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Cold stress management in dairy herd

Banana Weevil and Its Management

Donkey Milk –A Great Substitute Of Human Milk

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Judging of Livestock

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Livestock judging is used as a tool for improvement, forming sound opinions and giving oral reasons. It helps in selection of animals on the basis of their physical characteristics. It helps in culling of animals. Helps in avoid breeding of unproductive animals. To know the methods of judging.

PROCEDURE

Examine the form of the cow and the bull of ideal type. Make a mental (blind) picture of the cow keeping the following points in view:

For cows

General appearance -30 points
Body capacity -20 points
Dairy characters -20 points
Mammary system - 30 points

Qualities of a good judge

The essential qualifications which a good judge of any class of stock must possess are:

1. Knowledge of the parts of an animal.
2. Quick and accurate powers of observation.
3. Ability to form a mental image of many individual animals and to rank them by making comparisons.
4. Reasoning power that take into account practical considerations.
5. Ability to research a definite decision based on sound judgment.
6. Steady nerves and confidence in one's ability to make close independent decisions based entirely on the merits of the animals.
7. Evaluate and rank the individual animal according to her appearance on the day of judging, regardless of her rank at a previous show.
8. Firmness to stand by and defend one's placing without effending or in any way implying that one's decisions are infallible.

Do's and Don'ts for contest judge:

1. Do's

a. Make certain how the class is numbered, and keeps the numbers straight.
b. Get a clear picture of the class and of each individual animal in mind, so that they will he remembered when given reasons.
c. Make placings on the basis of the big things.
d. Make certain that the card is filled out completely and correctly, and that the correct numbers are kept in mind.
e. If permissible, make concise notes that will assist in recalling each individual in the class; record such things as distinctive colour, outstanding faults etc.

f. When giving reasons, use good poise and look the judge in the eye.
g. Give reasons clearly, and with conviction and confidence.
h. Give reasons in a logical sequence, give the major reason first.
i. Use comparative and descriptive term in giving reasons. Avoid such vague terns "good", "better" and "best".
j. Concede or grant good points and faults, regardless of the placing of the animal.

2. Don'ts

a. Don't place animals on the basis of smal relatively unimportant characters
b. Don't destroy Self cofidence and Self-respect by discussing the class with others before giving reasons.
c. Don't pay attention to what you over hear other say about a class be an independent judge.
d. Don't give wordy and meaningless reasons.
e. Don't bluff, if you don't know the answer a question, say no.

How to use the judging guides:

1. Examine animals in the order indicated, namely: -
(a) Side views
(b) Rear views
(c) Front views
(d) Handling
2. Study the points listed under "ideal type" and know "the common faults"
3. Rank or place the animals according to their consistent rating on all points, especially the most important ones, or if you prefer, use the score card method which follows

EVALUATION OF DEFECTS:

A. Disqualifications

1. Total blindness
2. Permanent lameness
3. One or more blind quarters in cows.
4. Very abnormal milk from an impaired quarter (bloody, clottted, watery).
5. Only one testicle or abnormal testicles in bulls.
6. Free martin heifers, unless proved pregnant.

B. Serious Discriminations

I. Wry face (face twisted side ways).
2. Parrot jaw (over hot jaw).
3. Badly winged shoulders
4. Very abnormal tail setting i.e. wry tail (tail set to head either side).
5. Bucked knees, blemished hock, crooked hind legs, weak pasterns, extreme toeing-out in rear, badly bowed pasterns.
6. Crampy hind legs.
7. Very abnormal milk or a partially impaired quarter (bloody, clotted, watery).
8. Broken udder attachment (A weak udder attachment)
9:Uncalved heifers showing evidence of having been milked.

C. Slight discrimination

I. Blind in one eye.
2. A slight tendency toward a parrot, or overshot jaw in female.
3. Loose shoulder attachment with a slight tendency to wing.
4. Capped hip (point of hip knocked down).
5. Slightly wry tail or either slight

deficiency about the tail setting.
6. Temporary lameness.
7. Slightly undersized.
8. Temporary abnormal milk.
9. A tendency towards weakness in udder attachment.
10. Slightly unbalanced quarters.
11. Temporary or minor injuries which do not affect the animals usefulness.

(A) Score Card for dairy Cow:

General appearance ----------30

Attractive individuality with faminity, vigor, stretch, scale, harmonious blending of all parts and impressive style and carriage. All parts of cow should be considered in evaluating a cow's general appearance--- (10)

Breed characteristics : Breed type and size

Head : Clean cut, proportionate to body, broad muzzle with large open nostrils, jaws strong, large, blight eyes, forehead, broad and moderately dished, bridge of nose straight, ears medium size and alertly carried.

Shoulder blades: Set smoothly and tightly against the body

Back: Straight and strong, loin-broad and nearly level----(10)

Rump: Long, wide and nearly level from hook bones, clean cut and free from patchiness, thurls, high and wide apart. Tail head set level with backline and free from coarseness.

Legs and feet: Bone flat and strong, pasterns short and strong, hocks cleanly moulded. Feet, short, compact and well rounded with deep heel and level sole. Forelegs medium in length, straight, wide apart, and squarely placed. Hind legs nearly perpendicular from hock to pastern from the side view and straight from the rear view ....(10)

Dairy character:----------20

Evidence of milking ability, angularity and general openness, without weakness, freedom from coarseness, giving due regards to period of lactation.

Neck: Long lean and blending smothly into the shoulders, clean cut throat., dewlap and_brisket.

Withers: Sharp

Ribs: Wide apart, rib bones wide, flat and long.

Flanks: Deep and refined.

Thighs: Incurring to flat, and wide apart from the rear view, providing ample room for the udder and its rear attachment.

Skin: Loose and paliable

Body capacity:----------20

Relatively large in proportion to size of animal, providing ample capacity, strength and vigor.

Barrel: Strongly supported, long and deep, ribs highly and widely sprung, depth and width of barrel tending to increase towards rear....(10)

Heart girth: Large and deep, with well sprung fore ribs blending into the shoulders full crops at elbows, wide chest floor....(10)

Mammary system----------30

A strongly attached, well balanced, capicious udder of fine texture indicating heavy production and long period of usefulness.

Udder: Symmetrical, moderately long, wide and deep, strongly attached, showing

moderate clearange between halves, no quartering on sides, soft, pliable and well collapsed after milking quarters evenly balanced----------(10)

Fore udder: Moderate length, uniform width from front to rear and strong attached----- (6)

Rear udder: High, wide, slightly rounded, fairly uniform width from top to floor and strongly attached-----(7)

Teats: Uniform size, of medium length and diameter, cylindrical, squarely placed under each quarter plumb and spaced from side and rear views-------(5)

MAMMARRY VEINS:

Large, long. tortous, branching. Because of the natural undeveloped mammary system in heifer calves and yearlings, less emphasis is placed on mammary system and more on general appearance, dairy character, and body capacity. A slight to serious discrimination applies to overdeveloped, fatty udders in heifer calves and yearlings-------(2)

Total =100

(B) Score card for dairy bull:

General appearance

Attractive individuality, with masculinity, vigor, stretch, and scale, harmonious blending of all parts, and impressive style and carriage. All parts of a bull should be considered in evaluating a bull's general appearance.

BREED CHARACTERISTICS

Head: clean-cut, proportionate to body.

Muzzle: broad with large open nostrils, jaws strong.

Forehead: broad and moderately dished, bridge of nose straight, Ears medium size and alertly carried-------(15)

Shoulder blades: Set smoothly and tightly against the body

Back: Straight and strong, loin broad and nearly level.

Rump: Long, wide and nearly level from hook bones to pin bones; clean-cut and free from patchiness. Thurls high and wide apart. Tail head set level with backline and free from coarseness. Tail slender----------**(15)**

Legs and Feet: Bone flat and strong, pasterns short and strong, hocks cleanly molded. Feet short, compact and rounded with deep heel and level sole. Fore legs medium in length, straight and wide apart, squarely placed. Hind legs nearly perpendicular from hock to pastern from the side view and straight from the rear view------- (15)

BODY CAPACITY

Relatively large in proportion to size of animal, providing ample capacity, strength and vigor:

Barrl: Strongly supported, long and deep. ribs highly and widely sprung, depth and width of barrel tending to increasing toward rear--(12)

Heart girth: Large and deep, with well sprung for ribs blending into the shoulders, full crops at elbows, wide chest floor----- (13)

Dairy character:

Angularity and general openness without weakness, freedom from coarseness.

Neck: Long, lean, with medium crest, and blending smoothly into shoulders, clean-cut

throat, dewlap and brisket. Withers-sharp.
Ribs: wide apart, rib bones wide, flat, and long.
Flanks: deep and refined.
Thighs: incurring to flat and wide apart from the rear view.
Skin: loose and pliable---------- (30)
For Bulls
General appearance - 45 points
Body capacity -25 points
Dairy characters - 30 points
1. Secure the animal with a halter and rope.
2. Direct the attendant it handling the animal to take it into the screening yard.
3. Examine the cow and bull and screening 'out the animals having major defects.
4. Allow the competiting animals into the judging ring.
5. Let the animal be accustomed to the judging ring.
6. Direct the attendant to walk the animal a round the ring. Let the animal take two to three rounds.
7. Carefully examine the physical characteristics of the animal while it go on round.
8. Examine the way of movement and temperament of the movement.
9. Start evaluating body parts of the animal in the sequence given in the score card.
10. Allot points to each of the body parts carefully.
11. Get the total score and place the individuals on the basis of total score.
12. Place the animals in the order of the total score obtained which reflects their merit as followed by the next highest and so on.

Plant Metabolic Engineering through Transcription Factors: A Novel Approach

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Plants produce a large numbers of metabolites through various metabolic pathways. They are divided into primary metabolites comprising of carbohydrates, proteins, lipids, nucleic acids and secondary metabolites like terpenes, phenolics and alkaloids. They are utilized as food, pharmaceutical compounds and raw materials for industry. Therefore, plant biosynthetic pathways have been intensively studied and genetic engineering to control the biosynthetic pathways has been applied for the effective production of useful metabolites.

There are three basic goals of metabolic engineering in plants

- To increase the production of desired compound
- To decrease the production of unwanted compound
- Production of a novel compound.

Strategies for achieving goals (Capell and Christou, 2004)

Engineering of single step in a pathway

- ✓ To increase or decrease metabolic flux
- ✓ To target compounds, to block competitive pathways
- ✓ To introduce short cuts that diverts metabolic flux in a particular way.

Engineering of multi steps in a pathway

- ✓ Up regulating more than consecutive enzymes in a pathway
- ✓ Up regulating enzymes in one pathway while suppressing those in another competing pathway (polycistronic antisense RNA)
- ✓ Using regulatory genes to establish multipoint control over one or more pathways in the cell i.e. transcription factors

TRANSCRIPTION FACTORS

Transcription factors (TFs) are master regulators controlling gene clusters. TFs are proteinous in nature and are composed of atleast two discrete domains: a DNA binding domain (DBD) and an activation/repression domain (RD). TFs regulate the expression of genes positively (activator) or negatively (repressor) for different metabolic pathways.

Methods used for identification of transcription factors in plant (Schwechheimer *et al*., 1998)

1. Transient assay
2. *In vitro* transcription assay
3. Gene fusions for the identification of protein domains
4. *In vivo* protein-protein interaction studies
5. DNA-Protein interactions
6. Electrophoretic Mobility Shift Assay

7. DNA Footprinting Techniques
8. Transcriptome analysis
9. Tiling array
10. Microarray
11. ChIP-on-chip [Chromatin Immuno-precipitation ("ChIP") with microarray technology]

Strategies for manipulation of transcription factors (Iwase *et al*., 2009)

- Gain of function

Enhancement of an activation activity of a transcription factor

- Loss of function

Artificial transcription repressor designated by Chimeric Repressor gene-Silencing Technology (CRES-T)

Such studies have been reported before more than a decade. Fits and Memelink, (2000) studied the jasmonate-responsive transcriptional regulator gene *ORCA3* from *Catharanthus roseus,* which regulated the terpenoid indole alkaloid (TIA) metabolic pathways at multiple steps. Proanthocyanidins were metabolically engineered through co-expression of anthocyanidin reductase (*ANR*) and the *PAP1* MYB transcription factor (Xie *et al*., 2006). Misra *et al*., (2010) demonstrated that the flavonol-specific transcription factors, *AtMYB12*, leads to additional carbon flux for enhanced accumulation of flavonols and several other metabolites, which gave insect resistance to transgenic tobacco. The study indicated that the *PAP1* transcription factor is required for the production of anthocyanin which further utilized by *ANR* for the production of proanthocyanidin.

Van Eenennaam *et al*., (2004) designed artificial zinc finger protein transcription factor (ZFP-TF) which specifically bind with the promoter region of gene γ-methyl transferase (*GMT*) and significantly upregulated the expression of *GMT*, resulting in elevation of vitamin E content in transgenic Arabidopsis seeds.

Metabolic pathways can be searched in tools like KEGG (Kyoto Encyclopedia of Genes and Genomes) pathway databases wherein most of the metabolic pathways are available for molecular interaction and reaction networks. Similarly, databases for TF prediction like PLACE, PLANT CARE, Plant TFDB, Transfac, DATF, GRASSIUS etc. are available.

CONCLUSIONS

Modulation of transcription factors (metabolic regulator) appears to be an emergent techniques and more effective for the control of metabolic pathways than modulation of single enzyme genes in plants. Knowledge of metabolic pathways and its regulation through endogenous transcription factors could be helpful to design artificial transcription factors through which, the regulation of metabolic pathways are more effective.

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REVIEW ARTICLE

Common Health Problems and Their Management in Suckling Calves

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Health and management of replacement animals are important components of total herd profitability. The productivity of the herd can be negatively affected by impaired growth of calves, decreased milk production of animals that experienced chronic illness as baby calves, spread of infectious diseases from unhealthy calves to healthy calves and adult dairy animals, increased veterinary costs, and the limited opportunity for genetic selection due to high mortality of replacement animals. Among all animals present on a dairy farm, the highest morbidity and mortality rates generally occur in baby calves prior to weaning. Like grown up dairy animals, suckling calves also get infected with a number of diseases or ailments of various nature. Some of them such as umbilical abscess, blindness, white scour, dysentery, etc may prove quite disastrous. Some important diseases are briefly described here.

1. UMBILICAL ABSCESS

This condition is seen in young suckling calves as infected abscess at or near the umbilical opening. This may be caused due to neglect by the owner in not keeping the calf under hygienic condition or providing any bedding or by leaving the cut end of the umbilicus exposed to flies and bacteria without any antiseptic dressing. In this condition following symptoms are observed.

1. The infected part is hard, hot and painful with a foul smelling discharge at the opening.
2. Slight rise in body temperature.
3. Sometimes, swelling and pain at the leg joint may also occur.

Managemental Intervention

1. Clean affected part with a mild disinfectant such as a few drops of tincture of iodine or phenyl in clean water.
2. Foment and dress it with antiseptic powder like Mycodenn or Nebasulph.
3. Application of Horexane and Himax ointment will also be useful.
4. Keep the stall floor clean with disinfecting lotion like Phenyl, Salvon or ettol and provide a layer of dry straw or leaves as bedding for the calves.

2. WHITE SCOUR (DIARRHOEA):

White scour disease is fairly common in most calves, especially in buffalo calves. It occurs usually within first few weeks of birth. The condition always indicates poor management. Following factors may be responsible for this condition.

1. Over drinking of mother's milk, especially when it is rich in butter fat.
2. Improper feeding i.e. frequent feeding, more in quantity, milk rich in fat, cold and polluted milk.
3. Lying in mud floor especially when it is wet and insanitary.
4. Heavy worm infestation in the intestines.
5. Dark, dirty and ill-ventilated calf shed.

The main symptoms of this disease are severe whitish diarrhoea, dullness, progressive emaciation (weakness) etc. The dung of the calf is loose and watery. Often it is whitish or clayish in colour with an offensive odour .The calf strains and mourns with pain. Calves with diarrhea consistently have some degree of dehydration. Dehydration may be life threatening and can be assessed by observation of typical clinical signs as described below:

Table: Assessing Dehydration

Clinical Sign	Percent Dehydration
Few clinical signs	<5%
Sunken eyes, skin tenting for 3-5 seconds	6-7%
Depression, skin tenting for 8-10 seconds, dry mucous membranes	8-10%
Recumbent, cool extremities, poor pulse	11-12%
Death	>12%

Figure: Calf affected due to Diarrhoea

Managemental Intervention

1. Separate infected calves immediately, withhold whole milk and give only skimmed milk or gruel made of ragi flour and broken rice.
2. Give catechu, one and half tea spoonfull with equal quantity of chalk powder or jaggerry.
3. Administer orally the tablets of sulphromezathine, two tablets twice a day for thrice a day.
4. Antibiotics if bacteria are known to be the cause. **Note:** some antibiotics may be given as a preventative course in the form of an injection or an oral dose at birth.
5. Add two teaspoonfuls of Aurofac, Neften or lime water to the feed for a month.
6. Feed electrolytes, glucose, minerals and vitamins in liquid form to rehydrate affected calves.

7. Feeding probiotics is an option after a course of treatment.
8. Housing on dry hygienic floors, preferably with some bedding of dry straw or dry leaves.
9. Good ventilation and sunlight are essential.
10. Use a mouth gag to the calf at non-feeding time to prevent it from licking the walls and floors.

Table: Fluid Requirements for Treatment of Diarrhea

Calf Health	% Dehydration	Daily Milk	Oral Fluids
Healthy calf	0%	4.4 kg	0 kg/day
Mild diarrhea	2%	4.4	1.1 kg/day
Mild diarrhea	4%	4.4	2.2 kg/day
Depressed	6%	4.4	3.3 kg/day
Very ill	8%	4.4	4.4 kg/day
Recumbent	>10%	4.4	Need intravenous fluids

3. PNEUMONIA

Pneumonia is an inflammation of the lungs. Pneumonia occurs in young calves soon after birth or a few days later, especially during winter season. It is caused due to exposure to cold weather or by bacterial infection. It may also occur due to worm infestation in the lungs. Calves that develop pneumonia prior to weaning frequently share the same risk factors as those that develop diarrhea: failure or incomplete transfer of immunity from colostrum, prolonged exposure to adult cattle, and/or the ventilation limitations of warm housing. Large diurnal temperature variations and transportation or grouping stress can contribute to the development of pneumonia. As with diarrhea, frequently more than one agent is identified in an outbreak. Herds often experience outbreaks of pneumonia occurring in a number of calves at the same time. Antibiotic therapy is necessary but frequently yields disappointing results. Because of the significant impact that pneumonia has on growth and future productivity of dairy calves, early identification and treatment are important, but resolution of significant risk factors is imperative! Calves that develop chronic pneumonia seldom recover completely and should be culled. Early vaccination is not an effective means of prevention.

Figure: Nasal discharge in affected calf due to Pneumonia.

Among various symptoms, rise in body temperature, thick nasal discharge, dry cough, laboured respiration, indigestion and diarrhoea are most common clinical signs.

Managemental Intervention:

1. Early identification of sick calves based on symptoms and sign and Isolate sick calves to stop further spread.
2. Administration of warmed fluids is an effective way to raise body temperature.
3. Steron inhalation with eucalyptus or turpentine.
4. Antibiotic injection such as Penicillin or Ampicilline
5. Antibiotics can be given in milk for pre-weaned calves when more than 20% of a group is infected. A wide range of antibiotics are available to help control secondary bacteria. Use anti-inflammatory products to reduce lung inflammation and congestion
6. Non-steroidal anti-inflammatory drugs like aspirin, banamine, or ketoprofen can keep calves eating
7. Supplementation with probiotics may help restore the intestinal environment, especially after antibiotic use
8. Make sure fresh water is available at least twice daily and offer milk/milk replacer at the usual dilution and temperature, but reduce volume (to 1 liter, for example) and feed more frequently (4 times/day, if needed).
9. Provide dry, warm and well ventilated stall with dry bedding
10. The sick calf should be given warm, nutritious and easily digestible diet
11. Reduce stocking densities (1.5-2 m/calf).
12. Clear dung from yards and feed areas regularly to reduce ammonia build up.
13. Vaccinate, once the type of infection is known. There are vaccines available that prevent specific strains, such as the viruses IBR, PI3 & RSV, and Pasteurella, the most common secondary bacterial invader

4. DYSENTERY

Dysentery in calves is caused due to irritation in intestine or sometimes due to worms. It may also be caused by Coccidia, a protozoan parasite. Due to suffering of this condition, the calf strains, it does not eat and has abdominal pain. Small quantities of dung are passed with mucus and blood in it.

Managemental Intervention:

1. Give castor oil emulsion (2 to 4 ounces).
2. Give sulphaguanidine (2-4 tablets) twice a day for three days.
3. Feed 3 -4 sour pomegranate fruits, choppcd wilh the rind, daily for three or four days.
4. Feed the calf with rice gruel to which 10 gm of fenugreek has been added and boiled.

5. BLINDNESS

Blindness is a condition commonly seen in new born calves. It is caused due to lack of vitatnin A. The calf appears normal in all respects but after standing on its feet in about half an hour as any other normal calf, it is not able to find the udder and so keeps knocking about. The eyes look normal but when an attempt is made to touch the eyes with fingers or any other object, the eyelids will not close.

Managemental Intervention:

1. Give one or two tea-spoonful of good quality shark liver oil in feed at least twice a day for a month or more.

2. Vitmnin A preparations which are easily available in the market can be added to the feed for a month or more.
3. Feeds rich in vitmnin A such as yellow maize meal, chopped carrots, etc. should be fed till weaning.
4. A few injections of vitamin A preparations like Prepaline, should be administered to care the calf completely.

6. WORM INFESTATION

Worm infestation is a common problem in calves, sometimes even at birth. It occurs almost invariably in all buffalo calves. It is caused due to parasitic infestation, mostly roundworms and occasionally tapeworms, hookworms and even liverflukes. Secondary factors such as insanitary conditions of housing and ill management may also be responsible. In villages, it may also be due to polluted water and fodder from marshy areas. Various symptoms can be observed like the infected calves get diarrhea. Calf gets rough coat and depressed appetite. The affected calf develops the tendency to lick mud and eat anything and abdomen of affected calf becomes pendulous. Grinding of teeth may also be observed. Sometimes even worms may be passed out with dung.

Managemental Intervention:

1. To get rid of this affliction, the dung of affected calves should be got examined.
2. Deworming of the calf with known anthelmintics (worm dose) such as tablets of Decaris, Helmonil, oil of turpentine arecanut, asafoetida or tender leaves of neem with salt should be practiced.
3. Hygienic and sanitary condition of house and environment are primary preventive measure
4. Clean and fresh feed and water should be provided.

7. SKIN DISEASE (RING WORM)

Skin disease is a common occurrence among young suckling calves. Housing calves under unhygienic conditions, improper grooming and brushing and parasites like ticks, flies, lice, etc are the factors responsible for this condition.

In affected calves, hairless patches on the head, neck, face and sometimes on the legs are formed. They also get itching and irritation, which can be noticed. The animal rubs against walls, posts and trees.

Managemental Intervention:

1. Affected animals should be isolated.
2. Clip the hairs on the affected parts, remove crusts, clean the surface and paint it with tincture iodine.
3. Apply antifungal ointments such as Mycozol on the affected portion.
4. Natamycin can be applied as a spray to all parts of the animal and to all calves in a group.
5. Sometimes painting the affected portion with the juice of *Leucas aspera* or applying oil obtained by burning coconut oil, are also effective.
6. The calves should be given good nourishing diet and cod liver oil.
7. Thoroughly clean and disinfect the environment between batches of calves, disinfecting buildings and objects that could house fungal spores.
8. Vaccinate – only if there is a severe problem

CONCLUSION

While, the agents that cause disease are always there and can be extremely important in a disease outbreak, clean calves with good colostrum management, consistent feeding with plenty of calories in the diet and proper housing management practices can keeps calve healthy and disease free even if they become infected. The five C's formula (Colostrum, Cleanliness, Comfort, Calories and Consistency) may provide an effective approach for managing the young dairy calf.

Donkey Milk –A Great Substitute Of Human Milk

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Donkey – "the poor man horse" has been working together with human civilization for centuries. Donkey milk has been studied less in the past, but recently donkey milk is getting more attention due to its unique composition and therapeutic value. High lactose, low fat, high whey protein content and other micro elements profile make this milk very close to human milk. Apart from nutritional benefit donkey milk has plenty of therapeutic effect like anti carcinogenic effect and anti-atherosclerosis effect. Moreover DM is used for the treatment of several diseases such as stimulation of the immune system, diarrhoea, gastric disorders (because it contains proteins with antimicrobial activity), prevention of osteoporosis (because it has high amount of calcium), cardiovascular disease, high blood pressure, high cholesterol level and liver problems (because of its high PUFA content, low ω6 to ω3 fatty acids ratio and low energetic value).

Donkey (*Equus asinus*) is a member of the horse family .The donkey (*Equus asinus*) domestication began about 6000 BC in present-day Libya, starting from one or two subspecies of African wild asses (*Equus africanus*). China with about 8 million has the highest donkey population world-wide. Donkey – "the poor man horse" has been working together with human civilization for centuries; the most common role is for transport. Compared with ruminant's milk, donkey milk has been studied less in the past, but in the last few years research interest for its composition, is similar to that of human milk also to clear up its legendary cosmetic and therapeutic properties.

Donkey milk very close to human milk

Except fat, composition of donkey milk, is very close to human milk, the low content of total proteins, particularly rich in whey proteins, high level of lactose, together with the peculiar mineral composition makes it more comparable with human milk than cow milk.

Composition of Different species of milk

Component	Cow	Donkey	Mare	Human
Fat, g/l	40	11	13	40
Protein, g/l	34	17	21	19
Lactose, g/l	48	66	64	65
Minerals, g/l	7	4	4	2
Solids not fat, g/l	90	92	93	73
Total solids, g/l	133	102	105	121
Cholesterol, mg/l	140	22	45	200
Calcium, mg/l	1200	680	890	320
Phosphorus, mg/l	930	500	560	140
Saturated FA, g/l	24	4	4	18
Monounsaturated FA, g/l	11	2	3	16
Polyunsaturated FA, g/l	1	4	5	5

Donkey milk composition depends on stage of lactation, feed, breed and the season of parturition . The average yield of donkey milk is 0.6-1.66 kg /day .

Carbohydrate content in Donkey milk

Lactose is the main carbohydrate of milk, in case of Donkey milk lactose content is generally around 6% -7% depending on the breed of Donkey, that is very similar to human milk lactose percentage. The high lactose content leads to osteogenesis processes improving the intestinal absorption of calcium, phosphorus and influencing the mineral accumulation in bone structure, which is useful for the prevention of osteoporosis.

Protein composition of Donkey milk

Proteins content of donkey milk ranges from 1.3% to 2.0%, lower than of cow milk (3.2%), and with a low casein/whey ratio (1.04 on average). Whey protein fractions are 35-50% of total protein for donkey milk , while in case of cow milk it represents only 20%. Casein content in donkey milk average 40-47 % of total protein which decreases during advancing of lactation. αs1-and β-caseins are the main casein of donkey milk but αs2-, γ-and k- caseins are not found in donkey milk. The three major whey proteins of donkey milk are α-lactalbumin, β-lactoglobulin and lysozyme. The percentage of 8 essential AA in donkey milk protein is 38% or higher than that of cow milk.

Fat content in donkey milk

The amount of fat in donkey milk is lower as compare to other species, though the fat content in donkey milk are affected by breeds, breeding systems, milking technique and interval of milking. Polyunsaturated fatty acids (PUFA) (ω6 and ω3) (52.2%) are higher in Donkey milk .Among minor PUFA like DHA and EPA are also present in minute amounts in donkey milk fat.

Minerals in donkey milk

The Ca, P, K, Na and Mg concentrations of donkey milk are very similar to those in mare milk and intermediate the higher values of ruminant milk and the lower values of human milk. However, the milk concentrations of macro minerals change

with the advancing of lactation showing a decrease in Ca, P and Mg contcentration.

Vitamins in donkey milk

The amount of several vitamins has not yet been detected in donkey milk. In DM, niacin (vitamin B3), thiamine (vitamin B1), riboflavin (vitamin B2) and cobalamin (B3) are higher than in human milk . The level of vitamin E is lower than that of human milk.

Microbial quality of Donkey milk

In fresh donkey milk, the somatic cell count (SCC) as well as the total bacterial count is reported to be lower as compare to fresh cow milk and shelf life of donkey milk is reported higher than that of cow milk. Higher shelf life and lower bacterial count in donkey milk is due to the presence of high level of antimicrobial substances such as lactoferrin and lysozyme.

Donkey milk in human nutrition

Today donkey milk is used both in human nutrition and in cosmetic. It is claimed to have special therapeutic properties due to the particular composition including high levels of whey protein, lactose and minerals and a low amount of fat. Donkey milk is a good substitute of breast milk , although it needs to be supplemented with about 4% medium-chain triglycerides to reach the right amount of lipids . Moreover DM is used for the treatment of several diseases such as stimulation of the immune system, diarrhoea, gastric disorders (because it contains proteins with antimicrobial activity), prevention of osteoporosis (because it has high amount of calcium), cardiovascular disease, high blood pressure, high cholesterol level and liver problems (because of its high PUFA content, low ω6 to ω3 fatty acids ratio and low energetic value). Moreover, DM induces the release of nitric oxide (NO) from human peripheral blood mononuclear cells which, being a strong vasodilator, can be recommended in the prevention of atherosclerosis

Milk protein allergy and Donkey milk

Cow milk is one of the most common cause of food allergies in children, occurring in between 0.3 and 7.5% of the infant population. Most studies revealed that β-lactoglobulin are the main allergens in cow milk. β- lactoglobulin content are less in donkey milk as compare to cow milk , it is also a good source of essential fatty acids; this category of fatty acids are very important in the diet of patients with Cow Milk Allergy (CMA), especially if affected by multiple food allergy.

CONCLUSION

In conclusion, donkey milk has been indicated as a valuable and safe source for the nutrition of cow-milk intolerant infants as well as an interesting nutraceutical food for older people, therefore as a brand new functional food. Compositional analysis of Donkey milk suggests that donkey milk is very similar to human milk, so humanization of donkey milk is easier than other species milk. Recent studies also suggested that presence of high quantity of antimicrobial and antioxidant substances make this milk valuable for pharmacy industry as well as cosmetic industry. In future more researches are needed for potent application of donkey milk and to know its physico- chemical changes during processing of various dairy products.

Management of Mastitis In Dairy Cows

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Mastitis is the inflammation of the mammary gland and udder tissue. It is a major endemic disease of dairy cattle. It usually occurs as an immune response to bacterial invasion of the teat canal by variety of bacterial sources present on the farm, and can also occur as a result of chemical, mechanical, or thermal injury to the cow's udder. Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and permanent damage to the udder occurs. Mastitis can be present in a herd sub clinical state. Practices such as close attention to milking hygiene, culling of chronically-infected cows, good housing management and effective nutrition to cows is necessary to promote good health and control herd mastitis. Mastitis is most often transmitted by contact with the milking machine, contaminated hands, bedding materials and other equipment. Mastitis treatment and control is one of the largest cost to the dairy industry around the world.

Mastitis is a common and costly disease in dairy animals. Mastitis in cattle considered the most important disease affecting milk production and reproductive efficiency. In India, the economic loss due to mastitis have increased about 115 fold in last five decades The detrimental effects of clinical mastitis on reproduction are more evident when cows experience both clinical mastitis and other diseases. Mastitis is the inflammation of mammary gland, and can be triggered by many factors such as trauma, injury to udder, infection due to microorganisms and chemical irritation (Philpot and Nickerson, 2000). The losses due to mastitis occur in the form of:

- Milk discarded due to poor milk quality.

- A reduction in yields due to illness and permanent damage to udder tissue.
- The extra labour required for mastitic cows.
- The costs of veterinary care and medicines.
- The cost of reduced longevity due to premature culling.

(Smith *et al*., 1985; Oliver, 1988; DeGraves and Fetrow, 1993)

SYMPTOMS OF MASTITIS

In some instances the cow's immune response is sufficient to efficiently generate a self-cure for the illness, usually in mild cases of the disease where the cow is strong and has a good immune response. Other cases can result in more severe illness, perhaps even leading to loss of a quarter or more of the udder, the loss of body tissue due to gangrene and in worse case situations, death. The incidence of mastitis is directly related to changes in the composition, magnitude, and efficiency of the mammary gland defense system. However, many different aspects of bovine mammary gland defenses are suboptimal during distinct periods of the lactation cycle, particularly around the transition period (Sordillo and Streicher, 2002).Clinical mastitis has wide degree of severity of symptoms which can range from mild to moderate to severe. The degree of illness and the symptoms present will depend on many factors, such as the breed, type of pathogen, stage of lactation, cyclicity stage, severity of infection, age of animal, nutrition and immune status of the cow. The environmental factors such as cleanliness, humidity and ambient temperature also have impact on the severity of clinical mastitis. Moderate to severe clinical cases can be very painful and sometime difficult to recover as a result culling of the effect cow is necessary. The most common symptoms of clinical mastitis are:

- Swelling, heat, hardness, redness, or pain in the udder.
- Changes in milk such as watery appearance, flakes, clots, or pus in milk.
- A reduction in milk yield.
- An increase in body temperature.
- The lack of appetite.
- Sunken eyes.
- Signs of diarrhoea and dehydration.
- A reduction in mobility, due to the pain of a swollen udder or simply due to feeling unwell.

In severe cases of acute clinical mastitis caused by *E. Coli* infections, the cow may appear very ill whereas subclinical mastitis can result in few symptoms and may only be found in a higher somatic cell count than normal animal. Most of the indicative symptoms, such as the swelling, heat, redness and the milk abnormalities are a result of an immune response in the cow, the changes in milk constituents caused by infection-fighting white blood cells attempting to eliminate the infective organisms that further lead to healing or damage of udder. Changes in milk composition even in cows with subclinical mastitis may result in significant changes in the protein composition in milk.

Causative agent of mastitis

Bacteria

- *Staphyllococus aurius*
- *E. coli*
- *Streptococcus dysgalactiae*
- *Staphylococcus epidermidis*
- *Streptococcus agalactiae*
- *Streptococcus uberis*
- *Brucella melitensis*
- *Mycoplasma species*
- *Klebsiella pneumoniae*
- *Enterobacter aerogenes*
- *Pasteurella spp*
- *Trueperella pyogenes* (*Arcanobacterium pyogenes*)
- *Proteus spp.*

TYPES OF MASTITIS

Mastitis may be classified according two different criteria: either according to the clinical symptoms or depending on the mode of transmission.

1 On the basis clinical symptoms:

- Clinical mastitis
- Sub-Clinical mastitis

2. On the basis of mode of transmission:

- Contagious mastitis
- environmental mastitis

TREATMENT OF MASTITIS

1. Antibiotic treatment

When clinical mastitis is detected, the cow is milked out and then given an intra-mammary infusion of antibiotic directly into the infected gland. Treatment is possible with long-acting antibiotics but milk from such cows is not marketable until drug residues have left the cow's system. Antibiotics may be systemic (injected into the body) or it may be forced upwards into the teat through the teat canal (intra-mammary infusion). The sign and symptom of clinical mastitis are observed by the milker through detection of clots or flakes in the milk from a cow that has a quarter sensitive to the touch (kicks a lot when you touch a particular quarter) or a quarter that is swollen or hot to the touch.

2. Intra-mammary infusion

Prior to intra mammary infusion, the teat is cleaned well and the tip of the teat is swabbed with an alcohol swab and allowed to dry for a seconds. The antibiotic put in streak canal with the help of cannula by inserting from the teat orifice. The cannula inserts completely through the streak canal but this could be carrying bacteria into the teat cistern. So it is important to clean the cannula properly before inserting in to the teat canal.

3. Non-responding cases

Those cases which are not responding to treatment often consider as chronically infected cows. The natural defense mechanism and antibiotic treatment helps fight against bacterial infection but condition is still not improve. In such case frequently stripping out the milk and require long treatment. Culling of chronically infected cows sometimes is the only way to effectively control spread of mastitis in the herd.

CONTROL OF MASTITIS

The new infections can be prevented by focusing management efforts as following:

- Detection of mastitis {by seeing the sign and symptom at milking parlour. using strip cup test and California mastitis test (CMT)}
- Identification of the causative agent

- Prevention of transmission by removing the source of the agent (milk contaminated fomites, bedding and persistently infected cows etc.)
- Hygiene of milker
- Hygiene of milking machine and milk utensil

The Knowledge of mammary gland anatomy and physiology, mammary defense mechanism, microbial habitats, microbial virulence factors, milking machine function and application of germicides is important in achieving effective mastitis control.

CONTROL OF CONTAGIOUS MASTITIS

Contagious mastitis can be effectively controlled through routine practices of teat dipping and dry cow antibiotic treatment. Teats must be dipped in germicide after each milking it will help to decrease the incidence of the disease. Each quarter must be treated with dry cow antibiotics at end of lactation. Cows with contagious mastitis should be milked last or a separate milking barn used for the infected cows. Milking claws should be flushed with hot water or germicide after Individual cloth or paper towels should be used to wash or dry teats. Milkers should have clean hands and wear gloves. The herd should be cultured and persistently infected cows should be culled. Teat lesions should be treated that occurs due to lacerations and machine damage. The proper functioning of milking machine is necessary for control of contagious mastitis. Vitamin E is a lipid soluble antioxidant that protects against lipid peroxidation initiated by free radicals and has been shown to play an important role in immune response and health of dairy cows (Spears and Weiss, 2008)

CONTROL OF ENVIRONMENTAL MASTITIS

Environmental pathogens are more difficult to control than the contagious pathogens. Many of these organisms are resistant to germicides in teat dip and antibiotics in dry cow therapy. Teats should be pre-dipped with germicide before milking. Sterile single-dose infusion products should be used and alcohol swab should be used. The milking parlor should be kept clean. The teat dipper should be kept clean. Identification of the source like bedding materials, dust on the corners of milking utensil and its removal can help to control the infection causing organisms. Zinc plays an important role in maintaining health and integrity of skin due to its role in cellular repair and replacement, and by increasing the speed of wound healing (Sordillo *et al*., 1997). Udders can be clipped to minimize the dust present on the hair over the udder. Only clean dry teats should be milked.

VACCINATION FOR MASTITIS

The development of potential vaccines to prevent or control mastitis continues to be an important goal. Vaccines are available for infection caused by *E. coli* and *Staphylococcus aureus*. A vaccine improved the spontaneous cure rate, but had no effect on the rate of new IMI (Pankey *et al*.,1985).Vaccination has been unsuccessful in reducing the number of new cases of mastitis. Some vaccines have been effective in improving spontaneous cure rates and reducing severity of infection. These vaccines result in an

increase in all types of leukocytes in the gland, thus improving defense. Overall, the success of vaccination has been minimal. Mastitis is multifactorial in origin that is also a difficult one for controlling through vaccine.

CONCLUSION

Mastitis cause heavy economic losses to dairy farmers. The farmers should pay extra attention to mastitis prevention and control, especially around the time of breeding. The appropriate management of lactating dairy cows to minimize the incidence of mastitis should increase the profitability of dairy herds by improving the milk quality, reducing the use of antibiotics, reducing the amount of milk discarded, reducing involuntary culling and improving reproductive performance. The segregation of the effected cow is necessary to prevent the spread of infection to healthy herd.

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Burning Problem of Stray Animals

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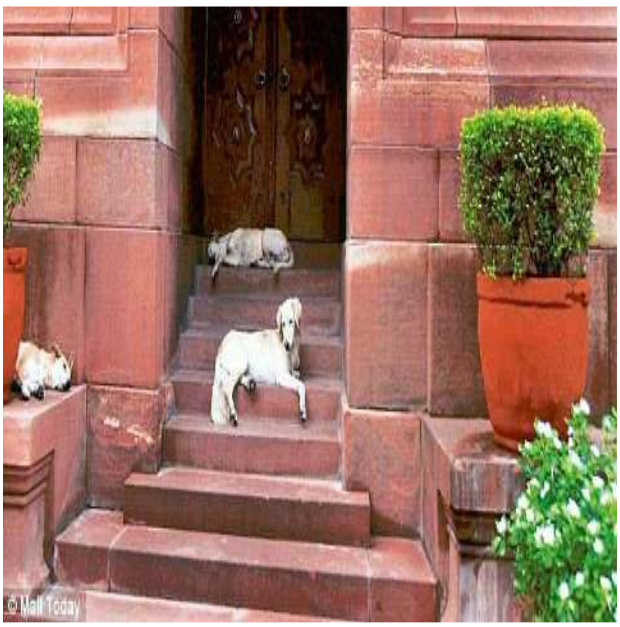
"OUR CHALLENGE FOR THE NEXT 10 YEARS IS TO CHANGE FUNDAMENTALLY THE THINKING OF GOVERNMENTS IN MANY DEVELOPING COUNTRIES WITH REGARD TO STRAY ANIMAL CONTROL. WE NEED TO HELP THEM SEE THAT RESPONSIBLE PET OWNERSHIP, ACHIEVED THROUGH LEGISLATION AND EDUCATION, IS INSTRUMENTAL IN REDUCING THE CYCLE OF INCREASING STRAY ANIMAL POPULATIONS."
~ Trevor Wheeler, Middle East Projects Director, WSPA

What is a 'Stray'?

'Stray' is a general term given to any domestic animal found roaming freely without human supervision. Strays depend on humans for most of their essential resources, such as food. They live virtually wherever cities exist, especially in the developing world where the local human population allows. Stray animals may be pets, cattle, pig, sheep and goat population in hilly areas which are simply allowed freedom by their owners. In 2012, the WHO estimated that India accounts for 20,000 rabies cases every year. India easily leads the world in numbers of street pigs, but relatively few are completely feral. Much of the Indian domestic pig population roams the streets to forage. Still there is large population of free roaming sheep, goat population in hilly areas of India.

Why are there so many stray dogs here anyway? Why aren't there any in



London and New York? Stray dogs are scavengers and garbage provides an ample source of food for them. In the absence of this food source, dogs would not be able to survive on the streets. There are stray dogs in developed countries too – but they are abandoned pets, or feral dogs. They are unable to survive or breed on city streets since they can find nothing to eat. Most are captured, housed in animal shelters and rehomed.

Herds of strays:

Block traffic and cause traffic jams / hazards / accidents. There are numerous incidents of two wheeler accidents caused by stray dogs annually. Scavenge for mounds of garbage dumps in the polluted streets/roads in order to graze it. Give milk that spreads diseases such as tuberculosis, which causes 5,00,000 deaths each year (in India).They Causes one of the deadly disease in humans like rabies which

accounts for lakhs of death every year in the world. Defecate on roads and clog sewers with dung. Add to the cities' garbage problem by rummaging through dustbins or garbage bins, spreading / littering trash, looking for food. They can be seen tearing open plastic garbage bags in search of food and leaving trails of dung. Occupy parks and land in residential areas. Share public spaces with humans. Squat and nap on busy roads / highways / intersections, and mingle among vendors in city markets.

LEGAL AUTHORITY AND ENFORCABLE LAWS MADE BY INDIAN GOVERNMENT

PLEASE ENFORCE…

Free roaming or wandering stray cattle come from illegal or unauthorised or

unregistered or unlicensed roadside dairies and cattle sheds. Delhi High Court (HC) has ruled that their menace to the city dwellers is a violation of the Fundamental Right `Right to Life' guaranteed by Article 21 of the Indian Constitution.

STEP TAKEN BY GOVERNMENT AND MUNICIPAL CORPORATIONS

The Animal Welfare Board of India (AWBI), a statutory body under the Environment and Forests Ministry, is struggling to rope in NGOs and animal welfare groups to implement the recently-approved National Rabies Control Pilot Project. The health ministry recently approved the implementation of the pilot project in Haryana for mass sterilization and vaccination of street dogs. The plan is to implement the project in other states if it proves successful in Haryana. Currently the work of sterilizing stray dogs done by only many NGO's all over India. This is a huge challenge - controlling this large population with such a small budget.

Animal Helplines in Delhi NCR region and also bird rescue helpline are working which are run by NGO'S and paid heavily for this work. The Delhi HC in 2002/2003/2004 has ordered / directed the Delhi government to cancel the license of a dairy or cattle shed in case the cattle belonging to it stray out of its dairy's or cattle shed 'premises. To prosecute the stray cattle owners who let their cattle roam the city streets freely, under Section 289 of the Indian Penal Code. To disconnect water and power connections to all illegal dairies and cattle sheds (April, 15, 2004). The section 289 IPC provides a minimum jail term of six months and maximum of one year and imposes a fine (for/on each animal/stray) on the owner if he fails to prevent his cattle/animal from causing any "probable" danger to human life, or a probable danger of grievous hurt to any other person.

Recommendations - Strategies for dealing with stray animals

There are three main ways that this can be done:

Legislation, education and sterilization**.**

Legislation

Legislation includes both national or primary laws that set out the main principles of stray control and animal protection, and by-laws that provide detail and allow for local differences. Registration can also be used to encourage neutering of owned animals by offering free or reduced registration of neutered animals. Legislation should require that all animals to be vaccinated against zoonoses that can endanger humans. Animal welfare officers can be employed to enforce the legislation at 'ground level'. Legislation is the responsibility of governments and local authorities.

Establishment of Village gosadans

Each village should have one Gosadan to take care of the stray cattle of the area. Also the seasonal left-outs can be

accommodated therein. The Gosadan has to be managed by the village community, with full involvement of the Village Panchayat. A

'Gosadan Committee' can be constituted in the meeting of Gram Sabha comprising persons from all walks of life. Technical persons such as from agriculture and veterinary side should invariably be co-opted on this committee. The State governments are required to make provisions regarding constitution of 'Gosadan Committees' in their respective Panchayati Raj Acts. Go-sadan can have a bio-gas plant of a suitable size to take care of its energy requirements for fuel, light and water pumping. Agencies like K.V.I.C., DRDAS and Non-Conventional Energy Development agencies can assist these Go-sadans in establishing Bio-gas plants.

ANIMAL BIRTH CONTROL PROGRAMMES

Neutering/Sterilisation of Owned Animals

Animal Welfare Board of India (AWBI)

wishes to promote the humane and effective population control of street / stray dogs through the use of Animal Birth Control (ABC) programmes in all municipal areas, including small towns and rural areas. Rabies and dog bites present a significant cause of human suffering and financial loss to the country.

EDUCATION/Responsible dog ownership

Training owners to care for dogs humanely and pushing for better dog population management reduce conflicts between humans and dogs, and help progress spread. Select a pet that's suited to your home and lifestyle.

Keep only the type and number of pets for which you can provide appropriate food, water, shelter, health care and companionship. Commit to the relationship for the life of your pet(s). Provide appropriate exercise and mental

stimulation. Properly socializes and trains your pet.

Reducing the Carrying Capacity

Animal proof and more regular removal of waste can effectively reduce the carrying capacity of the environment. Specific problem areas such as parks, city centres and main roads can be targeted to ensure that stray animals do not enter these areas to forage, hence reducing the nuisance complaints and keeping animals away from

fast moving traffic. Education programmes can also help to change people's littering habits and encourage responsible waste disposal.

Reuniting Lost Animals

Any programme that involves collecting stray animals from the streets should take

into account that some of these animals may be owned and provision should be made for owners to be reunited with their lost animals. Registration and identification will facilitate this process immensely. Tiny computer microchip ID (used in Delhi and Punjab) has been developed by the Spanish company Rumitag Costs Rs.500/600/900 ($10/12/22) Is hidden or put in an oral chalk-white and round-tipped ceramic capsule or pill made of a non-toxic inert metal of the size of a shotgun shell. Capsule is heavy enough so that it settles down in the rumen or reticulum and doesn't slip into the "fourth stomach", where most of the digestion takes place. The computer chip is shot down its stomach. Each chip has a Unique Cattle Identification (UCI) or serial Number that reveals / carries all relevant details like data on age, breed, owner's name and details, dairy to which it belongs, the health history, vaccination details and sale/ purchase details.

Re-homing

A clean, safe and healthy environment that meets both biological and psychological needs of all animals kept in the centre. Quarantine for all incoming animals to safeguard the current inhabitants from infectious diseases. Veterinary treatment and prophylactic disease measures should be available for all animals. Limitation on numbers housed at any one time to avoid compromising the welfare

Catch Neuter and Release (CNR) Programmes

CNR comes under many names, including

Trap, Neuter and Release (TNR) and Animal Birth Control (ABC). It essentially involves catching stray animals, sterilizing them, vaccinating them and then releasing them back to the place they were initially caught.

Role Of Trace Minerals In Production And Reproduction In Dairy Cows

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Minerals are essential for growth and reproduction and are involved in a large number of digestive, physiological and biosynthetic processes within the body. The mineral elements that are of particular importance are categorised into major (calcium, phosphorous, potassium, sodium, chlorine, sulphur and magnesium) and trace elements (iron, iodine, copper, manganese, zinc, cobalt, molybdenum and selenium). The minerals that affect reproduction in cattle are generally found within the trace element group, although deficiencies of calcium and phosphorus can also affect fertility.

The changing trends in animal production require the owner/manager to become more efficient in all aspects of the production cycle. Major contributors to economic returns include reproduction and nutritional management of the herd. To maintain high milk output, calving interval should be shortest, which means that post-partum uterine involution, anestrus and the duration of pregnancy in the cow should be given due consideration. The time of rebreeding may coincide with a period of high milk production and possibly with a period of negative energy balance. These nutritional stresses can affect the reproductive system and may be manifested as delayed return to cyclicity and failure to become pregnant.

Trace elements, though required in minute quantities (less than 100 mg/kg dry matter), are essential for maintaining health and immunity. They are involved in growth, production and reproduction. Trace elements act as cofactors of enzymes which are important to the immunity of animal. Superoxide dismutase, glutathione reductase, glutathione peroxidase, thioredoxin reductase, ceruloplasmin and catalase are important enzymes that have trace elements as cofactors. These enzymes act as antioxidants and prevent oxidative stress by neutralizing oxidants produced under different stresses. Besides, trace elements contribute to general health of animal thereby enhancing disease resistance. Trace elements are important for proper functioning of a number of enzymes and proteins which are involved in many physiological, biochemical and metabolic processes that contribute to growth and production. Overall, trace elements improve immune competence and productive performance.

The relationship between nutrition and reproduction in ruminants is complex and often quite variable. However, nutrient supply is a component of the management system that is under the control of the

producer and needs to be carefully evaluated. Nutrient requirements to support follicle growth, ovulation and early pregnancy are extremely low (less than 3 MJ/day) compared with requirements for maintenance and production (60-140 MJ/day). Nevertheless, in the case of lactating cows, inadequate nutrition in the short term, or as a consequence of a prolonged depletion of body reserves during early lactation, can have significant deleterious effects on resumption of ovarian activity for postpartum conception and fertility. In addition, the deleterious effects of nutrition around mating on embryo development are evident. In cattle, the degree of energy deficit during the first few weeks after calving is closely correlated with the interval to first oestrus, and other markers of reproductive success such as conception rate to first service, services per conception and calving to conception interval. In addition differences in negative energy balance (NEB) among cows is large and the NEB is more severe in third parity or older cows than in first parity animals.

FUNCTIONS OF TRACE MINERALS

Trace mineral functions can be described by four broad categories as under:

1. Structural function

These functions refers to minerals forming structural components of body organs and tissue. An example is the contribution of zinc to molecular and membrane stability.

2. Physiological function

Physiological funations occur when minerals in body fluids and tissues act as electrolytes to maintain osmotic pressure, acid base balance, and membrane permeability.

3. Catalytic function

These functions are probably the largest category for trace minerals as it refers to catalytic role of metallo-enzymes in enzyme and hormone systems. Trace elements serve as structural components of metalloenzymes. Upon removal of the trace elements, enzyme activity is lost. There are numerous metalloenzymes that are required for a wide range of metabolic activities such as energy production, protein digestion, cell replication, antioxidant activity and wound healing.

4. Regulatory function

Regulatory functions is exemplified by the role of zinc to influence transcription and iodine serving as a constituent of thyroxine, a hormone associated with thyroid function and energy metabolism.

Minerals interrelationships in animals:-

Balance among the nutrients, protein, energy, minerals and vitamins, is a key component in striving towards optimum animal production. Balance among the trace minerals themselves is also important consideration and often poses a large challenge due to antagonist interactions that can occur between minerals. The primary interactions that are recognized include the negative impact of high molybdenum and sulfur levels on copper absorption, interference caused by high iron levels for absorption of zinc, copper and manganese, and decreased zinc absorption in the presence of high dietary calcium. One trace mineral interaction that is often overlooked is that of zinc and copper. In order to maintain optimal status of both elements, dietary levels should be within a 1:3 up to 1:5 ratio of copper: zinc.

Many of today's animal production systems and expectations for performance induce periods of stress to the animal. In the presence of stress, trace mineral status of the animal is critical in minimizing negative effects on production.

SOME IMPORTANT TRACE MINERALS

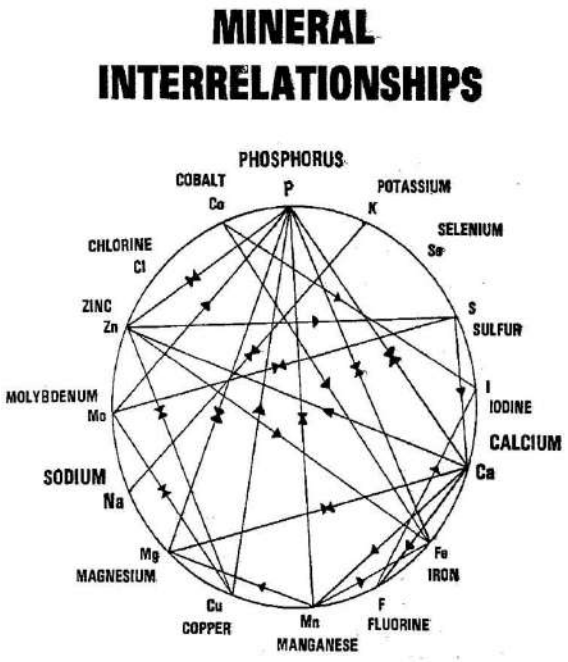
Copper (Cu)

Copper functions in the immune system through the following: energy production, neutrophil production and activity, antioxidant enzyme production, development of antibodies and lymphocyte replication. The importance of copper for maintaining the functions of the immune system has been demonstrated in several studies. Viral and bacterial challenges have been shown to increase serum ceruloplasmin and plasma copper in copper-depleted cattle indicating a major protective role for copper in infectious diseases. Low copper status has resulted in decreased humoral and cell-mediated immunity, as well as decreased neutrophil bactericidal capability in steers. Lower than normal tissue reserves in the fetal calf as a result of deficiency in the dam can impair development and growth. Increased incidence of scours, occurrence of abomasal ulcers shortly after birth and respiratory problems have both been attributed to inadequate copper levels in newborn calves.

The biological role of Cu is exerted through a number of Cu-containing proteins including ceruloplasmin and superoxidedismutase (SOD). When Cu is inadequate in animals, physiological and metabolic functions related to the Cu-enzymes may be impaired and, during clinical deficiency, symptoms will appear. Although low Cu content of feedstuffs is a common cause of Cu inadequacy, reducing bioavailability of Cu in ruminants may occur when dietary sulphur, molybdenum, zinc or iron are high.

Zinc (Zn)

zinc deficiency in ruminants has been postulated to weaken skin and others



tratified epithelia as well as reducing the magnitude of basal metabolic rate. Zinc is a cofactor for many proteins and enzymes involved in the acute phase response to infection and inflammation. Because the mammary gland is a skin gland, it is highly likely that zinc will have a positive role in its protection. Skin integrity of the teat has been shown to be especially linked with mastitis prevention. The keratin lining of the teat canal has been described as a physical and chemical barrier for protection of the mammary gland. Keratin lining may physically trap bacteria and prevent

migration into the mammary gland. Supplementation with zinc decreased the rate of new intramammary infections.

Zinc activates several enzyme systems and is a component of many metalloenzymes. It plays a vital role in hormone secretion, especially relating to growth, reproduction, immunocompetence and stress. Zinc is also involved in the generation of keratin and in skin nucleic acid and collagen synthesis. It isessential to the integrity of the immune system, in cation/anion exchange (and therefore water balance) as well as in the maintenance of normal vitamin A concentration in plasma and in ovarian function. Many animals therefore require supplemental Zn in the diet for normal body function because of either low levels in the dietary ingredients or the presence of antagonistic factors which decrease the bioavailability of the element. Antagonism might be due to metal ion interactions such as with Fe or Cu.

Manganese (Mn)

Manganese (Mn) is involved in the activities of several enzyme systems including hydrolases, kinases, decarboxylases and transferases as well as Fe containing enzymes which require Mn for their activity. It is therefore involved in carbohydrate, lipid and protein metabolism. It is also needed for bone growth and maintenance of connective and skeletal tissue. Mn also plays a role in reproduction and in immunological function. In pigs, Mn deficiency results in abnormal skeletal growth, increased fat deposition, reproductive problems and reduced milk production.

Selenium (Se)

Selenium (Se) is a semi-metal that is very similar to sulphur in its chemical properties. It is an essential constituent of the glutathione enzyme system; and a deficiency of Se will leave cells vulnerable to oxidation and increase the requirement for Vitamin E.

Effects of trace minerals on reproduction

Trace elements are essential for reproduction. Trace elements are important for reproductive performance in livestock because their supplementation improves reproduction. They are also involved in synthesis of hormones that are important for reproduction. Their deficiency affects both steroid and thyroid hormone production.

Reproductive performance of cattle may be compromised if zinc, copper, or manganese status is in the marginal to deficient range. Common copper deficiency symptoms in cattle include delayed or suppressed estrus, decreased conception, infertility and embryo death. Inadequate zinc levels have been associated with decreased fertility, abnormal estrus, abortion, and altered myometrial contractibility with prolonged labor. Manganese deficiency in cows results in suppression of conception rates, delayed estrus in post-partum females and young prepuberal heifers, infertility, abortion, immature ovaries and dystocia.

Dairy producers can benefit from year round complexed trace mineral supplementation due to additional effects such as enhanced milk production and reduced somatic cell counts. Improving

reproductive performance of dairy cows by achieving confirmed conception rates early in the breeding period could have economic returns to the producer.

EFFECT ON PRODUCTION

Balance among the nutrients, protein, energy, minerals and vitamins, is a key component in striving towards optimum animal production. Balance among the trace minerals themselves is also important consideration and often posses a large challenge due to antagonist interactions that can occur between minerals. The study showed that zinc has negative effect on copper status. Liver copper decreased 41% in 90 days when zinc was added to the diet to provide 90 ppm in the daily dry matter intake and no additional copper was added. The study also showed a synergistic effect of zinc and copper supplementation. Liver copper increased 103% with addition of copper and zinc together compared to a 26% increase with copper alone. To support this research from an animal performance perspective, Lee (1993) reported improvement in gain for calves grazing wheat pastures with the addition of zinc and copper that surpassed gains of cattle receiving either zinc only or copper only.

Mineral status in cattle using liver mineral concentrations

	Deficient	Marginal	Adequate	High	Toxic
Cobalt	<0.005		0.020-0.085	0.085-8.70	5.0-300
Copper	<33	33-125	125-300	600-1250	>1250
Iodine	<0.094		0.094-2.0		>0.781
Iron	<40		45-300	53-700	
Magnesium	<40-200		100-250		
Manganese	<5	5-10	10-15	15-25	
Phosphorus	6-14		6-14		
Potassium					
Selenium	<0.5	0.6-1.25	1.25-2.50	>2.5	
Zinc	<20	20-40	25-200	300-600	>1000

Source: Puls (1988) and Kincaid (1999)

EFFECT OF TRACE MINERALS ON GROWTH

Enhanced profitability of many animal production units is dependent upon optimum gain and efficient feed conversion of livestock. One of the first indicators of a marginal zinc deficiency is a depression in gain and conversion that are often present prior to any change in blood or liver levels. Providing adequate levels of bioavailable trace minerals can affect growth performance. In view of the role of trace minerals in growth, zinc, copper and manganese all serve as components in numerous enzyme systems associated with carbohydrate and protein metabolism.

Manganese is also instrumental in skeletal development and growth. Copper is required for synthesis of collagen and elastin fibers that provide structure and elasticity to connective tissue and blood vessels. Zinc is essential for epithelial tissue integrity, cell division and repair, and

uptake transport mechanism and utilization of Vitamins A and E.

EFFECT OF TRACE MINERALS ON IMMUNITY

The immune system is a highly developed mechanism that utilizes a diverse cell population to protect its host against invasion of bacteria, fungi, parasite and viruses. Trace minerals that have been identified as important for normal immune function and disease resistance include zinc, iron, copper, manganese and selenium. A deficiency in one or more of these elements can compromise immuno-competence of an animal. The first level of defense in the immune system is the skin. Zinc and manganese are key elements for maintaining epithelial tissue integrity. As we consider epithelial tissue, we must also recognize that the lining of the respiratory tract, lungs, gastro-intestinal tract and reproduction tract are also epithelial tissue. Maintaining the integrity and health of the tissue in these areas can result in a reduction of infiltration by pathogens.

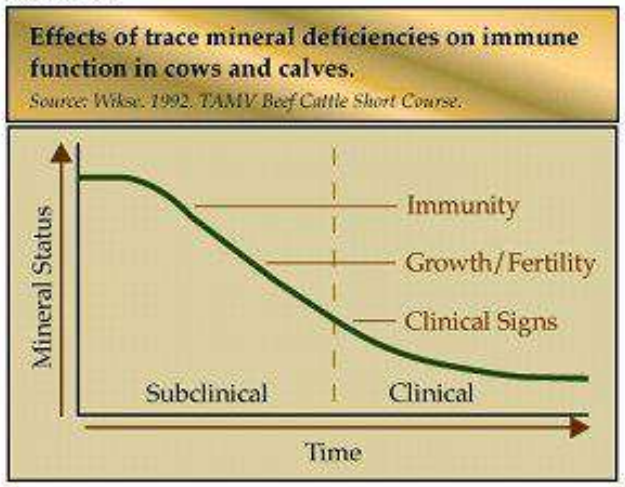
The 100-Day Contract in dairy animals feeding

The '100-day contract' with the dairy cow begins 30 days before calving and continues for 70 days after calving . This includes the final growth of the calf in utero, the birth of a healthy calf, a healthy cow during the period of maximum productivity, controlled loss of body condition and optimizing fertility at first breeding. A cow suffering from milk fever is at increased risk for retained placenta, left displaced abomasums, and/or ketosis.

As the median day indicates most of these diseases are likely to occur during the period immediately following calving. However, these disorders have an impact on production and reproduction during the entire lactation. These disorders disrupt the

cow's metabolic momentum towards high milk production and also have a negative effect on reproduction. Balancing energy and protein are critical in achieving maximum production and also reproduction.

Figure 1



As mineral status falls over time, immunity is affected first, followed by growth and fertility problems, and, finally, clinical signs of trace mineral deficiency.

Micronutrients, including minerals and vitamins are important in achieving optimum production. Several minerals and fat-soluble vitamins have been associated with reproductive performance. Of the macro minerals, calcium:phosphorus ratios and total intake of the minerals are important in preventing milk fever at calving. Phosphorus intake should be kept at a ratio of about 1.5: 1 relative to calcium. Cows suffering from milk fever are more prone to retained fetal membranes, a prolapsed uterus and metritis. Therefore drycow nutrition is important in prevention of these disorders and problems.

Two micronutrients associated with enhancing reproductive performance are zinc and selenium. The specific role of zinc in reproduction is not well defined, but animals deficient in Zn have been shown to have lower concentrations of FSH and LH, particularly in males. Zinc supports tissue healing and may be important in the postpartum involution as well as in mammary gland health. Zinc is also a component of enzyme systems that may influence hormone synthesis. Zinc has been shown to decrease the incidence of lameness in dairycows. Lameness has been associated in a significant increase in days to first service, days open and services per conception.The role of Selenium in reproduction has been more thoroughly established.

Supplementation of Se and Vitamin E have been shown to decrease the incidence of retained placenta, metritis and increased the rate of uterine involution. Vitamin E and Se reduce tissue damage and function and maintain tissue integrity. This could enhance the uterine environment and support better fertility.

CONCLUSIONS

Trace elements are required for numerous metabolic functions in livestock, and optimal production and performance require adequate intake of balanced trace minerals. As trace mineral status of the animal declines from adequate to marginal, immunity and enzyme function are compromised followed by the loss of performance and reproduction. Animals in a subclinical or marginal deficiency status are often difficult to identify; however, changes in a trace mineral program can result in improved production. Immunity, growth and reproduction are influenced by trace minerals. Formulation strategies should account for mineral forms, levels and for possible synergistic combinations such as zinc to copper ratios.

Colostrum: A Wonder Nutrition For New Born Calves Of Cattle And Buffaloes

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The first secretion from the mammary glands of cattle and buffaloes after giving birth to the calves is usually called colostrum. It is a wonderful gift of nature to the young ones to boost their new life on earth. Colostrum is available for the first 4-5 days of lactation. The consistency is usually thicker than milk with slightly more yellowish colouration. When colostrum is transformed to usual milk in the mammary gland, there is decrease in content of total protein, total solids, immunoglobulins and total ash with increase in lactose content. Calves should receive colostrum from their mothers within 2 hours of birth and the process should continue up to first 4 days of birth. If calves are not able to take by themselves, then they should be fed manually. Colostrum is a superb blend of several essential factors for the new born of which the immunoglobulins are most important. These are natural antibodies and up on ingestion, they provide protection to the new born from several deadly diseases. As a result, the immune system gets charged up. After birth, the concentration of immunoglobulins rapidly decreases in colostrum. After first milking, the concentration is reduced to about half while after fifth milking it becomes almost equal to that of milk. The concentration of immunoglobulins in colostrum of first milking is about 2-10 times than of blood serum of the mother cow. These antibodies can directly enter to the blood stream of calves up to 24 hours after birth, but after that they get destroyed in digestive tract of the calf and the immunity power is almost lost. Therefore it becomes very important to make sure about the availability of these antibodies to the calf as early as possible after birth. The major compositional difference between milk and colostrums is that the concentrations of protein and antibodies are pretty high in colostrum while the level of lactose is higher in milk. The nutritive value of colostrum is more and it also acts as a mild laxative for smooth expulsion of meconium (first faeces) from calves. Usually calves receive the colostrum from their mothers by themselves. But situations may arise where the calf is not able to take colostrum or the mother dies just after parturition. In such conditions, colostrum can be collected from the mother and fed to calves of any other mother manually. Colostrum can be preserved at 4^0 C temperature for 1 week and at -20^0 C temperature for longer durations. Preserved colostrum should be warmed to 35^0 C temperature before feeding to calves.

Table 1: Composition of colostrum (first 24 hours after calving) and milk

Component	Colostrum	Milk
Fat (%)	3.6	3.5
Total solids (%)	22.5	12.5
Solid not fat-SNF (%)	18.9	9.0
Lactose (%)	3.1	4.6
Protein (%)	14.3	3.3
Casein (%)	5.2	2.6
Albumin (%)	1.5	0.5
β- lactoglobulin (%)	0.8	0.3
α- lactalbumin (%)	0.27	0.13
Serum albumin (%)	0.13	0.04
Immunoglobulin (%)	5.5-6.8	0.09
Ash (%)	1.8	0.8
Calcium (%)	0.26	0.13
Phosphorus (%)	0.24	0.10
Magnesium (%)	0.04	0.01
Sodium (%)	0.07	0.06
Potassium (%)	0.14	0.16
Chloride (%)	0.12	0.10
Iron (mg per 100 g)	0.20	0.05
Copper (mg per 100 g)	0.06	0.02
Vitamins		
Carotenoids (µg/g fat)	35	7
Vitamin A (µg/g fat)	45	8
Vitamin D (ng/g fat)	30	15
Vitamin E (µg/g fat)	125	20
Thiamine (µg/100 g)	60	40
Riboflavin (µg/100 g)	500	150
Niacin (µg/100 g)	100	80

Table 2: Physical properties of colostrums and milk

Properties	Colostrum	Milk
Colour	Yellowish	Whitish to slightly yellowish
Taste	Slightly bitter	Sweet
Odour	Abnormal	Normal
Acidity	0.2 to 0.4	0.12 to 0.14
Freezing point (^{0}C)	- 0.606	-0.52 to -0.56
Specific gravity	1.05 to 1.08	1.029 to 1.032
Refractive index at 20^{0}C	More than milk	1.344 to 1.348
Electrical conductivity	More than milk	0.005 mho
Viscosity	More than milk	1.5 to 2.0 centipose

FEEDING COLOSTRUM: MOST IMPORTANT FACTOR IN CALF MANAGEMENT

Importance of colostrum feeding

The blood of new born calves contains very minute quantities of immunoglobulins. It is very important to feed the colostrum to the calves as soon as possible to ensure that they consume at least 100 g immunoglobulin G (I_g G) for better protection against diseases and good health. For ensuring adequate I_g G in blood of new born calves, at least 3 litres of colostrums is to be fed to them within 1 hour of their birth. Along with providing immune power to calves, colostrum has better nutrient availability than any other food as the nutrients are easily digestible and absorbable by calves. The ruminant colostrum contains a trypsin inhibitor which protects the immunoglobulins from digestion. The importance of colostrums is not only from its immunoglobulin content, but also the nutritive factors such as protein, fat, carbohydrate, vitamins and minerals play crucial roles in health status of calves. Colostrum is perhaps the only source of energy to the new born calves. Fat and lactose provide warmth to calves and help to maintain their body temperature. When colostrum feeding is not done, then the fat content of the body is able to provide energy only up to 18 hour in new born calves as a result the body condition breaks down which results in poor body growth. The concentration of vitamins and minerals is more in colostrum than milk. Researches have also indicated that colostrum contains many types of hormones and growth factors which facilitate growth and organ development in calves. For sufficient passive immunity in calves, about 200-300 g I_g G is necessary. Low quality, bloody or mastitis affected colostrum should never be offered to calves.

Those calves which fail to absorb sufficient amount of immunoglobulins particularly I_g G from their intestine will have blood serum I_g G level less than 10 mg/ml. Such calves will be prone to diseases like pneumonia and white scour with high mortality rate. Calves with serum I_g G level more than 10 mg/ml will be resistant to above diseases. During pregnancy, the I_g G from the serum of mother can not pass to the foetus due to placental barrier. As a matter fact the immunity status of new born calves completely depends on the availability of I_g G from colostrum only. The I_g G is absorbed from the intestine of calves to their blood and develops their immune system which is better known as passive immunity in calves.

Quality of colostrum

The quality of colostrum should be high to ensure adequate I_g G availability to calves. Colostrum quality depends on many factors such as breed of the dairy animal, number of pregnancies etc. For example: Jersey cows have I_g G level (9.0%) which is almost 2 times to that of Holstein cows (5.6%). Similarly the first calvers have less I_g G level. The I_g G level in first calvers in most of the organized dairy farms is up to 25-30% lower. Hence it may be possible that colostrum from such animals may not adequately protect their new borns. So the quality of colostrum should be checked at the earliest. There are several methods available to do this but the most convenient

is to use a colostrometer. This instrument is a type of hydrometer and measures the relative gravity (specific gravity) of colostrum. The working principle of this instrument is that the concentration of immunoglobulins is directly proportional to the specific gravity of colostrum. In simple words, colostrums with high specific gravity will have high concentration of immunoglobulins.

Table 3: Classification of colostrum quality as per colostrometer reading

Class	Concentration of I_g in colostrums (mg/ml)	Colour indication in colostrometer
Very good	50-140	Green
Moderate	20-50	Yellow
Poor	<20	Red

The temperature of colostrum directly influences the reading of colostrometer. So it should be used carefully. Most of the manufacturing companies advise to use the colostrometer when the temperature of the colostrum is about 20-25^0 C. It has been concluded from researches that the colostrometer will read more about concentration of immunoglobulins when the temperature of colostrum is below 20^0 C. On the other hand when the temperature is over 20^0 C, the instrument will read less. For example: the quality of colostrum at 5^0 C will be high by a colostrometer while the same instrument may indicate low quality at 35^0 C. So it is important to measure the quality of the colostrum at similar temperature to avoid confusion and wrong interpretation. But above all colostrometer is a very simple, time saving and effective technique to check the quality of colostrum.

It has also been observed that the amount of colostrum from the cow after birth is indirectly proportional to the concentration of I_g in colostrum. So it is understood that calves receiving high amount of colostrum from their mothers may not get enough I_g for developing sufficient immune power in them. It is obvious that new born calves get their immunity through colostrum only in first few days of birth. Calves start synthesizing immunoglobulins after 10th day of birth and at the age of 8 weeks the level of immunoglobulins becomes normal. But during this deficient period, the calves must receive high quality colostrum to boost up their immune system. For this, it is essential to get high quality colostrum from the mother cows. Therefore before milking the udder and teats should be properly cleaned and the quality of colostrum be tested by colostrometer.

If calf is unwilling to take colostrum from its mother or via nipple, then it should be forcefully given with help of stomach tube. As discussed earlier, for optimum immune power the serum I_g level should be at least 10 mg/ml. For this at least 2 litres of high quality colostrum is to be given to calves. Otherwise making this immunoglogulin level in calves within 24 hours of their birth artificially is not only expensive but also time consuming. As per scientific community, overall a new born calf should receive at least 100 g I_g through colostrum to achieve the desired serum I_g level. This calculation is based on following assumptions and facts.

1. The plasma volume of a new born calf is about 6.5% of the body weight. For a 40 kg calf, the plasma volume will be 40 × (6.5/100) = 2.28 litres.
2. To have a serum I_g level of 10 mg/ml, the requirement of total I_g = 2.28 litre × 10 g/litre = 22.8 g.
3. Considering the absorption rate of I_g at intestine of new born calf to be 25% (20-48%), the available I_g for absorption = 22.8 × (100/25) = 91.2 g.
4. If the colostrums is of high quality (concentration of I_g is 60 mg/ml), then to get 91.2 g I_g the requirement of colostrums = 91.2/60 = 1.52 litres.
5. If the colostrums is of low quality (concentration of I_g is 35 mg/ml), then to get 91.2 g I_g the requirement of colostrums = 91.2/35 = 2.61 litres.

If methods for assessing I_g level in colostrum are available such as colostrometer, then above calculation is very helpful for determining the required amount of colostrum for calves. If calves are under stressful conditions, then the requirement will be more.

Table 4: Requirement of colostrum (litres) according to body weight of calves at the time of birth to have serum I_g level of 10 mg/ml.

I_g level in serum (g/l)	Body weight (kg)					
	25	30	35	40	45	50
20	3.26	3.90	4.56	5.20	5.85	6.50
30	2.17	2.60	3.04	3.47	3.90	4.33
35	1.86	2.22	2.61	2.97	3.34	3.71
40	1.63	1.95	2.28	2.60	2.93	3.25
45	1.45	1.73	2.03	2.31	2.60	2.88
50	1.30	1.56	1.82	2.08	2.34	2.60
55	1.19	1.42	1.66	1.89	2.13	2.36
60	1.09	1.30	1.52	1.73	1.95	2.17
70	0.93	1.11	1.30	1.49	1.67	1.86
80	0.82	1.14	1.14	1.30	1.46	1.63

Types of I_g in colostrums and their absorption

Normally the I_g found in body system are synthesized in bone marrow. Plasma cells present in different body parts take up these I_g and transfer them to blood for ultimate utilization by immune system. The I_g can be divided into 5 types such as I_g G, I_g M, I_g A, I_g D and I_g E. Out of these I_g G, I_g M and I_g A are important from immunity point of view. I_g G and I_g M are responsible for whole body protection while I_g A is effective only at the inner surface of intestine.

The concentrations of these I_g are different in blood and colostrum. There are 2 forms of I_g G i.e. I_g G 1 and I_g G 2, the concentration of which are similar in blood of mother. But in colostrum, the major I_g G is I_g G 1. The concentrations of different types of I_g are different in milk and colostrum, which is evident from the following table.

Table 5: Concentrations of different types of I_g in colostrum and milk

Source	Concentration of I_g (g/l)			
	I_g G 1	I_g G 2	I_g M	I_g A
Colostrum	75.0	1.90	4.90	4.40
Milk	0.35	0.06	0.04	0.05

Absorption of I_g from intestine to blood stream takes place in 2 steps. In first step; I_g gets assimilated inside the intestinal epithelial cells and in second step; these cells are transferred to blood. The rate of

absorption primarily depends on the mutual relationship between 3 factors

1. The age of calf after birth at the time of feeding colostrum
2. Amount of colostrum
3. Time elapsed after colostrum feeding

As the intestinal epithelial cells develop day by day, the absorption of I_g by them gets reduced. This clearly points towards the importance of colostrum feeding to calves as early as possible after birth and as much amount possible. Too much cold or hot environment interferes with absorption of I_g. Calves should be protected from such situations.

Identification of calves deprived of colostrum

Many methods are available for this purpose. But the most convenient technique is to measure the serum total protein content. Serum protein level and antibody level are directly related to each other in calves of 2-10 days age. When the serum protein level is below 5 g/100 ml, then it is understood that the absorption of antibodies has not been adequate.

Colostrum replacer

If due to some reason colostrum could not be fed to calves, in such a situation the new born calves may be orally given aureomycin or terramycin antibiotic at a dose of 250 mg daily for the first 5 days and then at a dose of 125 mg for the next 16 days to develop adequate immunity. Artificial colostrum can also be prepared and fed to calves. Usually it is prepared by mixing 525 ml whole cow milk, 275 ml luke warm water, 1 freshly broken egg content, 1000 IU vitamin K and half to 1 table spoon full castor oil. The blood serum of mother cow can also be administered in the form of vaccine to calves to boost up their immunity power. Colostrum replacers are available in market which can also be fed. These types of replacers usually contain preformed immunoglobulins from cheese whey or from milk of vaccinated cows.

Preservation of colostrum

In situations where calves could not be fed with colostrum of their mothers within 30 minutes of their birth, previously preserved high quality colostrum is a great option. Colostrum can be preserved up to 1 year without any significant loss to its nutritive contents. Before feeding, preserved colostrum should be liquefied with little warm water at 35-38^0 C. Care should be taken not to do this process vigorously as this can damage the immunoglobulins and reduce their disease resistant power. It can also be done inside a microwave oven at low temperature. Freshly collected colostrums can be stored up to 7 days in refrigerator without any nutritive loss. Fresh colostrum if not fed to calves should quickly be refrigerated at 40^0 F in order to check any microbial contamination.

Adopting cattle-cum- fish farming: a management perspective

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Livestock production and processing generate by-products that may be important inputs for aquaculture. The main linkages between livestock and fish production involve the direct use of livestock wastes as well as the recycling of manure based nutrients which function as fertilizers to stimulate natural foodwebs. On a global basis, most cultured freshwater fish are produced in Asia with the help of semi-intensive systems of farming that depend on livestock wastes purposely used in ponds. The use of livestock wastes is needed even when high-quality supplementary feeds are available in intensive aquaculture systems.

Prospects of cattle-cum-fish farming

In Indian condition where a vast majority of farmers fall under small and marginal category with a limited income adoption of cattle cum fish farming can enhance and bring stability in their livelihood. It has following advantages that are at minimal cost from the same place and the same time fish and cow milk can be produced. It helps in controlling environmental pollution. Fish-cum-Dairy Farming is considered as an excellent innovation for the use of organic wastes. Use of cow/buffalo manure in fish farming is a commonly prevailing practice. On an average, one cow/buffalo excretes 12000 kg of dung and 8000 litre urine per year. The cattle faeces and urine are beneficial to the filter-feeding and omnivorous fishes. On an average, 3-4 cows/buffaloes can provide sufficient manure to fertilize one hectare pond. In this system, farmer gets milk, fish and calf as well which increases revenue and reduces input costs. The system gives a net profit of Rs.317000/- per year from one hectare land depending upon productivity.

This is a type of integrated farming of fish and cattle and can be divided into 2 groups:

1. Fishery practice
2. Cattle farming

1. Fishery practice

This practice is followed in the integration of cattle-cum-fish farming which is also known as "Composite fish culture system". Composite fish culture is very popular in India mostly in Assam. The whole management practices followed in case of composite fish culture system can be divided into-

A. Pre-stocking management

Construction of a new fish farm/ Renovation measures of an existing fish farm

i) Site selection

The availability of cheap land and plenty of unpolluted freshwater are the most important factors to be considered while selecting a site. Criteria to be followed for site selection are-

1) Water quality: biological, physical and chemical nature of water
2) Drainage: There should be replacement and recycling facility
3) Soil quality: Among the physical properties of the soil, water retention capacity, P^H and productivity of the soil are very important. Soil in its every 100 gm should contain 50- 75 mg nitrogen, 6-12 mg phosphorous and 1.5- 2.5 gm organic carbon and soil P^H should be in between 7.5- 8.5.
4) Fish seed: Availability of quality fish and prawn seed.
5) Fish feed: The local availability of fed ingredients as well as their cost is also very important as out of the total operational cost of fish farming 60% of the expenses goes for feed alone.
6) Climatic factors: Rainfall, temperature, evaporation rate, flood, cyclones, etc are the important climatic factors.
7) Industrial and agricultural pollution: The insecticides used in agriculture are toxic to fish. Beyond a certain level, heavy metals and various chemicals discarded from industries are also poisonous to fish.
8) Construction expenses: The expenses for earth moving, RCC work, spare parts, cost of construction materials, like brick, rubble, steel, cement, *etc.* need to be surveyed and varied from region to region. Other factors are availability of labours, financial facilities, marketing facilities *etc.*

ii) Pond construction

Scientifically constructed fish farm has 4 types of ponds they are-

i. Nursery pond: Area of nursery pond ranges from 100-500 $m^2$and the depth of water should be in between 1-1.5 m. This pond covers 5% area of total productive area of the fish farm.
ii. Rearing pond: Area of rearing pond varies between 500-1000 m^2 and the depth of water ranges from 1.5-2.0 m. This type of pond covers 15% area of the total productive area of the fish farm. Sometimes it may be used as stocking pond also.
iii. Stocking pond: Area of stocking pond varies between 1000-20000 $m^2$and the depth of water ranges from 2-2.5 m. This type of pond covers 60-70% area of the total productive area of the fish farm.
iv. Bio pond: Now a day's special type of pond is also seen in some farms. It acts as a large settling tank, where the water used for fish ponds of a farm is purified biologically. The area covered by this pond is 7-10% of the total productive area of a fish farm.

The above mentioned pond of a fish farm is constructed in 2 ways and they are-

Dug out pond

This is constructed in a plain area by digging soil. This type of fish pond is more suitable for fish farming as they can be constructed by the fish farmer based on their requirements scientifically by maintaining the shape, size, depth, etc. Normally small size rectangular pond is preferred. But pond may be of any type- circular, square, rectangular, etc.

Embankment pond

This type of pond is constructed in undulating and hilly areas. This is economic to dig out pond from the construction side but it is not good from the fish culture point of view. This is because the size, shape, depth can't be fixed as per the scientific fish culture specification. Here in the inlets and out lets small mess size bamboo or nylon made screen is tied. This prevents the entry of unwanted fish, aquatic insects into the culture system and also stops the escaping of cultured fishes from the culture system.

Sl No.	Soil & water P^H	Soil & water type	Quick Lime required (Kg. /ha.)
1.	4.0- 5.0	Highly acidic	2000
2.	5.0- 6.0	Acidic	1200
3.	6.0- 6.5	A little acidic	1000
4.	6.5- 7.0	Neutral	400

iii) Pond preparation for stocking with fish

Liming and fertilization

The pond is filled with water upto a depth of 2-2.5 m. Then water P^H is measured and based on the P^H value liming is done as mentioned below. After 7-10 days of liming fertilization is done. Both organic and inorganic fertilizers can be used. Cow dung contains 0.5% nitrogen, 0.1% phosphorous and 0.5% potash. Therefore cow dung act as an excellent organic fertilizer. In this integration system cow dung @ 267 Kg/ bigha water spread area is applied as organic fertilizer. Inorganic fertilizer- urea @ 13 Kg/ bigha/ year, single super phosphate @ 3 Kg/ bigha/ year and murate of potash 12 kg/ bigha/ year is applied after 7-15 days of application organic fertilizer. 1/3rd of the required amount of lime and fertilizer is applied initially to the pond and then the rest amounts is divided equally into 11 installments and are applied to the pond at monthly regular interval. Then by seeing the pond productivity after 7- 15 days of application of inorganic fertilizer fish seed is released to the pond water. Liming helps in maintaining the P^H of fish pond water. This helps in increasing the natural productivity of the pond. Liming also helps in maintaining the cultured fish stock disease free. It is done based on the soil and water P^H. Liming dose based on soil and water P^H is given below

Liming schedule depending on soil and water P^H

Removal of aquatic weed

Unwanted aquatic weeds are needed to be removed from fish pond as it reduces the pond productivity. These unwanted aquatic weeds could be removed manually, mechanically, chemically and biologically. If possible manual removal method is better. Grass carp, java puthi, tilapia etc. are good biological agent in removing aquatic weed from fish pond. Chemicals used in the removal of aquatic weeds from fish pond are:

Chemical	Quantity to apply	Weed controlled
1.2-4 D	4.5- 6.5 kg/ha water spread area	Floating weed like Eichronia
2- 4 D Ester	9-13 kg/ha	Do-
2-4 D Sodium	10-12 kg/ha (in solution form)	Small floating weed, loke duck weed
Simazine	5 kg/ha	Floating weed like Eichornia & small floating weed,like duck weed
Paraquat	0.02 kg/ha (in solution form)	Small floating weed like duck weed
Sodium arsenite	5-6 mg/lit of water in pond	Submerged rooted weed like hydrilla, valisnaria *etc.*
Super phosphate	500 mg/lit of water in pond	-do-
Urea	50-100 mg/lit of water in pond	Otellia

Removal weed fishes, insects, unwanted organisms

This is done by repeated netting or by using chemicals. Soap oil emulsion (soap: oil: 1: 3) over the pond water surface is most commonly used technique to kill the insects in fishponds. Mohua oil cake@ 200-250 ppm or tea seed cake@ 750-975 Kg/ha gives encouraging result in controlling weed fishes of a pond and it also helps in reducing the quantity of organic fertilizer required by 50%. Commercially available bleaching powder@ 97- 113 Kg/ha (13- 15 Kg/bigha) can also be used as fish toxicant.

Control of algal bloom

Some time a thick layer of algal bloom of brown or green colour is seen over the water surface of pond. This can be removed from fish pond by using a piece of split bamboo followed by liming based on water P^H as mentioned earlier. Chemicals like- coppersulphate @ 0.1- 0.5 mg/lit. of water or diuron@ 0.3- 0.5 mg/lit. of water also helps in controlling this bloom.

Partial replenishment of water

Since total dewatering is not possible, so depending on the feasibility some percentage of pond water may be pump out and the same is refilled with new water. But the water depth should be restricted to 2-2.5 m for good production of fish.

B. On stocking management

Fish species can be cultured: Rohu (*Labeo rohita*), Catla or Bahu or Dhekera or Bhokua (*Catla catla*), Mrigal or Mirika (*Cirrhinus mrigala*), Silver carp (*Hypophthalmichthys molitrix*), Common carp (*Cyprinus carpio*), Grass carp (*Ctenopharyngodon idella*), Tilapia (*Oreochromis mossambica*), Magur (*Clarias batrachus*), Java puthi (*Puntius javanicus*), Kurhi (*Labeo gonius*), Freshwater prawn *etc.* Fish fingerling i.e. 10-15 cm size fish seed is the best stocking material in the stocking pond.

Number of fish seed to be stocked

The stocking density depends on the species, culture period, desired individual size and intensity of management. In composite fish culture in stocking pond fish seed of 10-15 cm length (fingerling) is stocked at the rate of 7000- 8000 nos. / ha.

f) Species composition: Considering the seed availability; productivity, size & depth, etc. of pond; market demand; etc. 3, 4 or 6 species combination can be introduced into the cultured pond. Maintaining the stocking density at 1000 nos. of fingerlings/ bigha the stocking percentage and number are given below-

Fish species	% of species composition (numbers/ bigha)		
	3 species	4 species	6 species
1. Catla or bahu or dhekera or bhakua.	50 (500)	50 (500)	30 (300)
2. Rohu.	30 (300)	25 (250)	20 (200)
3. Mirika.	20 (200)	20 (200)	10 (100)
4. Common carp.	----	5 (50)	5 (50)
5. Silver carp.	----	----	20 (200)
6. Grass carp.	----	----	15 (150)

Cares to be taken during stocking

Stocking of fish seed in the stocking pond should be done in the morning hours. Before stocking the fish seed is need to be conditioned. Through conditioning the fish seed are adjusted to the new environment. It may require from few minutes to hours time. First the container carries the fish seed are placed over the surface water of the fish pond for few times where the fishes will be stocked. This helps in bringing the temperature of the container water to the pond water temperature. Then slowly a little amount of water from the pond to be stocked is introduced into the container having the fish seed and acclimatized them. This process may be repeated for 2- 3 times on need basis. After conditioning fish seed from the container to the pond which is to be stocked is released slowly. This helps in minimizing the mortality of fish seed in the pond immediately after stocking.

C. Post stocking management

Feeding: Apart from natural food most of the cultured fish species takes artificial feed. Feeding alone can increase the production from ponds by 4 times. In general the artificial feed should contain 30-40% protein, 5-10% fat, 50-60% carbohydrates, less than 5% cellulose, 10% water, vitamins and minerals. Usually Indian farmers give rice bran and oil cake in powder form to the Indian Major Carps. But it is a crude method. Normally in composite fish culture feed can be prepared by the farmers themselves using the commonly available ingredients at their locality as mentioned

Ingredients	Composition %
Rice bran	49.25
Oil cake (mustard/ ground nut)	49.25
Fish meal	1.0
Mineral mixture	0.5

Cattle Farming practices

Normally in these cattle cum fish farming type of integration indirect method is recommended. In this type of farming the following management practices is followed:

Construction cattle shed

In case of cattle-cum- fish farming cattles are farmed in intensive system. The all essential items required for them are supplied in the shed itself. For free air and sunlight along with the shed a platform is also constructed. The cow shed is constructed at a stable and elevated site allowing direct sunlight to the platform, gutters and mangers of the

cattle shed. The floor of the cattle shed should be slightly inclined leading to a drain that is connected to a soak pit. Provisions for space may be made for suckling calf, older calf and cow. A covered pit may be nearby to store cow dung. The roof of the cattle shed can be constructed with tin, asbestos, thatched, etc. But thatched roof is always preferred.

Selection of cattle breed and their numbers for farming

In the cattle-cum-fish farming dairy cattle is found best. Based on the following criteria a dairy cattle breed is selected for farming with fish. They also should have good heat and disease resistant capacity. The mammary vein should be prominent, large tortuous and well branching. It has been found that the half bred (i.e. 50% Jersey and 50% local) dairy cattle is the suitable for fish-cum cattle farming. There is no such limit on the number of cattle to be farmed in this type of integration. Depending on the market for milk, space and other facility available in the fish farm the Number of cattle may be increase or decrease. But for a fish pond of size 0.1 ha (4 katha) 1dairy cattle along with calf is sufficient to fertilize the pond water for good fish production. The excess amount of cow dung received from farming more numbers of cattle can be used in the production of other agricultural crops in the farm.

Introducing cattle into the cattle shed

The cattle shed and other appliances to be used in this farming practice should disinfect before bringing the cattle into the shed. The disinfectant like- potash, lime, etc. may be used. Normally the cattles are brought to the cattle shed 2 months prior to stocking of pond with fish seed or otherwise the cattles are brought to the cattle shed in such a way that the needed quantity of cow dung (267 kg/ bigha or 2000 kg/ ha.) as initial dose is kept ready for application in the fish pond before stocking the pond with fish seed.

FEEDING MANAGEMENT

Farmed cattle are supplied their feed into the cattle shed itself. The required quantities of feed of a day is divided into 2- 3 installments and are fed to the cattles in 2- 3 times a day. Along with feed sufficient amount of water must be provided.

HEALTH MANAGEMENT

The cattle shed and the other utensils that are going to use in the farming of cattle with fish should disinfected with disinfectant like- potash or lime, etc. before introducing cattle into the shed. At the time of introduction of cattle into the cattle shed they should given bath and they should be given bath now and then during the farming period. Avoidance of over crowding, supply of feed in required quantity and quality along with drinking water, protection from heat, maintenance of hygiene in the cattle shed are some of prophylactic measures to be taken to prevent the occurrence of disease among the farmed cattles. Catlle should be vaccinated against all viral diseases in time. If any disease is occurring then treatment should be given in consultation with a local veterinary expert.

CONCLUSION

From a pond of 0.1 ha. (4 katha) water spread area in this system of farming 350 kg fish,

2400 liter milk and a calf can produce in a year.The availing of synergistic benefits between dairy and fishery farming will require recycling of nutrients and other resources within and from enterprise to enterprise. The packages of practices for fish-cum-dairy have been successfully developed and verified extensively for economic viability and feasibility at the farmer's level. Recognizing integrated farming as a commercial system can be adopted by carrying out suitable modifications in the location of different agro climatic regions, where water resources, healthy stocks of animals and agricultural land are available. The sustainable integrated fish based mixed farming can be remunerative therefore provide livelihood as well as generate employment

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Strategy Of Cold Stress Management In Dairy Herd

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India has huge livestock population which resides in 15 different agro-climatic zones. There is extreme variation in temperature among the seasons. The dairy animals can tolerate a particular range of temperature and perform well without expenditure of extra energy called thermoneutral zone. The production and reproduction efficiency of the animals are adversely affected when environmental temperature falls below lower critical temperature. The animal produces heat to cope up with cold wave, if they become unable to do so then there is development of cold stress. Farmers can prevent the cold stress by adopting some modification in nutrition, housing and management of the animal during extreme cold weather. Different category of animals should be cared in different way and if there is development of disease induced by cold stress then it should be properly treated within time.

India is bestowed with 151.1 million indigenous cattle, 39.7 million crossbreds and 108.7 million buffaloes (1). The diverse livestock population resides in 15 different agro climatic zones with large variations in environmental temperature. The temperature varies from 40- 45 ^{0}C in summer to even subzero in winter in most parts of the country. Animals' performance and health status remains better in thermoneutral zone. Below lower critical temperature animal starts expending energy to fight against chilling environmental temperature, if there is imbalance between the two then cold stress develop.

Predominant factors of cold stress

When the temperature fluctuation is frequent then cold weather shows pronounced effect. The prevailing wind wave and extreme cold condition in month of December and January further aggravate the situation. As study conducted by Tarr (2) in cattle with winter coats, it was found that if environmental temperature is -1^{0}C and wind velocity is 32kph then the

effective temperature experienced by the animal is equivalent to the still air temperature of -13^{0}C.

Normally, crossbred performs better in range of 4 - 24 ^{0}C in contrast to indigenous animals which has its optimum thermoneutral zone in range of 15-27 ^{0}C. Crossbred may tolerate sub-zero temperature because they are genetically endowed.

Table 1: Effect of Wind chill on cattle with winter coat (values are effective environmental temperatures)

Wind speed (kph)	Air Temp. (^{0}C)								
	-18	-15	-12	-9	-7	-4	-1	+2	+4
0	-18	-15	-12	-9	-7	-4	-1	+2	+4
8	-21	-18	-16	-13	-11	-8	-5	-2	+1
16	-24	-21	-18	-16	-13	-11	-8	-5	-2
24	-26	-23	-21	-18	-16	-13	-10	-7	-4
32	-29	-26	-23	-21	-18	-16	-13	-10	-7

Crossbreds have more subcutaneous fat with long and thick body hair which helps to conserve more body heat. The body characteristics of indigenous cattle like presence of less subcutaneous fat, thin skin, short and thin body hairs, comparatively less body volume to the surface area etc. are helpful to combat high environmental temperature but of little significance if cold weather prevails. Thick fat layer acts as an insulator and protects against cold wave. Thick and long body hairs also protect underlying skin and body parts. Buffaloes are better in this respect as compared to cattle but buffalo calves are more prone to cold stress.

EFFECTS OF COLD STRESS

An animal suffering from cold stress undergoes several physiological and systemic changes like temperature of skin and extremities severely decreased. The rumination and intake of dry matter increases as a result passage of feed to rumen increases but dry matter digestibility is lower down [3]. The energy requirement of the animal is very high to overcome lowered body temperature. In Indian condition, maximum calving takes place in winter season. The calves are very prone to cold stress because thermoregulatory center is not well developed at this stage of life. Further, if not given due care to neonates, it may lead to the development of pneumonia. This is the major reason of calf mortality in any herds.

The adult animals cope up the adverse cold condition by increasing the nutrient requirement, which helps in production of more energy. If proper nutritional care is not given to animal during this phase then milk production of lactating animal reduces. In case of down calvers there is gradual loss of body weight and body condition score. As a result the calves born are weak and this increases calf mortality rate and hampers reproductive efficiency.

STRATEGY TO REDUCE COLD STRESS

Feeding strategy

If the effective temperature goes down below lower critical temperature of the animal body, animal needs to increase production of heat so that body temperature of these homeotherms can be maintained. To counteract this adverse situation animal should be given energy dense diet; if it is not happened then animals utilize body reserve and lose the production and reproduction efficiency**.** For this, feed should be incorporated with concentrate having higher TDN value and optimum fiber content. The protein content should also be high because at low protein level the rumen microbial digestion of fiber is not efficient. For protein source cotton seed cake, soybean cake can be supplemented [4]. Bypass fat and proteins can also be incorporated to high yielders depending on their yield.

The colostrum feeding of calf within half an hour after birth should be done. It provides long term immunity and protects calf against pneumonia induced by cold stress. Adequate amount should be provided daily for at least 5 days post-partum.

Housing strategy

Although both barn system and loose housing system is well adapted in different part of India. Loose housing is generally preferred in tropical climate, but in temperate Himalayan region and heavy rainfall areas, where barn system is preferred [5]. In loose housing system, the shelter part is almost open from all sides. The animals are in direct contact of cold weather. So, farmers should cover the shed with gunny bag or hanging curtains. This will protect animals against direct cold wave. In conventional barns, the open space should be covered with curtains leaving space for ventilation.

Managemental interventions: The role of management is crucial to protect animals against cold. Following strategy may be followed during cold season:-

1) Keep the floor and bedding dry, it will

Figure: Housing management to ameliorate cold stress (courtesy-NDRI, Karnal)

protect calf against pneumonia and adults from other respiratory symptoms.

2) Individual calf pen should be provided and their proper care should be practiced.
3) Provision of bedding in calf pen and adult animal house should insure. Straw, saw dust and paddy straw can be used as bedding material. It provides a lot of comfort to animals during night when they rest.
4) As animals show herding behavior to reduce the cold stress as a natural phenomenon, so bedding material should be well spread over the area where animals rest.
5) The bedding material should be changed periodically to maintain hygienic condition.
6) The animals body should be cleaned regularly because clean and dry hair coat provide better insulation against cold.
7) There should be provision of free access and ad-libtum supply of luke warm water during extreme cold.
8) Animal house should be equipped with electric bulbs or infrared lamps or some short of heat source to keep them warm.
9) Always remain in touch of weather forecasting to be ready for undue and abrupt fluctuation in the weather condition.

TREATMENT OF DISEASED ANIMALS

If severe cold condition prevails for long duration, sometimes animals get affected with hypothermia. There is lowering of body temperature on its behalf which is manifested by lowering of rectal temperature, cooling of body surface, slow heart rate, slow breathing, and mucous membrane of eye becomes anemic. The best way to tackle this problem is to provide external source of heat i.e., to keep the animal in direct sunlight, completely prevent from cold wave and provide artificial source of heat if possible. In field condition, farmers can keep the animal warm by providing straw bedding and gunny bag over the body. They can also use infrared heat lamp from a distance of 75 cm, so that it may generate heat in vicinity of animal without harming exposed tissue. The animal should be ventilated with warmed and humified air. For treatment, intravenous fluid like dextrose should be warmed up to 42 ^{0}C and administered. If there is hypoadrenocorticism then corticosteroid therapy is also recommended [6].

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Banana Weevil and Its Management

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Banana is one of the most important fruit crop in India and it accounts for 32 per cent of total fruit production. It is widely cultivated in varying agro-climatic regions under different systems of production. In India, banana and plantains are infested with more than 15 insect pests. Among them, Banana weevils (Order- Coleoptera, Family- Curculionidae) - Pseudostem weevil, *Odoiporus longicollis* and Rhizome weevil, *Cosmopolites sordidus* are the key pests causing considerable damage. Yield loss to the tune of 10 -10 per cent was recorded due to their infestation. If t's not checked it may extent up to 100 per cent. In order to tackle these major enemies, one must aware about their life history, symptoms of attack and possible management tactics. With these views, information- pertaining to above aspects is discussed hereunder.

Pseudostem Weevil (*Odoiporus longicollis*)

Symptoms of attack:

The weevils resemble the rhizome weevil. Adult female weevil punctures and inserts eggs into pseudostem. The emerging grubs bows into pseudostem and peduncles of the fruit and tunnels often become infected with rots. In heavily attacked plants the pseudostem is severely weakened and easily breaks.

Life history:

Eggs are laid singly in small cuts in the seudostem and the emerging grub bore

Odoiporus longicollis

Cosmopolites sordidus

straight into it. Burrowing grub makes long tunnels through the pseudostem and in some cases it may extend in to the fruit bunches. Pupation takes place in fibrous cocoon inside the pseudostem and it takes about a week. The adult is small weevil, brown after emergence gradually turning black, 14 mm long with elongated snout. It may live up to two years and feed on tissue of banana plants, often being found in larval galleries.

MANAGEMENT

a. Cultural methods enlisted above in the management of rhizome weevil will also help to keep the population level of pseudostem weevil down.
b. Remove affected plants along with the rhizome and destroy them by burning the life stages of the insect using kerosene or by burying the material in deep pits in soil.
c. Set traps using pseudostem of approximately 0.5 m length, which are split lengthwise and laid in the field. Adults attracted to it during nights may be collected and destroyed.
d. Spray *Beauveria bassiana* or *Metarhizium anisopliae* var. *anisopliae* @ 10 g per litre or *Beauveria bassiana* @ 10 g per 30 cm long split pseudostem to attract and kill adult weevils.
e. Fill all the leaf axils with dried powdered neem seed kernels @ 50 g per plant (3.-3 1/2 month old plants) may help to reduce the infestation of pseudostem weevil.
f. Remove the dry outer sheaths of the pseudostem of all infested and uninfested plants in the endemic areas and spray any of the recommended insecticides.
g. Drenching insecticide solution [(carbaryl 50 WP @ 4 g/ litre or chlorpyrifos 20 EC @ 2.5 - 3 ml/litre) + 1 ml Sandowit] in all the leaf axils, rhizome and surrounding soil and all-round the entire pseudostem by inserting the nozzle of rocker sprayer through the bore holes (made by the grub) if any and also within the outer sheathes by slightly raising the same at different spots is also effective
h. Spray quinalphos 0.05 per cent or chlorpyrifos 0.03 per cent or carbaryl 0.2 per cent in the pseudostem weevil infested plots. Repeat the treatment after 3 weeks if the infestation persists.

Rhizome Weevil (*Cosmopolites sordidus*)

Symptoms of attack:

Female adult weevils puncture healthy rhizomes and pseudostems at ground level and insert eggs through it. The emerging grubs tunnel into the rhizome and feed on it resulting in the stunting of rhizome. The tissues at the edge of the tunnels turn brown and rots. If the infestation occurs on a mature rhizome, damage symptoms such as yellowing and withering of leaves, reduction in leaf number, bunch size and the fruit number appear.

LIFE HISTORY

Eggs are laid singly in small pit made in the pseudo stem near ground level by female weevil. They are elongate, oval, and white legless grub with a brown head capsule. The grub period lasts for 14-21 days. Pupation takes place in holes bored by grub and it lasts for 5-7 days. Pupa is white in colour and 12 mm in length. The

newly emerged weevil is brown, turning almost black after a few days. Its normal is dead or decaying banana plants. It does not usually fly and may live up to two years. Each female lays 10-50 or more eggs and they are nocturnal in habit.

MANAGEMENT

Cultural methods are most important and in many areas these methods will be sufficient to keep the population level down. It includes:

a. Old stems should be cut off at ground level
b. Cut rhizome should be covered with impacted soil
c. Old stems should be cut into stripes and used for mulching
d. Remove weeds from the fields
e. Deep ploughing of the land so as to expose the inner soil layer to the sun
f. Use clean and healthy suckers for planting
g. Cut and remove the outer layer of the rhizome and sundry for 5-4 days after smearing it with slurry of cow-dung and ash
h. Set traps using pseudostem of approximately 0.5 m length, which are split lengthwise and laid in the field. Adults attracted to it during nights may be collected and destroyed.
i. Setting up of pheromone traps "Cosmolure" @ 4nos/ha to collect and destroy adults.
j. Dip the sun dried suckers in 0.4 per cent carbaryl (50 WP) solution for 30 minutes before planting gives protection against rhizome weevils.

Riboswitches: The RNA Sensors

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RNA molecules were conventionally viewed as passive messengers of genetic information and now after every few years, their novel functions are discovered. Some mRNAs termed as riboswitches can sense changes in the levels of cellular metabolites and activate or repress genes involved in the biosynthesis and transport of metabolites. Aptly called 'living molecular fossils', they operate without the assistance of accessory proteins and are believed to be remnants of an ancient time when gene regulation was strictly based on RNA. (Cech, 2004). The term riboswitch was coined by Ron Breaker of Yale University and appeared in print in 2002. The existence of riboswitches in all domains of life adds some support to the RNA world hypothesis, which holds that life originally existed using only RNA and proteins came later; this hypothesis requires that all critical functions performed by proteins could be performed by RNA. First experimental validations of riboswitches were published in 2002.

Riboswitches are now recognized as one of the major metabolite-controlling systems that account for about 2% of genetic regulation in bacteria and that respond to various metabolites including co-enzymes, sugars, nucleotide bases, amino acids and cations. Riboswitches appear to be pervasive in eubacteria, suggesting that this form of regulation is an important mechanism by which metabolic genes are controlled (Blount and Breaker, 2006). Riboswitches are structured elements typically found in the 5' untranslated regions of mRNAs, where they regulate gene expression by binding to small metabolites. Riboswitches demonstrate that naturally occurring RNA can bind small molecules specifically, a capability that many previously believed was the domain of proteins or artificially constructed RNAs called aptamers (Bocobza and Aharoni, 2008).

Riboswitch is a part of an mRNA molecule that

* Can directly bind a small target molecule
* Whose binding to target affects the gene's activity
* Present in untranslated regions of mRNAs
* Contain secondary structures
* Each riboswitch is able to bind with high specificity their cellular target metabolite, without the involvement of a protein cofactor.
* Is directly involved in regulating its own activity, depending on the

presence or absence of its target molecule

- ❖ Aptamer - Binding domain
  - ✓ Has structured binding pocket
  - ✓ High affinity for target molecule
    - ❖ High specificity for target molecule
  - ✓ Expression platform – Reacts upon ligand binding by the aptamer
  - ✓ Conformational change alters gene expression

The aptamer directly binds the small molecule, and the expression platform undergoes structural changes in response to the changes in the aptamer.

The expression platform is what regulates gene expression. Because of the modular nature of RNA structures, different types of expression platform can be linked to the conserved aptamer domain (Bayer et al, 2005).

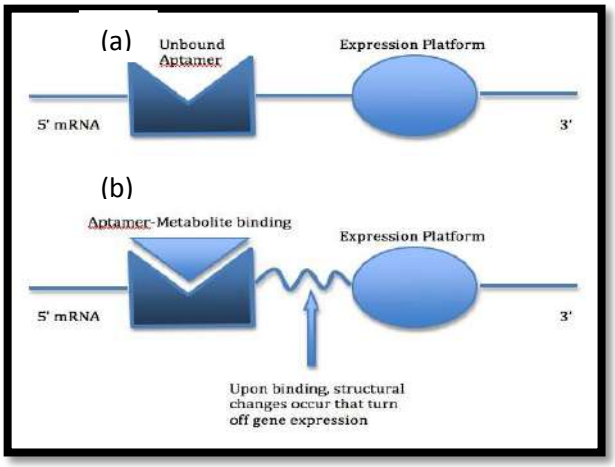

Fig 1: Structure of Riboswitch.
(a) Aptamer not bound
(b) Aptamer bound turning off gene expression

- ◈ Target molecule / Metabolite

Small target molecules are organic molecules that are not polymers.

They are small molecular weight molecules such as constituents of amino acid, nitrogen bases, monosaccharides, coenzymes etc.

MECHANISM OF ACTION

Riboswitches can alter gene expression at the level of transcription attenuation or translation initiation, and can up- or down-regulate gene expression by harnessing appropriate changes in the mRNA structure (Bocobza et al., 2007).

TYPES OF RIBOSWITCHES

« B_{12} Riboswitch
« Thiamine Riboswitch
« Flavin mononucleotide Riboswitch
« Guanine and Adenine Riboswitchs
« Glycine Riboswitch
« SAM / SAH Riboswitch
« Lysine Riboswitch
« *glm*S Riboswitch
« Pre Q_1 Riboswitch

Riboswitches can be employed for enhancing target gene expression in eukaryotes. New RNA motifs suggest an expanded scope for riboswitches in bacterial genetic control. Riboswitches can be validated as drug targets, describing the existing technology for riboswitch drug discovery.

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Animal Cloning: Benefits and Drawbacks

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Making generally identical mammals especially humans are a topic of considerable interest to both scientists and common individuals. Nature itself is the greatest cloning agent. In about one of every 75 human conceptions, the fertilized ovum splits for some unknown reason and produces monozygotic twins. In clothing, this same operation is carried out intentionally in a laboratory. The word "cloning" etymologically comes from the Greek and means "asexual reproduction". Animal cloning refers to the creation of one or more generally identical animals by transferring the nucleus of a body cell into an egg from which the Nuclear Transfer (NT) or cell nuclear replacement (CNR) or somatic cell nuclear transfer (SNT) and is how Dolly was produced. Even with the risks associated with reproductive cloning. DNA cloning has been benefits to using DNA cloning. DNA cloning has been used to produce insulin for diabetics, tissue plasminogen activator for dissolving blood clots, a vaccination for Hepatits B, and many other vaccinations and medicines to help control or cure illnesses and disease. Therapeutic cloning is the most controversial type of cloning, but some scientists hope that some day, they will be able to use this type of cloning to create donor organs and be able to gain an insight into genetic diseases.

Types of animal cloning

There are presently three types of cloning procedures:

DEVELOPING EMBRYOS

Embryo cloning (Artificial twining)

This is a medical technique which produces monozygotic (identical) twins or triplets. It duplicates the process that nature uses to produce twins or triplets. One or more cells are removed from a fertilized embryo and encouraged to develop into one or more duplicate embryos. Twins or triplets are thus formed, with identical DNA. This has been done for many years on various species of animals; only very limited experimentation has been done on humans. It has been successfully carried out for years on many species of animals.

Adult DNA cloning (reproductive cloning)

This technique which is intended to produce a duplicate of an existing animal. It has been used to clone a sheep and other mammals. The DNA from an ovum is removed and replaced with the DNA from a cell removed from an adult animal. Then, the fertilized ovum, now called a pre-embryo, is implanted in a womb and allowed to develop into a new animal. As of 2002-JAN, It had not been tried on humans. It is specifically forbidden by law in many countries. There are rumors that Dr. Severino Aninori has successfully initiated a pregnancy through reproductive cloning. It has the potential of producing animal studies. It also has the potential of producing sever genetic defects. For the latter reason alone, many medical ethicists consider it to be a profoundly immoral procedure when done on humans. It is

specifically forbidden in many countries since it has the potential of producing a twin of an existing person. This is also known as Nuclear Transfer (NT) or cell nuclear replacement (CNR) or somatic cell nuclear transfer (SNT)and is how Dolly was produced.

THERAPEUTIC CLONING

This is a procedure whose initial stages are identical to adult DNA cloning. However, the stem cells are removed from the pre-embryo with the intent of producing tissue or a whole organ for transplant back into the person who supplied the DNA. The pre-embryo dies in the process. The goal of therapeutic cloning is to produce a healthy copy of a sick person's tissue or organ for transplant. This technique would be vastly superior to relying on organ transplants from other people. The supply would be unlimited, so there would be no waiting lists. The tissue or organ would have the sick person's original DNA: the patient would not have to take immunosuppressant drugs for the rest of their life, as is now required after transplants. There would not be any danger of organ rejecting. The goal of therapeutic cloning is to produce a healthy copy of a sick person's tissue or Organs for transplant without the need of any immunosuppressant drugs. On Feb 27, 1997 the scientific community and general public were electrified by the announcement that a lamb "DOLLY" had been cloned from a single adult sheep cell. She had a mother but no father. Headlines like 'The lamb that roared'. 'Even again', 'Marry had a little …clone' rocked the newspapers first page. The stunning achievement was the work of Ian Wilmut and Keith H.S. Campbell of Roslin Institute, Edinburgh, Scotland. Dolly was born on July 5, 1996 but researchers waited till it was mature. In December 19, 1997 issue, Science magazine pronounced it as the 'Technological breakthrough of the year'. 1997 Wilmut and their team create Polly, the first sheep with a human gene in every cell of its body.

Cloning around the world

At first Dolly was a "clone alone" but in august 1998, a group in Hawaii published a report of the cloning of over 50 mice by nuclear transfer. Since then, research groups around the world have reported the cloning of cattle, sheep, mice, goats and pigs etc.

Benefits of Cloning

Cloning will improve the overall quality of science and life. The cloning experiences may add to the increase understanding of genetics.

Cloning for 'Spare parts' or 'Therapeutic cloning'

Cloning technique may be one day enable the production of 'spare parts' such as tissue and organs. These spare parts could be used for the treatment of damaged or diseased tissue and organs. One human organ, skin is already grown in the laboratory. Healthy skin cells taken from a patient who has suffered severe burns can be grown to provide a self compatible skin graft. Scientists are able to grow skin more readily than other organs or tissue because nature, differentiated skin cells retain the ability to divided & produces more cells. Most other types of adult cells need to be 'reprogrammed' before they are able to divide. Researches are now attempting to 'reprogram' and grow other self-compatible cells, such as never cells for patients with spinal injuries or muscles cell from heart attack victims.

Year of birth	Cloned animals	Place of cloning
5th July 1996	Dolly the sheep	Roslin Institute
1997	Neit & Ditto the primates the Rhesus monkey	Oregon Regional Primate Research Centre
1997	50 Mice	University of Hawaii Medical School
1998	5 pair of calves	Ishikawa Prefectural livestock Research centre, Japan
Jan 4 2000	Rhesus Monkey: Tetra	Oregon Health Sciences University (OHSU)
2000	Piglets	Virginia, US
2001	Noah-the Bull Gaur	Advanced cell technology Inc, US
2001	Copy cat the kitten	College of Veterinary Medicine Texas A & M University
2001	Rabbit	National Institute of Research, France
30 May 2003	The world's first cloned mule	University of Idaho, Quebec
2003	First Deer cloned from adult mule	Texax A & M university, Viagen
2005	First cloned Dog	Seoul National University Puppy
2007	Two female of an endangered species of wolf named Snowolf and snowoffy	South Korea
2009	First Cloned Camel (Injaz)	Camel Reproduction Centre, Dubai
2009	Buffalo calf	NDRI, India
2009	First cloned Goat	Isfahan, Iran

COMMERCIAL OPPORTUNITIES

Today the field of biomedical appears to be the first major commercial opportunity for cloning technology. This is field were cloning and genetic engineering will first be used in combination. In cattle only one in 1000 embryos injected with the DNA construct results in a transgenic calf. Cloning presents many advantages over microinjection. One is the fact that fewer embryos need to be produced to obtain a transgenic thus eliminating the cost of carrying non-transgenic pregnancies to term. All of the offspring are embryos were selected for the gene of interest being present in the donor cells. Thirdly, the sex of the cloned offspring is known since the sex the starting donor cell is predetermined.

Cloning offers the potential of having a gird of cloned animals producing the pharmaceutical protein in three years. An estimated two years of developmental research can be eliminated when herd of cloned transgenic females are produced. This means clinical traits can be stated two years earlier this shortcut is great attraction to pharmaceutical companies.

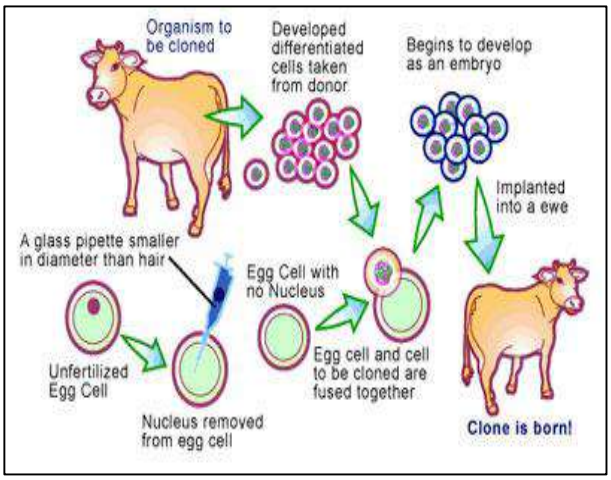
Yet another biomedical opportunity is developing procure cloning technologies for organ transplantation application. The potential of using this technology in this field is large and some suggest it could becoe a 6 billion global market at maturity.

POTENTIAL BENEFITS FOR HUMAN MEDICINE

The cloning can be use for a human protein used to treat or prevent desired transgene. This code for a human protein used to treat or prevent disease (such as factor viii and interferon) and large quantities of the protein could be produced in the animal milk under the control of specific promoters. As protein can be isolated from milk relatively simply, this might be an extremely cheap and efficient way to produce of large quantities of human or animal pharmaceuticals. It might be competitive with present methods of producing recombinant proteins when one considers the cost and problems of producing antiviral drugs as well as protein for immunization and therapy, the potential for pharmaceutical production in cattle becomes economically attractive.

These potential benefits of cloning are often ignored in the debate about its used for human reproduction. Yet, cloning could not reproduce an individual with the same attitudes, beliefs and behaviour as the original person because of the predominant influence of non-genetic factors in human development.

However, we should not lose the substantial benefits of other applications of cloning technology in the regulatory and legislative processesand moratoriums should not impeded progress to achieve these benefits.



ARTIFICIAL MEAT PRODUCTION: THE FUTURE OF FOOD

Humans rely on animals for meat and dairy products, which put a significant strain on Earth's already, stretched resources and real estate. Livestock systems currently occupy 30 percent of the planet's terrestrial surface area (excluding ice-covered regions) and 228 million tonnes of meat is produced every year. To meet future demand, the UN's Food and agriculture Organization estimates that annual global meat production will need to double to 463 million tonnes by 2050. Animals also contribute to climate change. Rearing livestock accounts for 18 percent of greenhouse gas emissions – more than the transportation sector – largely due to the release of methane from digestion and indirectly through human activity, such as clearing forests to provide land for grazing. Synthetic meat could therefore reduce the demand for livestock, helping to feed the world and combat climte change. In a more

science – fiction scenario, the technology for growing our own meat could even provide a source of protein for astronauts on long space missions or those colonizing other worlds: in the early 2000s, a NASA-funded project produced edible lab-grown muscle from goldfish. Essentially, all the meat- billions of pounds of it would be to grow cells from common livestock animals like cows of chickens in large flat sheets. The thin sheets would then be stacked to resemble meat. The other proposed methods would be to grow muscle cells on small beads that stretch with small changes in temperature. The tissue produced could be used to make precessed meat such as hamburgers or chicken nuggets. The research is being done at the University of Maryland and is based artificial meat for space missions. But why produce artificial meat commercially?

One reason would be to make meat healthier for the consumer. Meat contains a lot of omega-6 fatty acid, which is good, but not in large amounts. The omega-6 fatty acids could be replaced with omega-3 fatty acids which are more beneficial. Another reason is that raising livestock has a huge environmental impact. Livestock require millions of gallons of water, large amounts of land, and produce huge amounts of waste. The use of srtificial meat would help to protect the environment by potentially reducing the number of livestock needed to meet the demands for meat. Further, the production and consumption of meat has many additional potential issues including meat-borne pathogens and contaminants, antibiotic-resistant bacteria due to the routine use of antibiotics in livestock and inhumane treatment of farm animals.

The other application of cloning are the technology eased for improve breeding by being capable to directly reproduce an animal with a desirable set of genetic traits. A new anti-cancer treatment is an antiangiogenesis drug (a drug that inhibit tumors from creating the new capillary networks needed for their growth) called aaTT III which is produced in milk of transgenic goat. The cloning can also be useful to recreating animals from endangered species. By cryopreserving cells from these species, they never need become extent.

DISADVANTAGES OF ANIMAL CLONING

Loss of genetic diversity

Gene diversity is what keeps an entire species from being wiped out by a singular virus if none of them have natural immunities. This is due to the lack of gene diversity. Gene mutations happen naturally, and help to explain why some people naturally are taller, shorter, or more athletic than others. Some people and animals naturally have a stronger immune system. If gene diversity is lost due to excessive cloning, there are no mutations to allow some of the cloned group to survive a newly introduced disease.

Cloned animals have shorted life spans

There are some evidences that length of the chromosome ends called telomeres is associated with ageing. Dolly has shorter telomere than expected other experiment in USA claim that cloning can produce longer telomeres, implying apparently younger animals. There is an indication that, despite the empirical results, the basic science of nucleus transfer cloning is still comparatively little understood. It may not be premature ageing that is tissue so much as whether more conventional further happen at a higher rate in cloned animals & thus lead to on average to shorter life span. There are relatively few cloned farm

animals in existence so it is difficult to say about longer term issue. Dolly is unique whether a problem like Dolly's arthritis is actually cloning a just a random effect.

Animal welfare problem is cloning

The pattern of failure is varied, most problem have been in pregnancy and shortly after. Typical examples have been over or under development of the placenta, unusually large foetuses, fetal death in pregnancy a shortly after birth. Faults may have arisen either because the nuclease transfer produced did not work properly a cell line from which the cellsto be cloned may not be of the best quality.

Reasons of cloning pets is unethical

Artificial insemination and embryo transfer technology, which are the manipulation in the detail of normal reproduction, nuclease transfer cloning of animals that normally reproduce sexually is a wholly artificial act without correspondence in nature. In the light of the intrinsic value of all animals, regardless of weathers suffering and welfare problem were over come, we have argued that animal cloning would not be justified, except in special circumstance where it enabled something of great moral value that could be achieved in no other way. By comparison with these cloning a pet animal ranks essentially cosmetic applications, which is not morally justified. Just because some one is rich enough to pay does not make it morally justified and definitely suggests a trivialization of embryo science in diverting skills and knowledge away from meeting serious ethical needs on to something that for many would represent an excessive co-modification of the animals.

CONCLUSION

Cloning will during up a great controversy on whether if cloning is the "right" thing to do or not. Nuclear transfer, cloning and steam cell research have enormous implication for future of biotechnology & biomedical engineering. The Red Cross has begun major cloning project relating to production to transgenic pigs for organ clone. The goal of animal cloning and similar research is to develop efficient ways to alter animals genetically and reproduce them reliably. Alterations have included adding genes (such as those for human proteins) to create drug-producing animals as well as inactivating genes to study the effects and possibly create animal models of human diseases. Cloning technology also may someday be used in humans to produce whole organs from single cells or to raise animals having genetically altered organs suitable for transplanting to humans. At the same time human cloning is the high of irresponsibility. It goes against legal, ethical and medical understanding. As things currently stands, couples asking for their clone babies would likely to produce deformed babies, miscarriage and early death than a healthy baby. No desire for a child is worth such terrible odds.S

Increasing Role of Kisan Credit Card

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Kisan Credit Card is a credit card to provide affordable credit for farmers in India. It was started by the Government of India, Reserve Bank of India (RBI), and National Bank for Agriculture and Rural Development (NABARD) in 1998-99 to help farmers access timely and adequate credit. The Kisan Credit Card allows farmers to have cash credit facilities without going through time-consuming bank credit screening processes repeatedly. Repayment can be rescheduled if there is a bad crop season, and extensions are offered for up to four years. The card is valid for three years and subject to annual renewals. Withdrawals are made using slips, cards, and a passbook.

OBJECTIVE

To provide insurance coverage and financial support to the farmers in the event of failure of crops as a result of natural calamities, pests and diseases.

1. To encourage farmers to adopt progressive farming practices, high value inputs and higher technology in agriculture.
2. To help stabilise farm incomes, particularly in disaster years.
3. To support and stimulate primarily production of food crops and oilseeds.
4. Farmers to be covered: All farmers (both loanee and non-loanee irrespective of their size of holdings) including sharecroppers, tenant farmers growing insurable crops covered.
5. Sum insured: The sum insured extends up to the value of threshold yield of the crop, with an option to cover up to 150% of average yield of the crop on payment of extra premium.
6. Premium subsidy: 50% subsidy in premium allowed to Small and Marginal Farmers, to be shared equally by the Government of India and State Government/Union Territory. Premium subsidy to be phased out over a period of 5 years.

Advantages of the KCC Scheme to the farmers

1. Simplifies disbursement procedures
2. Removes rigidity regarding cash and kind
3. No need to apply for a loan for every crop
4. Assured availability of credit at any time enabling reduced interest burden for the farmer.
5. Helps buy seeds, fertilizers at farmer's convenience and choice
6. Helps buy on cash-avail discount from dealers

7. Credit facility for 3 years – no need for seasonal appraisal
8. Maximum credit limit based on agriculture income
9. Any number of withdrawals subject to credit limit
10. Repayment only after harvest
11. Rate of interest as applicable to agriculture advance
12. Security, margin and documentation norms as applicable to agricultural advance
13. Access to adequate and timely credit to farmers
14. Full year's credit requirement of the borrower taken care of. Minimum paper work and simplification of documentation for withdraw of funds from the bank.
15. Flexibility to draw cash and buy inputs.
16. Assured availability of credit at any time enabling reduced interest burden for the farmer. Flexibility of drawals from a branch other than the issuing branch at the discretion of the bank.

SALIENT FEATURES SCHEME

1. Eligible farmers to be provided with a Kisan Credit Card and a pass book or card-cum-pass book.
2. Revolving cash credit facility involving any number of drawals and repayments within the limit.
3. Limit to be fixed on the basis of operational land holding, cropping pattern and scale of finance.
4. Entire production credit needs for full year plus ancillary activities related to crop production to be considered while fixing limit.
5. Sub-limits to cover short term, medium term as well as term credit are fixed at the discretion of banks.
6. Card valid for 3 to 5 years subject to annual review. As incentive for good performance, credit limits could be enhanced to take care of increase in costs, change in cropping pattern, etc.
7. Each drawal to be repaid within a maximum period of 12 months.
8. Conversion/reschedulement of loans also permissible in case of damage to crops due to natural calamities.
9. Security, margin, rate of interest, etc. as per RBI norms.
10. Operations may be through issuing branch (and also PACS in the case of Cooperative Banks) through other designated branches at the discretion of bank.
11. Withdrawals through slips/cheques accompanied by card and passbook.
12. Crop loans disbursed under KCC Scheme for notified crops are covered under Rashtriya Krishi Bima Yojna (National Crop Insurance Scheme), a crop insurance scheme introduced at the behest of Government of India to protect the interest of the farmer against loss of crop yield caused by natural calamities, pest attacks etc

CONTENTS OF CREDIT CARD

Beneficiaries covered under the Scheme are issued with a credit card and a pass book or a credit card cum pass book incorporating the name, address, particulars of land holding, borrowing limit, validity period, a passport size photograph of holder etc., which may serve both as an identity card and facilitate recording of transactions on an ongoing basis.Borrower is required to produce the card cum pass book whenever he/she operates the account

SUMMARY

Kisan Credit Card is one of the most innovative, widely accepted highly appreciated and non-discriminatory banking products, beneficial to farmers. Thought KCC is evidently ,ore flexible and used as a cash credit facility, it appears that it will be some time before it can be used fully as a credit card. The moneylender continues to play a crucial role in financing the farmers. It is necessary that the scope of KCC is expanded further to facilitate faster receipt of credit and marginalize the role of moneylender.

Resilience in Agriculture through Crop Diversification and Protected cultivation: Powerful Tool for Managing Environmental Changes

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Environmental changes may affect many different aspects of agricultural production. With greater climate variability, shifting temperature and precipitation patterns, and other global change components, we expect to see a range of crop and ecosystem responses that will affect integral agricultural processes. Such effects include changes in nutrient cycling and soil moisture, as well as shifts in pest occurrences and plant diseases, all of which will greatly influence food production and food security (Jones and Thornton 2003). Recognition that climate change could have negative consequences for agricultural production has generated a desire to build resilience into agricultural systems. Resilience is defined as the propensity of a system to retain its organizational structure and productivity following a perturbation (Holling, 1973). Thus, a resilient agro ecosystem will continue to provide a vital service such as food production if challenged by severe drought or by a large reduction in rainfall. One rational and cost-effective method may be the implementation of increased agricultural crop diversification. Crop diversification can improve resilience in a variety of ways: by engendering a greater ability to suppress pest outbreaks and dampen pathogen transmission, which may worsen under future climate scenarios, as well as by buffering crop production from the effects of greater climate variability and extreme events.

Common advantages found in most diverse systems:

- reduced disease, weed and insect pressures;
- reduced need for nitrogen fertilizer;
- reduced erosion;
- increased soil fertility and increased yields
- diversification also can provide habitat for beneficial insects and reduces pest numbers by rendering host crops less apparent for colonization by pests
- increases economic stability by reducing financial risk, stabilizing farm income, and increasing choice of farm practices
- provide year round employment to farm labor and farmers

Such benefits point toward the obvious value of adopting crop diversification to

improve resilience, yet adoption has been slow. Economic incentives encouraging production of a select few crops, the push for biotechnology strategies, and the belief that monocultures are more productive than diversified systems have been hindrances in promoting this strategy. However, crop diversification can be implemented in a variety of forms and at a variety of scales, allowing farmers to choose a strategy that both increases resilience and provides economic benefits.

The importance of horticulture in improving the productivity of land, generating employment, improving economic conditions of the farmers and entrepreneurs, enhancing exports and, above all, providing nutritional security to the people, is widely acknowledged. Moreover, with burgeoning population the pressure on land have been building up immensely, and day by day landholdings are shrinking. Thus technologies providing maximum returns per unit space are present day demand. In such conditions protected cultivation seems only surviving tool, where per unit production is several times higher than open cultivation. Also, protected cultivation is powerful tool against the climatic adversities. Thus, crop diversification and protected cultivation are important tool for combating climate change and developing sustainable agriculture systems in the state which can provide an alternative source of income to people resulting in their socio-economical upliftment.

As a result of crop diversification, workers are employed on a year-round basis or for a longer season and thus have higher incomes and can provide a better standard of living for their families than their seasonal counterparts. Farmers have found many benefits from a year-round or extended employment system. Some of these are

- increased worker availability,
- increased productivity and dependability,
- less need for worker training and
- increased personal satisfaction.

Farmers nationwide are smelling a profit by including more horticultural crops in their cropping pattern. Horticulturist, especially, floriculturists in some states are fetching good money with flowers and greenhouses. The proficient knack of educated farmers taking up horticulture and the influx of new technology are contributing to the increasing horticulture market not only in the metros but also in the Middle East and European countries. Area under protected cultivation has increased manifold in past decade.

In recent years area under protected cultivation of gerbera, cucumber, colored capsicum and banana under tissue culture and drip irrigation are increasing due to more production and better market price. Horticultural crops yield much higher net profit per unit area as compared to agronomical crops and further use of protected cultivation multiplies the profit per unit area manifolds. Out of total geographical area of India 329 million ha of the country, the land use ststistics are available for about 305 million ha. According to the land use data of 2000-2001 the arable land was estimated at 166.48 million ha (54.6%) and the

culturable wasteland at 13.61 million ha (4.5 %). This land could be brought under cultivation of various horticultural crops requiring very low water and care like, bhel, aonla, custard apple, datepalm, cashewnut, etc. according to type of soil and availability of irrigation water.

Thus, various reasons/benefits for including horticultural crops in present cropping system are:

1**. Per Unit Area Yield is High**: As compared to the field crops, per hectare yield of horticulture crops is very high. From an fruit area of land more yield is obtained e.g. paddy gives a maximum yield of only 30 q/ha, while Banana gives 300 to 500 q/ha, Pine apple 450 q/ha and Grapes 90 - 150 q/ha. In present shortage of food and scarcity of land by growing fruits more food can be produced.

2. High Returns per Unit Area: From one unit area of land more income will be obtained e.g. Well-kept orchard of apple, grapes and sweet orange can give more than Rs. 50,000 per ha as net income.

3. A Free Grower/Labor Remains Engaged for the Whole: An opportunity for maintaining labors throughout the year like the cereals where one cannot keep him self and employ the labors during the slack season.

4. Best Utilization of Waste Land: Some fruit crops can offer best utilization of waste land crops like wood apple, custard apple, karonda, litchi etc. can be grown in such areas.

5. More Calories are Obtained Per Unit Area: To meet the annual calories requirements of food per year one would have to cultivate about 0.44 ha of wheat or 0.03 ha of banana or 0.06 ha of mango for satisfying once need. Thus mango produces about 9 times more food energy than the wheat produced per unit area.

6. Raw Material for Industries: Fruit farming is the base for several industries like canning, essential oils etc which in turn provide work for more people.

7. Use of Undulating Lands: Fruit growing can be practiced in places where the gradient is uneven or where the land is undulating and agronomical crops cannot be cultivated. In Konkan region, mango and cashew are cultivated on large scales on hilly and hill back area.

8. Fruits and vegetables are the important energy giving material to the human body

The development of resilient agricultural systems is an essential topic of study because many communities greatly depend on the provisioning ecosystem services of such systems (food, fodder, fuel) for their livelihoods (Altieri, 1999). Many agricultural based economies have few other livelihood strategies (Tilman *et al.* 2002), and small family farms have little capital to invest in expensive adaptation strategies, which increases the vulnerability of rural, agricultural communities to a changing environment. The challenge for the research community is to develop resilient agricultural systems using rational, affordable strategies such that ecosystem functions and services can be maintained and livelihoods can be protected. In this regards adoption of horticulture and protected cultivation can be instrumental in developing a sustainable and climate resilient system for our area.

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