugs. Prolonged gastric retention improves bioavailability, reduces drug waste, and improves solubility for drugs that are less soluble in a high pH environment. It has applications also for local drug delivery to the stomach and proximal small intestines. Gastro retention helps to provide better availability of new products with new therapeutic possibilities and substantial benefits for patients. Several techniques, including floating, swelling, inflation, and adhesion have been explored to increase the gastro-retention of dosage forms. The floating drug delivery system and bioadhesive drug delivery are widely used technique for gastro-retention. The floating systems in particular have been extensively researched, mainly because it does not adversely affect the motility of GI tract. Other types of gastro retentive systems are Gas generating system, raft forming system, low density system, bioadhesive system, hydro dynamically balanced system, swelling system, high density system (hydro gel) and magnetic system.

5. SMEDDS

Self Micro Emulsifying Drug Delivery System (SMEDDS) employs drug intrinsic activity known as ouzo effect, is oil-in-water micro emulsion that formed when strongly hydrophobic oil mixed with water miscible solvents like ethanol. SMEDDS formulations are isotropic mixtures of an oil, a surfactant, a co-surfactant (or solubilizer), and a drug. The basic principle of this system is its ability to form fine oil-in-water (o/w) micro-emulsions under gentle agitation following dilution by aqueous phases (i.e., the digestive motility of the stomach and intestine provide the agitation required for self-emulsification in vivo in the lumen of the gut). This spontaneous formation of an emulsion in the gastrointestinal tract presents the drug in a solubilized form, and the small size of the formed droplet provides a large interfacial surface area for drug absorption. It is more stable than other emulsions and also has some commercial applications like increased bioavailability and reduced production cost and dose of the drug.

Hardness of Water and Its Impact on Animal Health

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Water is required for digestion and metabolism of energy and nutrients; transport in circulation of nutrients and metabolites to and from tissues; excretion of waste products (via urine, feces, and respiration); maintenance of proper ion, fluid, and heat balance; and, as a fluid and cushioning environment for the developing fetus (Murphy, 1983). The quality of water matters much as the quantity for our livestock health and well being. The water requirement per unit of body mass of a lactating dairy cow is much important for its whole lactation yield. This is because the yield of milk secretion is composed of 87% water.

WATER REQUIREMENT AND ITS IMPORTANCE

Total body water content of the bodies of adult dairy cattle ranges between 56 and 81% of body weight depending upon stage in the lactation cycle (Murphy, 1983). Loss of only about 20% of total body water is fatal. Cattle and buffalo generally consumes 35-45 litters a day. Cows generally spend 10-15 minutes in drinking water. The Dairy NRC 2001 suggests using the Murphy et al. (1983) equation to predict water intake of lactating dairy cows as it includes many of the major factors affecting water intake. Drinking water intake (kg/d) = 15.99 + (1.58 x DMI, kg/d) + (0.9 x milk, kg/d) + (0.05 x Na intake, g/d) + (1.20 x min temp C) (Murphy et al., 1983).

Research on drinking water intake of dry cows is limited. Holter and Urban (1992) identified dietary variables of DM and crude protein (CP) in the following equation as factors affecting water intake of dry cows: Free water intake (kg/d) = -10.34 + (0.2296 x dry matter % of diet) + 0.2212 x DMI (kg/d) + (0.03944 x (CP% of diet) (Holter and Urban, 1992).

Table 1: Estimates of daily consumption of water (l/d) for various livestock group:

Livestock species	Daily water consumption(l/d)
Dairy cattle	20-70
Buffalo	40-70
Growing cattle	10-20
Bulls	30-60
Sheep and Goat	2-5
Horse	25-50
Camel	25-35

HARDNESS OF WATER

Water hardness is the traditional measure of the capacity of water to react with soap, hard water requiring considerably more soap to produce a lather. Hard water often produces a noticeable deposit of precipitate (e.g. insoluble metals, soaps or salts) in containers, including “bathtub ring”. Hard water is due mainly to high concentrations of calcium and magnesium; but, iron, manganese, strontium and aluminum also contribute Water containing 290 ppm total hardness had no effect on milk production, weight gain, or water consumption. Temporary hardness is a type of water hardness caused by the presence of dissolved bicarbonate minerals (calcium bicarbonate and magnesium bicarbonate). When dissolved these minerals yield calcium and magnesium cations (Ca2+, Mg2+) and carbonate and bicarbonate anions (CO32-, HCO3-). However, unlike the permanent hardness caused by sulfate and chloride compounds, this "temporary" hardness can be reduced either by boiling the water, or by the addition of lime (calcium hydroxide) through the softening process of lime softening.Boiling promotes the formation of carbonate from the bicarbonate and

Table 2: Relation of water alkalinity with the water hardness:

Guide to the Use of Water Alkalinity and Hardness for Livestock and Poultry	
Alkalinity less than hardness	Indicates the presence of salts of calcium and magnesium are more likely to be sulfates (instead ofcarbonates).
Alkalinity equal to hardness	Indicates the presence of mostly salts of magnesium and calcium.
Alkalinity greater than hardness	Indicates the presence of sodium and potassium salts in addition to calcium and magnesium.

precipitates calcium carbonate out of solution, leaving water that is softer upon cooling. Permanent hardness is hardness (mineral content) that cannot be removed by boiling. When this is the case, it is usually caused by the presence of calcium sulfate and/or magnesium sulfates as well as the chloride of calcium and magnesium in the water, which do not precipitate out as the temperature increases. Ions causing permanent hardness of water can be removed using a water softener, or ion exchange column.

Table 3: Water hardness on scale

Classification	Hardness in mg/L	Hardness in mmol/L	Hardness in dGH/°dH	Hardness in gpg
Soft	0–60	0–0.60	0.3-3.00	0-3.50
Moderately hard	61–120	0.61–1.20	3.72-6.75	3.56-7.01
Hard	121–180	1.21–1.80	6.78–10.08	7.06-10.51
Very hard	≥ 181	≥ 1.81	≥ 10.14	≥ 10.57

INFLUENCE ON LIVESTOCK HEALTH

Although hardness has no effect on water safety, it can result in the accumulation of scale (mostly magnesium, manganese, iron, and calcium carbonates) in water delivery equipment. The clogging of pipes and drinkers can lead to reduced water consumption and its associated problems. Patterson et al. (2003) showed a quadratic decline in average daily gain (ADG), dry matter intake (DMI), and gain/feed in confined steers as water sulfate increased from approximately 400 to 4700 mg/L (ppm). High sulfate water can have a deleterious effect on cattle performance. Cattle consuming water with a sulfate concentration >3,500 ppm had decreased feed and water intake. However, no effect on feed and water intake or growth was seen when cattle consumed water up to 2,500 ppm of sulfate for 90 days (Digesti, et al., 1976). Ingestion of high-sulfate water causes increased ruminal H2S generation (Loneragan et al. 1997). Because of the lower ruminal pH, ruminants consuming high-grain diets are at higher risk for sulfur-associated PEM than those consuming forage-based diets. In addition to increasing the potential for sulfur-associated PEM, high concentrations of sulfates can also contribute to copper deficiencies in ruminants (Wright et al. 2000; Wright and Patterson 2005). A reduction in copper status can have a negative impact on the health, growth performance, and reproductive function of livestock. Excessive levels of sodium (Na) have a

diuretic effect. Studies indicate that a sodium level of 50 mg/L (ppm)is detrimental to poultry performance if the sulfate level is also 50 mg/L or higher and the chloride level is 14 mg/L or higher (Carter 1996). In ruminant animals and horses (which have a cecum), bacteria reduce nitrate to nitrite, which enters the bloodstream and interferes with the ability of hemoglobin to carry oxygen. Animals may die due to lack of oxygen. Symptoms of nitrate poisoning include labored breathing, a blue muzzle, trembling, lack of coordination, and an inability to stand.

Production and reproduction were unaffected in dairy cattle consuming water containing 86 ppm nitrate-nitrogen for almost two years in a Wisconsin study (Kahler, et al., 1974), but some reproductive performance decline (increased services per conception and longer calving interval) was noted in the third year. There are various means to get rid of the temporary hardness of water by boiling, adding washing soda and filtering it through filter or fine cloths. Permanent hardness can be removed by ion exchange, reverse osmosis and calagon (sodium aluminium silicate) treatment. Water should be under permissible limits of salts and alkalinity.

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Pasture Development and Animal Sustainability

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Pasture is land with vegetation cover used for grazing of livestock as part of farm or in ranching or other unenclosed pastoral systems or used by wild animals for grazing or browsing. Prior to the advent of factory farming, pasture was the primary source of food for grazing animals such as cattle and horses (Roy, 2009). It is still used extensively, particularly in arid regions where pasture land is unsuitable for any other agricultural production. In more humid regions, pasture grazing is exploited extensively for free range and organic farming. Pasture growth can consist of grasses, legumes, other forbs, shrubs or a mixture. Soil type, minimum annual temperature, and rainfall are important factors in pasture management. This spreads over area of 12 million ha and about 3.94% of the geographical area of the country. The distribution of pasture lands are mostly noticed in the states like Himachal Pradesh (36.44%), Sikkim (13.31%), Karnataka (6.54%), Madhya Pradesh (6.35%), Rajasthan (5.39%), Maharashtra (5.11%) and Gujarat (4.49%) (Kundu*et al.*, 2005).

PASTURE MANAGEMENT

Management is the key to healthy, productive pastures. Controlled, rotational, or management-intensive grazing has increased forage production for many producers. Skillfully using livestock to harvest forages leads to improved soil fertility, diverse, dense, and useful pasture ecology, and an extended grazing season. Fertile soil and productive pastures, in turn, support healthy animals.

Well-managed forage systems contribute to an operation's sustainability in several important ways:

1) Lands most susceptible to erosion (or otherwise unsuitable for annual crops) can be maintained as permanent sod.
2) Land used for row crops benefits from a year or more in pasture as part of a crop rotation plan. The life cycles of annual weeds and other

crop pests are interrupted during the pasture years of the rotation.

3) Soil fertility improves as the content of organic matter increases under good grazing management.
4) Soil structure improves over time as compaction and hardpan is reduced.
5) Ruminants (cattle, sheep, deer, goat) thrive in a better balanced agro-ecosystem and produce milk, meat, and fiber from grasses that cannot be digested by humans. Livestock eat excess plant materials while animal wastes contribute nutrients for plant growth.
6) Marketing meat, milk, fiber, and other animal products can diversify producer income.

The grazing activity is mainly dependent on the availability of the grazing resources from pastures and other grazing lands viz. forests, various trees, crops and groves, cultivable wastelands and fallow land. India contributes 15% of the world livestock population while it has 2% of world's geographical area and cropping area under fodder production is about 8.3 million ha (4.4%) (Roy, 2009).

The managemental practices of grassland and pasture include the following steps:

A) Selection of the plant species.

B) Establishment and renovation of pasture and grassland.

C) Management of grasslands and pastures.

A) SELECTION OF PLANT SPECIES

The selection of plant species for the pasture will not only depend on its nutritive value but also on several factors like purpose of the pasture soil , climate of the area and system of pasture which is being followed.

B) ESTABLISHMENT OF PASTURE

1) Land clearing- The bushes of inedible and poisonous plant type should be destroyed.

Clearing can be done by mechanical, chemical or by other methods. Mechanical- The big bushes can be removed either using hand tools or machines. The use of machines like tractors is limited to the plains. Controlled burning- Benefits of burning are: (1) Removal of old growth (2) Partial control of unwanted bushes, diseases and pests. Limitations of burning are: (1) increased erosion (2) Injury to other vegetation like trees (3) Loss of organic matter and nitrogen (4) Exposure of soil. Chemical application- Some of the herbicides used are 2, 4-D; 2, 4, 5-T; and Dicamba. The concentrated mineral acids can be used to kill the undesirable biomass.

2*) Seeding and planting of desired species:*

The season of the seeding or planting vary from region to region depending on the climatic factors. The quantity of grass seed and legume should be calculated keeping in view the desired grass: legume ratio in the pasture and weight of the seed. While seeding, should be taken that the seeds are dormant. The seed treatment against various insects, pests and diseases may be done prior to sowing. The seeding can be done either through broadcasting or with the help of a seed drill. The grass seeds are usually broadcasted while legume seeds are sowed in rows at a distance of 20-25cm. Although seeding is easier transplantation of seedling is also practiced. Some species of grass/legume can be propagated by root slips or stem cuttings.

3) Application of fertilizer:

Fertilizer application is required in the eroded and low fertility soil and is necessary for the boosting of initial growth of grass/legume mixture, at the same time to correct the acute deficiencies of nutrients in the soil. At first, a basal application of 5 tones of Farm Yard Manure (FYM) along with 40 kg N and 20 kg P_2O_5 per hectare land is to be mixed in the soil. After 1month of establishment a top dressing with another 20 kg N/ ha is given. In subsequent years mixture of 20 kg N + 20 kg P_2O_5 / ha is beneficial after shower of rain.

4) Care of newly established grassland:

The newly seeded or planted forage species are susceptible to the environmental changes. These are dominated by the precursors of earlier biomass it the initial phase. The weeding is therefore necessary, unwanted grasses should be removed as well as re-growth occurring as harmful bush should also be removed. The birds eat the cotyledons therefore a watch on the bird is required. The entry of the animals and grazing on the pasture should be avoided during first year of growth, for this fencing can be provided. The pasture should be irrigated during winter and summer depending upon the irrigation facility and intensity of rain in the area.

5) Establishing pasture with partial cleaning:

For establishment following measures can be adopted-

1) Removal of the thorny and harmful bushes and undesired toxic plant species.
2) Seeding and planting of the desired species of legumes.
3) Application of the fertilizers.

4) The proper care of the pasture to maintain suitable grass – legume ratio of the herbage.
5) Regular removal of the unwanted plant species.
6) In case the legumes are not present in suitable ratio (1: 1), reseeding or re- planting of legume in pasture is required.

C) MANAGEMENT OF PASTURE

The management of the pasture and grassland is necessary to obtain maximum livestock production and at the same time conserving the fertility of the land along with soil conservation.

1) Proper harvesting schedule of grass-legume pasture- The harvesting schedule of the pasture may be fixed on the basis of agro – climatic conditions and the type of vegetation in the pasture. The intensity of harvesting also influences the total yield of the forage mixture and the longevity of the pasture. In the monsoon fed area of the northern India, 2-3 cutting can be done, in areas with rainfall throughout the year 6-8 cutting is required and in area where irrigation facility is present 8-10 cutting is required.

2) Renovation of the pasture – regular care should be taken to correct the grass-legume ratio still after every 3 years the renovation program should be implemented.

3) Managing livestock on pasture- the herbage production of the entire pasture and the intake of herbage by the animal together determine the capacity of the pasture. The mixing of animals of different feeding habit together while grazing results in efficient utilization of herbage. The practice of grazing buffaloes, cows, sheep and goat together is a common practice in India. The cows which clip are followed by buffaloes in the pasture. The sheep graze at ground level follow the cow and buffalo, while goat browse on bushes. Overcrowding and overstocking should be avoided.

The grazing on the pasture should be done on the following basis –

a) Stocking rate and Carrying capacity of the grassland- stocking rate is the amount of land located to each animal unit for the entire grazable period of the year. Carrying capacity is defined as the maximum no. of animals that an area of land support on the sustainable basis, expressed as stocking rate in ha / animal unit.

b) Growth rate of the herbage.

c) Type of animals.

FUTURE THRUST

Forage production must be taken up as a first management goal and 25% of the forest area should be put under trees with regulated accessibility to the farmers. Growing forage grasses and fodder trees along village roads and panchayat lands Growing forage grasses and fodder trees on terrace risers/bunds- a non competitive land use system Conservation of native biodiversity for future improvement. Breeding biotic, abiotic, stress tolerant cultivars of forage species suitable for area not used under arable agriculture. Participatory techniques to be adopted to identify the problems and to carry out the improvement programme. In-depth studies on migratory graziers Forage based agro forestry systems Controlled grazing to maintain the productivity of pasture (grazing should be allowed as per carrying capacity).

CONCLUSIONS

It may be concluded that the forage production situation in the region is very alarming and corrective measures have to be taken to improve the same. Delineation of the area for various agricultural activities should be created and adhered under legislation. A comprehensive grazing policy needs to be formulated for the entire zone. Both grazing and forage cultivation has to be considered complementary to each other and simultaneous efforts are required to improve the both. Fodder tree improvement programmes for higher leaf fodder have to be initiated. In order to improve the grasslands, the grassland management needs to be considered holistically promoting the interaction between grassland, livestock and the grazing communities, so that this vast natural resource can serve human society substantially, more particularly grazing communities of the region.

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Management of Breeding Bull

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Breeding bulls require special care and management for production of quality semen. The bull rearing and management should start from calf itself. If sufficient care is not taken from the calf itself growth rates are affected and they mature lately leading to poor breeding.

Figure: Adult breeding bull Bull calf rearing

Immediately after selection of bull calves they should be separated from rest of the bull calves and transferred to separate calf pens for taking special care towards their feeding and management. This will also help in preventing development of vices like naval sucking; reduce the incidence of calf scours and parasitic infestation. The calves should be fed individually according to their body weight. Within two hours of their birth they are fed with colostrum so that they get resistance to diseases till they are vaccinated. Fresh water should be provided in the calf pens.

Table 1: Milk feeding schedule

Age in Days	Colostrum/Milk (colostrums upto 5 days)
1-4	1/10th of the body weight
5-30	1/10th body weight
31-60	1/15th body weight
61-90	1/20th body weight

Feeding concentrates to the young calves can be commenced as early as 7-10 days. The calves can be trained slowly to take concentrate feed. The calf feed should contain more protein about 20% and 70%

total digestible nutrients. The calf feed should contain led fiber. By seventh month the bull calf should be able to take 1 Kg of concentrate feed. Green fodder can be offered to the calf from second month onwards slowly.

Table 2: Concentrate feed requirement

Age in Months	Amount of concentrate feed to be given
2	150 grams
3	300 grams
4	500 grams
5-6	750 grams
7	1 Kilogram

Bull calves should get sufficient quantity of vitamin A and minerals and trace elements. The basic preventive vaccinations for contagious diseases like foot and mouth, Rinderpest, should be done before the calf leaves to the bull rearing stations.

Table 3: Vaccination schedule of young calves:

Age	What is to be done?
10-15 days	Deworming (continue every month up to 4 months)
2 Months	FMD Vaccination
3 Months	Booster dose of FMD. Repeat every 6 months
4-6 Months	Rinderpest vaccination with tissue culture vaccine
6 Months	H.S. and B.Q. vaccination

HOUSING OF BULLS:

Bulls should be provided with comfortable bull sheds with free flow of air and ventilation. The sheds should be maintained in clean and hygienic way. The standard floor space for an average bull is 12 m^2 loose boxes. Each loose box should be provided with a run of 24 m^2. Provision of cross ventilation, feeding manger and water trough should be made. It is not always possible to provide separate boxes to bulls for economy reasons etc. The bulls can be tied in two rows face to face with strong railings in between them. For buffalo bulls loose box type is preferred since they have tendency to fight each other and have a strong sense of revenge. In general the following points should be taken care in construction of bull sheds.

- The floor should be hard and non slippery.
- Proper drainage for urine, waste water and dung should be provided.
- Protection against strong winds during summer and winter.
- Fresh and clean drinking water should be provided.
- Plant trees around the bull sheds to keep them cool in summer season.
- Bulls should be properly controlled well and partitions from bull to bull to avoid fighting.

- The feed mangers should have an overhead semi circular shape to avoid spillage of feed while feeding.
- The bull sheds should be nearer to the semen collection yards and exercising rings.
- The drainage from the bull sheds should be connected to a slurry tank for usage in the fodder plots.

FEEDING OF ADULT BULLS:

Bulls of all breeds grow up to age of 5 years of age and during this period they need good growth promoting rations. Bulls need 2% of dry matter of their body weight and 15-18% of digestible crude protein.

Table 4: Nutritional requirement of breeding bulls in semen collection

Live weight (Kg)	DCP (Kg)	TDN (Kg)	Carotene (Mg)	Calcium (gm)	Phosphorous (gm)
400	0.38	3.6	45	9	9
500	0.45	4.5	55	11	11
600	0.53	5.4	66	13	13

Bulls should be fed twice a day both morning and evening dividing the daily ration into two halves. Normally a bull weighing about 600 Kg body weight require about 12 Kg of dry matter which should be met 50% by green grass 25% by concentrates and 25% dry fodder. A mineral and vitamin mix should be offered that contains adequate calcium, phosphorus, and vitamin A. A standard mineral mix would be 40% dicalcium phosphate, 20% limestone, 30% trace mineral salt, and 10% selenium 90 (mg/lb) premix. Quality green forages should provide enough vitamin A. If forages are weathered and/ or of low quality, an intramuscular injection of 3 million IU of vitamin A is advisable. A vitamin A injection might also be considered with corn silage-based diets.

Other managemental practices

Identification of bulls

Bulls need proper identification. Young calves can be tattooed inside of the ear. When it is transferred to bull rearing stations a good flexible plastic ear tag can be applied so that the number can be seen from a distance. The number of the bull can be written boldly with a permanent marking pen on the plastic tag. Bulls can also be cold branded on the rump. But it is not suitable for buffalo bulls.

Exercise

To keep the bulls in good condition regular exercise is needed. It keeps the bulls active in semen collection. The exercise can be given with an exercise ring in the morning hours. The bulls also can be left in the paddocks. Exercise also prevents over growth of the hooves. Bulls

need 1-2 hours of exercise at least 3-4 times in a week to keep them active.

Growth rates

Monitoring of the growth rates is essential particularly for young bulls. The bulls should be weighed once in a month and the growth chart should be drawn and studied. Along with the body weight the girth and the height at withers also should be measured.

Scrotal measurements

Should be taken once in a month with a tape and recorded. This can be taken on a warm day or keeping the bull in the sun till the scrotum is well relaxed. Regular grooming of bulls should be done with a stiff brush to remove the loose hairs and scales from the body. This helps to keep the bull clean. A coir brush can be used for this purpose and brushing should be done against the hairs first.

Hoof trimming

Bulls constantly tied on hard floors tend to develop overgrown hooves. Overgrown hooves reduce the mobility and the service ability of the bull. Hoof trimming requires skill and proper control of the bull in a special trevis. A trained person and proper equipment is necessary. Cleaning of bulls helps to reduce contamination of semen with dirt, loose hairs and dung. The bull should be washed with forced water and dried. The perennial region and thighs should be washed thoroughly by scrubbing with a hard brush. Providing bedding to the bull also helps in keeping them clean and saves much time in washing.

Dressing of the prepuce of bulls

Bulls having long preputial hair needs trimming periodically. Otherwise dirt and dung adhere to the hairs and become a source of infection contaminating the semen also at the time of semen collection. But it should be kept in mind that the hairs should not be trimmed too close to the prepuce. Close trimming irritates and the bulls tend to masturbate. As such the hairs should be trimmed leaving 1-2 cm length.

Disinfection of sheds and mangers

Once in way the mangers should be cleaned and whitewashed with lime to keep them clean. Around the bull sheds insecticides also should be sprayed to control ticks and other vectors. The bull sheds also should be cleaned daily with disinfectant solution. At the entry points disinfectant solution also should be provided to make all the visitors coming dip their feet and enter onto the bull sheds. As a precaution it is better not to allow visitors into the bull shed as it disturbs the routine and they carry infection.

Treatment of sick animals

Sick animals should be identified and removed to the sick bull shed for proper treatment. Clinical sheets should be maintained noting all the symptoms, treatment and any investigations done.

Screening of bulls against contagious diseases

Bulls maintained for semen collection should be free from al contagious diseases. They should be regularly screened for Brucellosis, Tuberculosis, John's disease and Trichomoniasis. Positive reactors should be culled and disposed off.

Brucellosis: Once in 3 months

T.B, John's disease: Once in a year

Trichomoniasis:As and when suspected

All the new entrants should be tested and mixed only if they are free from contagious diseases.

QUARANTINE OF BULLS

New entrants particularly bulls purchased from outside areas other than organized farms should not be mixed with the bull in the bull station immediately. They should be kept in quarantine for 2months and all the tests should be completed and only bulls free from above diseases should be allowed into the bull sheds.

Training of young bulls in semen collection

The bulls after selection at 14-18 months of age should be trained for semen collection in the bull rearing stations. The young bulls should be left in the paddocks in groups and watched from a distance. Generally they mount on each other, sniff the perineum and sheaths of other bulls. When this observed in the paddocks the bulls should be brought to the semen collection yard and trained in semen collection. It is preferable to train the bulls in the morning hours between 7 AM to 9 AM. During this time the weather will be cool and quiet for the bulls. The training should be given gradually and patiently. Rough treatment should be avoided which reflects badly and the bull may become a non reactor and shy bull.

In the beginning the bull may not show interest in mounting because of the new surroundings and people. Slowly the bull gets accustomed to the new surroundings and tries to mount after seeing the older bulls mounting. Exerting patience is very important. The bull must learn to mount only on another bull. It should not be trained to mount on female animals. This should not be encouraged. The dummy selected should be smaller than the bull and strong enough to hold the weight. The dummy should not be nervous and help the mounting bull. Time should be allowed till the bull acquaint with the teaser. When the bull starts mounting and shows active desire and

sniffs the dummy semen collection can be tried. In the beginning the bull should be allowed to mount and protruding the penis the semen collector should try to handle gently and divert to a side. In this way the bull learns that the semen collector does not harm him. Slowly artificial vagina (A.V) can be given when the bull is anxious to give a thrust. In the beginning the temperature of the A.V. should be 420C and less pressure. Bull thus reacted to A.V should be regularly tried in semen collection once in a week. When once the young bull is donating semen to the A.V confidently it can be transferred to bull stations for entry into regular breeding programme. The bull should be transferred along with its complete file.

Standard of Air Pollutants In Relation To Animal Production

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The effect of air pollutant on animal production system is well established but acceptable upper limits firmly exist (Wathes *et al., 1983*). The standard for protection of human being against occupational and industrial workplace has often been suggested as appropriate guidelines for housed animals. Very few report are available regarding air quality parameters to which animal are exposed in total confinement housing and their effect on animal health and production. The threshold limit value for time- weighted average concentration for a normal 8 h day/40–h week, or major gaseous contaminants are 5000, 25 and 10 ppm for CO_2, NH_3, and H_2S respectively (American conference of Governmental Industrial Hygienists, 1984). However a recent report for the Commission Internationale du Geneie Rural by the Scottish Farm Building Investigation Unit (SFBIU, 1984) recommended maximum concentration for CO_2, NH_3 and H_2S in animal housing of 3000, 20 and 0.5 ppm respectively. But H_2S concentration level may be permissible to 5 ppm at the time of manure removal. To design environmental control system for animal housing to meet specific air quality standards requires information on the rates of production of the individual contaminants within them. However, data are not available at present on such rates and the effects of management's practices and housing system (Scott *et al*., 1983).

CRITICAL TEMPERATURE

An optimal thermal environment is usually defined for each species in terms of its effects on production. There are a few specific recommendations in terms of disease. Several authors have discussed and reported the effects of temperature on the milk yield of dairy cows (Webester,1981; Neumann and Kliche, 1988), the performance of fattening pigs (Hann and Nienaber,1988) and the egg yield of laying hens (Charles,1984). The lower critical temperature (LCT) defines the lower limit of the range of optimal

temperature. The upper limit is given by the upper critical temperature (UCT). LCT is affected by factors such as age, sex, breed (Henken *et al.,* 1991) food energy level and intake, feathering (Macleod,1984), stocking density (Burmester,1986), bedding system (Bruce,1981) etc. Some selected values for LCT and UCT are shown in Table 1.

Table 1: Critical temperature in different species

Species	LCT (^{0}C)	UCT(^{0}C)	Optimal performance
Dry cow <10 kg milk/day	-15	27	5-15
C.B cow	5	30	15-25
Indigenous cow	5	38	25-30
>22 kg milk/day	-25	22	5-15
Calf new born upto 2 wks	5	27	15-25
Calf 1 months old	5	28	10-25
Swine	17	28	20-24
Piglet (3 day-2 wks)	22	32	28-30
Sheep	-10	30	5-15

STANDARD OF AIR POLLUTANTS

Temperature

Ambient temperature as the only indicator of animal comfort, thermal indices has been developed to better characterize the influence of multiple environmental variables on the animal. The temperature-humidity index (THI), first proposed by Thom (1959), has been extensively applied for moderate to hot conditions, even with recognized limitations related to air speed and radiation heat loads (NOAA, 1976). At the present time, the THI has become the standard for classifying thermal environments in many animal studies and selection of management practices during seasons other than winter (Hahn *et al*., 2003). The THI has further been used as the basis for the Livestock Weather Safety Index (LWSI; LCI, 1970) to describe categories of heat stress associated with hot weather conditions for livestock exposed to extreme conditions. Categories in the LWSI are alert (74 < THI < 79), danger (79 ≤ THI < 84), and emergency (THI ≥ 84). Additionally, THI between 70 and 74 is an indication to producers that they need to be aware that the potential for heat stress in livestock exists.

Animal room should be design in such a way that in both winter and summer season temperature should be fully controlled and continuously maintained. It should be monitored by instrument at least once a day. The target should be to maintain the room temperature in a band width of 4^{0}C. If animal's thermoregulatory

ability has been affected by anesthesia or other scientific procedures, a higher room temperature or more bedding materials should be provided. But in some species shade or shelter will be required in the summer and additional food, heat as well as shelter in winter to maintain the constant temperature.

Relative humidity

The extreme variation in relative humidity can have adverse effects on the well-being of animals as well as affecting the rate of heat loss. So it can also influence activity and food intake. The RH in animal's room should be maintained at 55% ±10%. Prolonged period below 40 % and above 70 % can adversely affect the animal's performance. Chickens are more tolerant than mammals and a range of 30-70% is acceptable. Too low humidity in the air will cause irritation of the mucous membranes, while too high humidity may promote growth of fungus infections. High humidity may also contribute to decay in structures. If possible keep the relative humidity in the range of 40 to 80%.

Ventilation

Ventilation systems are required in animals housing for following purpose:

- To regulate the temperature and humidity in prescribed limit
- To reduce the levels and spread of odours, noxious gases dust and infectious diseases.
- To provide appropriate and sufficient air quality.

The ventilation rate should be related to its stocking density and heat generated by animals and equipments in the rooms. In fully stocked room for rodents and lagomorphs, 15-20 changes of fresh or conditioned air per hour distributed throughout the room are normally adequate. For cats, dogs, and primates, 10-12 changes per hour may be adequate. In general ventilation system can be used to create differential air pressure within the buildings as part of barrier system. Clean areas are generally maintained at higher pressure and hazards areas at low pressure than those adjacent to them to minimize the leakage of dirty air into cleaner areas and the escape of air borne hazards air outside the premises.

Ventilation rates in enclosed facilities (MWPS, 1989, 1990) should increase from a cold-season minimum (to remove water vapor, contaminants, and odors as well as modify inside temperature) to a hot-season

maximum (usually around 10 times the minimum rate, to limit the increase in temperature inside the house that is due to the solar radiation load and sensible animal heat). It is important to recognize the approximately 10-fold increase in ventilation rate from winter to summer that is required in a typical livestock or poultry house. Because the animals themselves are the major source of water vapor, heat, and (indirectly) odorous matter, ventilation rate calculated on the basis of animal mass is more accurate than that based on air exchange rate guideline.

During cold weather, ventilation in houses for neonatal animals should maintain acceptable air quality in terms of water vapor and other pollutants without chilling the animals. Air speed should be less than 0.25 m/s (50 ft/min) past very young animals. There should be no drafts on young poultry or pigs. During hot, warm, or cool atmospheric conditions, ventilation of animal houses should maintain the thermal comfort of the animal to the extent possible. Ideally, the ventilation rate should be high enough to prevent indoor temperature from exceeding outdoor temperature (temperature rise limit; Curtis, 1983) by more than 3°C (5°F) when the atmospheric temperature is above 32°C (90°F) for small animals and above 25°C (78°F) for larger ones. In arid and semi-arid regions where the potential for evaporative heat loss is great, air temperature may peak at over 43°C (110°F) for 1 or 2 d or longer without affecting animal well-being if animals have been acclimatized by chronic exposure. So Ventilation system design should be based on building construction and the rates of water vapor and heat production of the animals housed (Curtis, 1983; Hinkle and Strombaugh, 1983)

Air Movements

Air movements will assist in heat loss by evaporation and by conduction/ convection as long as the air temperature is lower than the skin temperature. When the air temperature approaches the skin temperature rapid air movements are experienced as comfortable, but at low temperatures it will lead to excessive cooling of unprotected skin areas (cold draught). In addition air movements are required to remove noxious and toxic gases and to supply the animal with fresh air for breathing. A wind velocity of 0.2m/s is generally regarded as a minimum requirement, but it can be increased to 1.0m/s, when the temperature is nearing

the upper critical, or more when it goes beyond that.

Lighting

Lighting system is more important for nocturnal and crepuscular mammals. The light intensity, wavelength, and photoperiod are important aspects for better performance of animals. The intensity of light should be range 350-400 lux in most of laboratory houses. The wavelength have little role on animal production and adverse effect has been reported. To regulate circadian rhythm and breeding cycles in animals, the light to dark ration should be maintained properly. The circadian clock of some species may be affected as much by light pulses of less than one second during the dark phase as by a long photoperiod.

Dust particle

The dust in animal housing originates from the feed, the bedding material and from the animals themselves. A small amount enters the animal house with the incoming ventilation air. The dust particles are carriers for gases, microorganisms, endotoxins and various other substances such as skin cells and manure particles (Donham, 1989). Animal house dust consists up to 90 % of organic matter (Aengst, 1984).The amount of airborne dust fluctuates greatly both in the course of a day and according to the type of animal. Recent investigations carried out in 329 animal houses in four different EU countries revealed the dust concentrations. The results are given in 24 hours mean values for inhalable and respirable dust (TAKAI *et al*., 1998). The highest dust concentrations are found in poultry housing followed by pig and cattle. Most of this dust may leave the animal houses by way of the exhaust air and is distributed in the surroundings. Assuming a mean dust concentration of 2 mg/m^3 in the exhaust air of a piggery housing 1000 fattening pigs and a mean ventilation rate of 200 m^3 /LU per hour (1 LU- livestock unit= 500 kg live weight) throughout the year the total dust emission per year will be about 500 kg. The emission rate of respirable dust from piggeries is about 60 mg/LU/ hour. Presently it is unknown how far these fine particles are distributed in the environment of animal houses (Hartung, 1998).The health effects of dust particles depend very much on the nature of the dust (organic, inorganic), the compounds the particles are carrying (bacteria, toxins) and the diameter of the particles. Particles with aerodynamic diameters smaller than

5 µm can penetrate deep into the lung. The larger particles are deposited in the upper airways. High dust concentrations can irritate the mucous membranes and overload the lung clearance mechanisms. Together with the dust particles microorganisms can be transported into the respiratory system causing infections. Endotoxins can trigger allergic reactions in the airways of susceptible humans, even in low concentrations.

Bioaerosol

Under commercial production the airborne particles will contain a mixture of biological material from a range of sources. The chickens produce large amounts of dust as a result of epithelial desquamation, as well as from feed, manure, faeces and litter (Matkovic *et al.,* 2009). This dust consists of a variety of airborne particles of biological origin, i.e. bacteria, fungi, endotoxins (lipopolysaccharide, LPS) of Gram-negative bacteria, 1.3-beta-glucan of fungi, fungal spores and mycelium fragments.

Table 2: Polish norms of different micro-organism in poultry houses

Polish norm	Mesophilic bacteria	Staphylococci	Fungi
Not pollution	$<1x10^3$	0	$3x10^3$-$5x10^3$
Medium pollution	$1x10^3$-$3x10^3$	<25	$5x10^3$-$1x10^4$
Heavy pollution	$>3x10^3$	>25	$>1x10^4$

The particles in a bioaerosol are generally 0.3 to 100 µm in diameter; however, the respirable size fraction of 1 to 10 µm is of primary concern. Bioaerosols, ranging in size from 1.0 to 5.0 µm, generally remain in the air, whereas larger particles are deposited on surfaces (Srikanth *et al.,* 2008).

Microorganisms and endotoxins in animal houses

Microorganisms and endotoxins belong to the prominent aerial pollutants in farm animal housings which have been linked with several production diseases (Wathes, 1994;Hartung, 1994). It has been assumed to pose a risk for the health of farmers and workers in the farms (Donham, 1990) and to the neighboring residential areas around intensive livestock enterprises. Concentrations of airborne microorganisms are particularly high in pig and poultry houses (Clark *et al.,* 1983; Cormier *et al.,* 1990; Ewerth *et al.,* 1983).Usually microorganisms and endotoxins (lipopolysaccharides, LPS) are associated with dust particles and present a biologically active aerosol (bioaerosol). The quantities of bacteria in animal house

air can be very high at times but show vast variations which depend on daily and seasonal influences as well as on the animal species and on the keeping and management system (Müller and WIeser, 1987). Another crucial problem when measuring airborne microorganisms is the sampling method. At present there is no generally accepted standard sampling procedure available. Total counts of bacteria, Gram negative bacteria (Enterobacteriaceae) and fungi and yeasts were of general concern. The highest bacteria concentrations were detected in broiler houses. Concentrations of about 6.43 log CFU per m^3 air on average were found during the day as well as during the night. In contrast to broiler houses, houses for laying hens had lower concentrations of between 4 and 5 log CFU per m^3. For pigs, average concentrations of 5.1 log CFU per m^3 and for cattle of 4.3 log CFU per m^3 were detected. In all cases the concentrations were greater in the day than at night. This diurnal distribution was also observed for Enterobacteriaceae with the exception of layers. The overall concentrations differed during the day between 3 and nearly 4 log CFU per m3. Only fattening pigs and layers had higher yields of Enterobacteriaceae, ranging between 4.2 and 4.7 log CFU per m3. In cattle houses, concentrations of 2.3 log CFU per m3 and in pig and poultry houses 3.9 log CFU per m^3 observed. The mean daily fungi concentration was 3.8 for cattle, 3.7 for pigs and 4.0 for poultry log CFU per m^3, respectively.

During the night, the mean fungi concentration was 3.6 for cattle, 3.8 for pigs and 3.7 log CFU per m3 for poultry. Based on the concentration of airborne microorganisms, the measurements were ranked by animal type. During the day and night, broiler houses had the highest concentrations of total bacteria and of fungi, while the highest concentrations of Enterobacteriaceae were recorded during the day in fattening pig units. The highest concentration was found during the night in houses for laying hens. Compared with pigs and poultry the ET concentration in cattle houses was low. For inhalable ET, mean concentrations ranged between 7.4 and 63.9 ng m^3 and for respirable ET, concentrations ranged between 0.6 and 6.7 ng m^3. Mean ET concentrations were higher for pigs. Inhalable ET concentration ranged between 52.3 and 186.5 ng m^3 with related respirable ET concentrations of between 7.4 and 18.9 ng m-3 . Concentrations were highest for poultry;

mean values ranged between 338.9 and 860.4 ng ET m^3 air in inhalable dust fractions and from 9.6 to 58.1 ng ET m^3 air in respirable dust. The overall percentage of the RD/ID ratio differed between species, ie. 8.6 % for cattle, 8.8 % for pigs and 5.7 % for poultry. For the RN/IN ratio, values of 13.9, 12.2 and 9.0% were calculated, respectively. For the same dust fractions significant variations between the different housing types were estimated. For ID samples, the ET concentration was higher in cattle buildings with litter ($p<0.01$), while cattle houses with slats showed higher ET concentrations for IN samples ($p<0.04$).Pig houses in The Netherlands had the highest ET concentrations in the RN fraction ($p<0.03$). The highest ET concentrations for ID ($p<0.007$), IN ($p<0.007$), RD ($p<0.0004$) and RN ($p<0.0002$) in weaner houses were detected with mesh or slat flooring. As a consequence, for nearly all dust fractions the ET concentration was higher in the mesh/slats housing type ($p<0.03$) than in buildings with litter or slats alone. Housing types with litter showed the highest ET concentrations ($p<0.002$) only for ID. Differences between poultry houses were also observed.

BACTERIAL COUNTS

The research work carried out for the evaluation of microbiological air contamination in some barns (cow sheds, pig sties, poultry houses) and dairy buildings. The emission levels of bioaerosols from chosen farming objects into atmospheric air were also estimated. Air sampling was carried out in rural areas in Podlasie in January and February (Karwowska, 2004).

Two kinds of barns were taken into account:

Modern type — exploited for less then10 years, with mechanical ventilation, improved feeding systems, without or with thin-layer bedding (cow sheds I and II, pigsty IV)

Conventional type — older ones, without ventilation systems (only natural ventilation), with traditional bedding and feeding methods (cowshed III, pigsty V, poultry houses VI and VII).

Temperature of atmospheric air ranged between -2°C and +1°C; temperatures inside barns and dairy objects was 10-12°C and 7-13°C, respectively. Relative indoor air humidity was about 80-90%, and of atmospheric air 37%.It has been stated, that the number of microorganisms(as CFU/m3) in barns ranged between $1.7x10^3$-$8.8x10^4$ for mesophilic bacteria,

$3.5x10^1$-$8.3x10^2$for hemolytic bacteria, $1.5x10^3$-$4.6x10^4$ for staphylococci, $5x10^0$-$2x10^2$ for coligroup bacteria and $1.7x10^2$-$2.4x10^4$ for moulds.The most significant microbiological contamination has been detected at sampling point number IV (a modern pigsty). High amounts of mannitol+ staphylococci occurred in pigsties (IV, V), cow shed (II) and poultry house (VII). In some cases (II, V, VII) the number of staphylococci was higher than the number of mesophilic bacteria on MPA agar. Two cow-sheds (I, II), one pigsty (IV) and one poultry house (VII) were strongly contaminated with moulds.

Table 4: Average number of micro-organism in old and modern farm building

Micro-organism	Average no. of micro-organism (CFU/M^3)	
	Conventional type building	Modern type building
Mesophilic bacteria	$9.5\pm5.7x10^3$	$3.9\pm2.6x10^4$
Mannitol+ Staphylococci	$1.9\pm1.2x10^4$	$1.2\pm0.5x10^4$
Haemolytic bacteria	$5.2\pm1.6x10^2$	$2.4\pm1.4x10^2$
Coli group bacteria	$3.9\pm1.9x10^1$	$1.2\pm0.6x10^2$
Moulds	$5.1\pm2.9x10^3$	$1.5\pm0.5x10^4$

CONCLUSIONS

In recent years the increasing use of intensive livestock production systems has become a source of solid , liquid and air borne emissions that can be both a nuisance and environmentally harmful. The most important greenhouse gases are methane (CH4), nitrous oxide (N2O) and carbon dioxide (CO2) . In spite of the low amount of CH4 in the atmosphere relative to that of CO2, its importance as a pollutant is considered to be 21 times greater than that of CO2 , while that of N2O is 310 times greater (Hartung, 2003).There are loads of dusts, micro-organisms and endotoxins present in animal house air. These substances are emitted in considerable amounts from buildings and manure stores which lead to health risk for animal and man. Suitable abatement techniques for gases such as ammonia and particulates are available. But these should be employed in practice. There is still a considerable lack of knowledge on the distribution and health effects of airborne particulate emissions from livestock sources in the environment. For licensing new animal farms as well as residential areas in the farming environment more precise information on

the travel distance of harmful particles and compounds are required.

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Designer Milk – A Genetic Approach in Dairy Technology

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Milk is a natural complete food, which provides fat, protein, essential vitamins and minerals and also a good source of calcium that is essential for the prevention of bone disorders such as osteoporosis. With the changing social and eating behaviour, the milk should be of special value so that it can compete with other dairy products and energy drink. For this milk have to be designed in such a way, which increase its properties according to the need of the changing scenario. Designing of the milk means production of the milk that has certain specific values viz., improve the immunity, utilization of lactose and alleviate diarrhoea. Low fat, more protein, less lactose, changed amino acid and fatty acid profiles and without b-lactoglobulin are important properties of 'designing' milk for human health point of view. Designer milks will give improved and value added products naturally with improved nutraceuticals to meet the requirements of the new millennium. Now a day's biotechnologists have identified genetic markers in cows for disease or desirable traits such as milk fat synthesis. So, in future we can expect the cows that will produce low fat milk naturally, which can be achieved through combinations of traditional genetics, marker-assisted selection and genetic modification of dairy cattle and by farm and feed management. From human health point of view some of the desirable improvements are-(1) Increased proportion of unsaturated fatty acids and low fat milk and its products, (2) Low lactose content and (3) complete absence of b-lactoglobulin from milk.

ALTERATION IN MILK FAT

The consumption of full cream milk is declining due to high proportion of saturated fats (i.e., 60%), which leads to increase in LDL (low density lipoprotein) in blood, a risk factor for heart disease. Milk fat designing means producing milk with low fat particularly low saturated fat and increased linoleic acid in milk fat. This can be designed by change in feed for dairy animals and genetic interventions. Feeding rumen protected fat supplements enables the dairy animals to produce milk products containing structurally important dietary fats that are required for specific biological

activities such as vision and neural development, antioxidants, anticancer substances and the dietary modification of genetically linked disorders viz., heart diseases. Feeding protected canola/ soybean in ratio of 70/30 w/w significantly increased the proportion of C18:1 cis (oleic acid), C18:2 (linoleic acid) and C18:3 (linolenic). Similarly, protected soybean/tuna oil (ratio 70/30; w/w) significantly increased the proportion of C 18:2 (linoleic acid), C18:3 Uinolenic), C20:5 (EPA-eicosapentaenoic acid) and C22:6 (DHA; docosahexaenoic acid) while, feeding conjugated linoleic acid (CLA)/casein (1:1; w/w) supplements protected from ruminal hydrogenation increased the CLA isomers 9 cis 11 trans, 10 trans 12 cis. There was a reduction in the C16:0 (palmitic acid) by feeding protected supplements. The alternative method to increase milk fat is selection of cattle based on DGAT1 genotype, which code for acyl-coenzyme A: diacylglycerol acyltransferase1, is located on chromosome 14 in cattle and plays important role in synthesis of triacyiglycerol.

ALTERATION IN MILK PROTEIN

Casein is main milk protein. Through genetic engineering, transgenic cows secreting elevated levels of b-(8-20%) and k-caseins (twofold) have been produced. Brophy's group produced the transgenic animals, which have increased total milk protein by 13-20% and total milk casein by 17-35% in comparison to than that of non-transgenic cows. b-casein is the most abundant milk protein which is involved in binding calcium phosphate and controlling milk calcium levels. Higher k-casein content in milk is linked to smaller micelles, better heat stability and improved cheese-making properties. Adding L-taurine, L-leucine and L-phenylalanine in feed improved amino acid profile, which is another additional benefit.

MODIFICATION IN LACTOSE

The enzymatic hydrolysis of lactose is done by -galctosidase into glucose and galactose and then their absorption into blood. In human beings, the level of 3-galctosidase declines from early childhood to adolescent. When such adult ingest milk or their products, the lactose remain undigested leading to malabosrbtion, which further increase the water retention in gut and bacterial proliferation upset the gastrointestinal tract, which will lead to diarrhoea and dehydration. Since, milk is an important component of human diet especially for calcium, so lactose intolerance can limit this source. In later stage, this may cause bone disorders like osteoporosis.

HUMANIZED BOVINE MILK

It is well established that mother's milk is best for the newborn baby. In many of cases if there is non-availability of mother's milk than it can be replaced by cow's milk. But the composition of human milk and bovine milk differ in many aspects. One of them is lactoferrin (LF), the iron binding protein having antimicrobial property and role in regulating immune system. Its level in human milk is about 1 g L' (in human colostrum 7 g L') while in bovine's milk it is only one-tenth than that of human milk.

REDUCING MILK ALLERGIES

In a study conducted on African and Americans (age group 12-40 years) the lactose content of milk was not the cause of cause of milk intolerance in one third of human being. In children, milk allergy to bovine's milk is due to b-lg, which is absent in human milk. Thus, elimination of this protein by knocking out gene responsible for b-lg from bovines is unlikely to have any detrimental effects on bovine and might overcome milk allergy problems associated with bovine milk.

MILK AND THERAPEUTICS

Scientists are trying to produce the proteins that can be helpful in human therapeutics. In this regards GTC Biotherapeutics uses both cows and goats for the production of therapeutic proteins, including plasma proteins, monoclonal antibodies and vaccines. Recently, recombinant human antithrombin III has been produced in goat milk, which is an anti-coagulant protein in blood. Researchers are also working on production of vaccine against malaria from goat milk, which can be cheaper than current methods. With the use of biotechnology, it might be possible in future to produce specific antibodies in mammary tissue that can prevent its own infection as well as helpful in preventing the disease in human beings and treating the diseases such as phenylketonuria (PKU), hereditary emphysema and cystic fibrosis. With the help of bioengineering, goat can be used in the production of spider silk in its milk that can be of immense help for preparing medical micro sutures and tennis racket strings.

CONCLUSION

Despite all these promising prospects, there is a tendency among human beings to resist change, especially those of transgenic. Thus, the future of biotechnologically modified foods is at crossroads even after three decades of promising results. Various ethical, legal and social issues should be solved before we would go for designer milk similar to organic herds. The future of the dairy industry is not just about producing more and more milk, but about producing more milk of the right kind. Thus, we can expect that in future dairy farmers maybe the producers of designer milk.