Indian Farmer

ISSN 2394-1227

A Monthly Magazine

Volume: 2 | Special Issue-II | March- 2015 | Pages 72

Disease Management of Dairy Animals

Animal Welfare: Concept and Assessment of Welfare

Contagious Diseases of Cattle and Buffaloes

www.indianfarmer.net

INDIAN FARMER

A Monthly Magazine

Volume: 2, Special Issue-II **March -2015**

Review Article

Non-Contagious Diseases of Cows and Buffaloes: An overview

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These diseases occur among the animals mostly due to management irregularities, dietetic errors or deficiency in the system or sometimes due to toxic substances. Many of the common non-contagious ailments occur on all kinds of dairy cattle irrespective of breed, age or sex, mostly due to improper care and management. These non-contagious diseases will not spread from animal to animal nor will they ordinarily prove fatal because most of them are amenable to treatment if promptly detected and treated. The common non-contagious diseases or ailments met with cows and Buffaloes are milk fever, metritis, mammits, tympanities, diarrhoea, constipation, etc. These diseases are briefly discussed here.

1. MILK FEVER

Milk fever also known as parturient hypocalcaemia and parturent paresis. It is a disease which has assumed considerable importance with the development of high yielding milking cows. Strictly speaking, the disease is not a fever because the signs of fever such as rise in body temperature are absent. Usually it occurs in cattle which have recently calved, often in the first few days after calving. The disease usually occurs in 5 -10 years old cows and is chiefly caused by a sudden decrease in blood calcium level. The volume of milk secretion, particularly when the udder is completely emptied soon after birth may lower the calcium from its normal level of about 10 mg to 3-8 ug per 100 ml of blood. Inorganic phosphorus level is usually decreased from 4 to 6 mg to 1.5-5.0 per 100 ml of blood. The production of colostrums by the animal may also bring about rapid reduction in the concentration of the blood calcium.

Fig: Animals affected due to Milk fever

Symptoms

1. The animal becomes excited and restless, starts shivering with an impression of great discomfort by lashing its tail and paddling its hind feet.
2. The animal lies down on her brisket with the head resting on one side of shoulder; snores and moans for a while and later becomes un-conscious.
3. Eyes become dull with pupils dilated.
4. Breathing becomes deep and slow, pulse is fast but weak, extremities get cold and the temperature falls to 3 or 4 degree below normal.
5. Dung and urine are not passed and the gas collects in the stomach.
6. The animal loses sense, falls down with partial or complete paralysis of hind quarters and dies within 24 hours if not attended properly.

These symptoms may appear a day prior to calving or even after a month of calving though the majority of cases arise during the first 2 or 3 days of calving.

Treatment and control

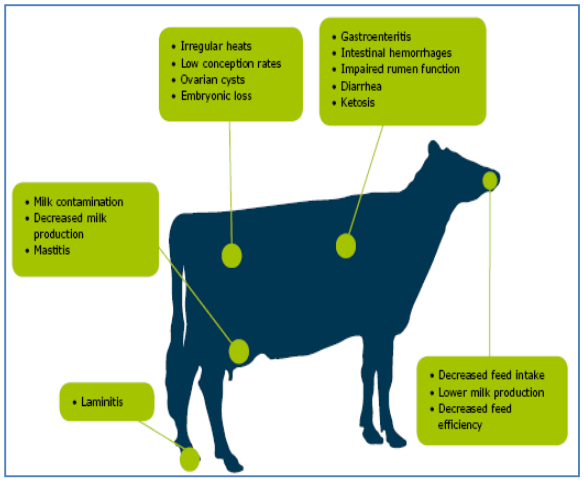
The treatment consists of the slow injection during about 20 minutes, into the blood stream, of 300 ml of 20% solution of calcium borogluconate and the simultaneous injection by the subcutaneous route of 50 to 100 ml of the same solution. The treatment may be repeated in 3 to 4 hours if necessary. In areas of magnesium deficiencies about 11 gm of magnesium sulphate by mouth may be administered to the animal.

The addition of calcium in the ration is contra-indicated as this may even increase the incidence of the disease, particularly if the diet is alkaline. Adding sodium propionate to the feed for 2 or 3 weeks after calving may help to some extent but the availability of sodium propionate is doubtful.

The incidence of the disease may be reduced if the cows are only particularly milked during the first three days after parturition and are injected with calcium boro-gluconate immediately after calving.

2. KETOSIS

Ketosis in cattle is a condition occurring due to metabolic disorder. There will be an imbalance between the nutritive intake and nutrition requirement for the body. The condition usually occurs in high producing dairy cattle. There will be low blood glucose level and depletion of glycogen reserves, of the liver. As a result protein is mobilized from the body to be converted into a glucose in the liver by the process called gluconeogenesis.. Stored fat of the body is also mobilized. Production of ketone bodies is increased and they accumulate in the blood and urine.



Symptoms

I. The affected animal shows decreased appetite.

2. Milk yield is suddenly decreased.

3. Breath of animal has peculiar sweetish smell.

4. The urine also gets a peculiar smell, similar to that of ammonia.

5. Body weight of tile animal rapidly reduces.

Treatment and control

The treatment consists of the intravenous injection of glucose or fructose. Propionic acid can also be given as sodium propionate. Glycerol or propylene glycol is satisfactory when given orally.

To prevent the condition in cows proper care should be taken in the feeding. Feeding balanced ration to high producers and pregnant cows and giving them molasses or jaggery will prevent this condition.

3. TYMPANITIS

This is also called bloat or aphara condition. The condition is characterized by the accumulation of gas or foam in the rumen. The abdomen becomes greatly distended especially on the left side in front of the hip bone. The condition arises due to the greedy feeding on lush green especially leguminous fodder, when the animal is in half starved condition. Weak and convalescing animals are more susceptible to this ailment as they cannot digest protein rich feed and the fermentation of undigested feed takes place.

Symptoms

Formation of gas always occurs to a certain extent in the stomach of cattle. But when it occurs in large quantities the following symptoms may be observed.

1. Bloated condition of the hollow of the left flank which, if topped with fingers, produces a drum like sound.
2. The animal shows the signs of pain, frequently lying down and getting up with arched back.
3. Rumination is suspended.
4. Tension increases leading to breathing difficulty, the animal may fall down if neglected and may even die of suffocation.

Treatment and control

Fermentation can be checked by giving internally anti-fermentative drugs such as turpentine, camphor, asafoetida and ammonium carbonate in right quantities. At the same time, try to remove the gas already formed inside, by cleansing the rectum by a warm soap-water enema. The earliest treatment in a village will be to take 20-30 gm of asafoetida, burn it, powder it and put inside a bread and shove into the oesophagus. Follow it after one hour. In severe cases when the distension is intense, a puncture may be made in the

left flank with a trocar and canula to relieve the gas quickly.

To prevent this condition, care in feeding lush green fodder such as legumes should be taken. Weak stomach animals should not be given fat and protein rich fodder in large quantities.

4. EPHEMERAL FEVER

This is a three days sickness condition and is often met with dairy cows especially during winter months. It is also known as rheumatic fever or stiff sickness of cows. This disease is peculiar to cattle and no other animals.

The causal organism of this disease is not yet known but it is believed to be of viral origin. Lying on insanitary chill cement floors and exposure to cold may be the predisposing factors.

Fig: Animals affected due to Ephemeral fever

Symptoms

1. Sudden rise of body temperature to 104-107^{0}F accompanied by muscular pains and lachrymation and salivation.
2. The animal goes lame on only one of her legs without any injury or swelling, more commonly the front legs.
3. The cow is dull, off feed, stops rumination and breathes hard.
4. Milk yield is decreased, swelling is difficult.

Treatment and control

For treatment of this disease, 2 to 4 ounces of sodium salicylate with equal quantity of Epsom salt and one tea spoonful of ginger with a little jaggery is given by mouth and repeated after six hours. The sick cow is given laxative diet and warm gruel. She is also provided with a comfortable, warm housing.

Interavenous injection of sterile sodium salicylate solution by a qualified veterinary doctor, if available, will give immediate relief.

5. DIARRHOEA

Diarrhoea is more a symptom of a disease than a disease itself. It is a condition in which dung is passed out in liquid or semi-liquid form, unlike the normal dung which is solid or semisolid. It may be caused by unwholesome feed, spoiled food, toxic food, coarse indigestible fibrous matter or feed adulterated with sand, or stones, polluted water especially after rains which may contain harmful bacteria may also cause diarrhoea. In certain contagious diseases such as rinderpest, worm infestation etc., diarrhoea is a symptom.

Symptoms

1. Frequent parrage of watery motions and the soiling of buttocks, thighs and tail.
2. The animal is dull, belly tucked up with a staring coat.

Fig: Animals affected due to Diarrhoea

Treatment

At first, to remove bacteria and other possible irritants, the animal is given one litre of castor oil emulsion or one litre of linseed oil internally. A few hours later, mix 20 gm catechu, 40 gm chalk powder and 20 gm ginger powder. Feed this mixture with one litre of rice gruel to the animal. This can be repeated twice a day till the diarrhoea stops.

Animals diet should also be corrected by giving dry feed, bran, gram husk, etc and hay or straw instead of green grass.

6. CONSTIPATION

Constipation is a condition where the dung is not passed out with ease, in normal quantity of consistency and is usually a symptom seen in all conditions affecting the general health of the animal, sometimes with a rise in body temperature. The causes of constipation are numerous and some important ones are being given below.

1. Accumulation of dry and hard undigested feed in the stomach.
2. Over-eating of not easily digestible feed such as coarse fibrous roughages.
3. Hurried eating-gulping without proper chewing or rumination:
4. Inadequate intake of drinking water.
5. Increase in body temperature.
6. Inefficient functioning of certain internal organs as liver, intestines, etc.

Following symptoms are observed in constipation.

1. Dung is hard, sometimes even as pellets, passed in small quantities after straining and at times not passed out at all.
2. Loss of appetite.
3. Animal does not chew, stops rumination and shows signs of pain and discomfort.

Treatment

The affected animal should be given laxative diet like wet wheat bran mash, rice gruel and conjee water. Supply easily digestible green fodder. Make the animal drink adequate quantities of fresh water, if necessary by adding a little jaggery or salt or both to the water. Evacuate the rectum and give a warm soap water enema. As a first aid relief measure, use following preparation:

0.25 kg of common salt (sodium chloride)
8.25 kg of Epsom salt (magnesium sulphate)
50 gm of powdered ginger
25 gm powdered pepper
10 gm nux-vomica powder

These ingredients are mixed and divided into two parts. One part is given immediately with feed and the other after a few hours. Six hours later, give half a litre of groundnut oil mixed with 0.25 litre,

castor oil, which when given internally, will certainly get the hardened mass out.

To prevent constipation in cattle following precautionary steps may be taken.

1. To cows which have a tendency to constipate, supply easily digestible feed stuff With plenty of conjee water and drinking water with handful of salt and jaggery.
2. Stop feeding straw but give easily digestible succulent grass like paragrass and doobgrass.
3. Avoid fibrous feed and add a handful of common salt in the feed or conjee water every day as a rule.

CONCLUSION

Prevention, control and eradication are the three basic methods used in dealing with any disease in the cattle population. These three methods are applied depending upon the economic importance of disease and investment cost available for the control programme. For prevention, control and eradication of all contagious diseases (which are mainly caused by virus or bacteria), a potent vaccine is very essential. In susceptible areas or herds, vaccination progrmnme should be carried out well in advance. It is also imperative that cattle and buffalo owner should know all the signs of good health and understand the condition of his animals especially when they manifest symptoms of diseased condition, so that he can take effective steps in time to get his animal treated or to control the spread of infection. Every time it may not be possible for the owner to attend his sick animal and as such, he should take the help of a qualified veterinary doctor in proper time. However, there are certain diseases for which there is no any vaccine or scientific treatment course. In such a case, improvement in hygienic conditions, management practices and feeding standards is very important.

Performance of Buffaloes: Use of Natural Calf vs Synthetic Dummy Calf

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Under traditional management system of buffaloes as prevalent under village conditions, the calves are allowed to suckle their dams for their milk feeding as well as for the let down of milk. However, at most of organized buffalo farms and at many of commercial buffalo farms in the country the calves are weaned from their mothers at birth and artificially fed and reared. The practice of weaning of calves as being practiced at many farms has several adverse consequences both the calves and their dams. The buffalo is a highly social animal with strong maternal instincts. Under natural conditions, the bonding between dam and calf develops soon after birth (within 5 min) and usually persists for at least 1 year. There are several adverse consequences of weaning of calves on the dams. Experience has shown that about 25 % of buffaloes do not adapt to weaning as they do not let down milk without being suckled. Many a time due to more time taken for letdown of milk or no let down of milk at all after prolonged teat manipulation it is not uncommon to resort to exogenous application of oxytocin hormone injection in buffaloes. A common mechanism of milk ejection through the release of oxytocin followed by contraction of myoepithelial cells and removal of the alveolar milk seems to apply to the majority of species studied. However, there are species differences in the need or degree of oxytocin release at milking. In buffalo 95% milk stored in the alveolar compartment only 5% milk found in the cisternal. As a result, pre-milking stimulation is extreme importance for optimal milk ejection response in buffalos as compare to other dairy animals.

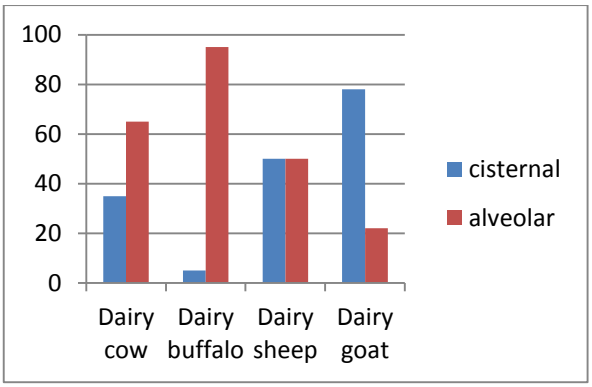


Fig. Proportion of milk stored in the udder of deferent species

The buffaloes whose calves have been weaned have poorer milking temperament and their lactation especially in first calvers are shorter lowering their lactation production. When the calf is suckling the residual milk after milking, the increased degree of udder emptying enhances production (Sandoval-Castro *et al.*, 2000). Suckled buffloes, especially those that suckle their

own calf, have been shown to have a longer interval to first oestrous compared to non-suckled buffaloes. The status of udder health measured in terms of subclinical mastitis, clinical mastitis and CMT score were better in restricted suckling than the artificial rearing calves. The protective effect of residual milk suckling on the mastitis might be stimulated by an increase in complete emptying of udder during suckling which may lead to a reduction in the substrat for bacterial growth and presence of antimicrobial lyphozymes in calf saliva.

Therefore there is a need to evolve some alternative practice which may allow for weaning of calves and at the same time ensure proper let down in buffaloes. The use of a synthetic dummy calf may simulate a let-down stimulus as good as provided by natural suckling and may ward-off the use of oxytocin and at the same time it may allow for mechanisation of milking operation and may improve the efficiency of milking.

The most common reasons for adopting this practice are:

- Accurate recording of milk yield
- The economical and scientific feeding of the calves
- The facilitation of the mechanization and automation of farm operations such as machine milking
- The saving of labour cost and ensuring clean milk production etc.

Various practices used for bonding establishing with dam and dummy calf:

1- **Replacement of calf with dummy calf immediately at the time of parturitio**n- in this method the animal is observed during the parturition and immediately after parturition the calf is removed without any contact to the dam and dummy calf is placed in front of the dam and body of dummy calf is smeared with the amniotic fluid so that it may lead to the bonding between the dam and dummy calf.

2- **Vaginal mucosa stimulated by manual massage**- in this method vaginal mucosa is stimulated by inserting the hand in the vagina of the animal and after the stimulation dummy calf is placed in front of the dam and this led to bonding between dam and dummy calf. The reason might be the same as vaginal mucosa release oxytocin from the hypothalamus and oxytocin acts on olfactory blub and causes the release of dopamine, which initiates the sensitive period during which animal identified the calf.

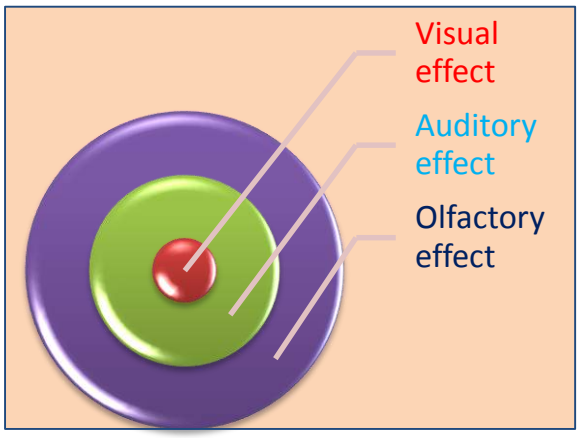
3- **Smearing of freshly drown milk on the body of the dummy cal**f- in this method milk of dam is smeared on the body of dummy calf and presented to the dam, dam licked the dummy calf and started identification of dummy calf. The licking of its own milk on the body of dummy calf may initiate the milk let-down. During the time of let-down the oxytocin is released from the pituitary which may sensitive olfactory bulb and causes the release of dopamine, which initiates the sensitive period.

4- **Smearing of urine on the body of the dummy calf**- in this method urine of the dam smeared on the

body of dummy calf and presented to the dam.

5- **Application of placental membranes on the body of the dummy calf**- in this method the placenta of the dam is rubbing on the body of the dummy calf after 12 hours of parturition and then presented to the dam.

6- **Use of recorded calf vocalization**- Vocal communications plays an important role in the social relationships in many animal species. Calling to one another is particularly important between mothers and their infants. These vocalizations may be used to locate and maintain contact between mothers and their offspring. Vocalizations are often used by hungry youngsters to signal to their mothers that it is time to eat.



Three main factors responsible for the maternal bonding between dam and calf –

A. **Auditory effect-** Vocal communications play an important role in the social relationships in many animal species. These vocalizations may be used to locate and maintain contact between mothers and their offspring. Vocalizations are often used by hungry youngsters to signal to their

mothers that it is time to eat.

B. **Visual effect-** The maternal bonding has been established, deprivation of visual effect results in the continue secretion of oxytocin. This substitute of an alien calf for milk ejection.

C. **Olfactory effect-** The roles of maternal olfaction in regulating the suckling-mediated inhibition of LH secretion, expression of maternal selectivity, and lactational performance. Olfaction is effective in permitting calf identification

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An Overview of Anthrax Infection

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Anthrax, a highly infectious and fatal disease of cattle, is caused by a relatively large spore-forming rectangular shaped bacterium called *Bacillus anthracis*. Anthrax occurs on all the continents, causes acute mortality in ruminants. The bacteria produce extremely potent toxins which are responsible for the ill effects, causing a high mortality rate. The bacteria produce spores on contact with oxygen. Signs of the illness usually appear 3 to 7 days after the spores are swallowed or inhaled. Once signs begin in animals, they usually die within two days. Hoofed animals, such as deer, cattle, goats, and sheep, are the main animals affected by this disease. They usually get the disease by swallowing anthrax spores while grazing on pasture contaminated with anthrax spores. Inhaling (breathing in) the spores, which are odourless, colourless and tasteless, may also cause infection in animals and people.

SYMPTOMS

- Loss of appetite i.e. off-feed
- Sudden rise in body temperature (104 - 105°F)
- Dyspnoea - difficult breathing
- Sudden death (often within 2 or 3 hours of being apparently normal) is by far the most common sign.
- Very occasionally some animals may show trembling, a high temperature, difficulty breathing, collapse and convulsions before death. This usually occurs over a period of 24 hours.
- After death blood may not clot, resulting in a small amount of bloody discharge from the nose, mouth and other openings.

DIAGNOSIS

- Rod-shaped bacteria surrounded by a capsule are visible in blood smears made from surface blood vessels.
- Post-mortem examinations should not be undertaken on suspected anthrax cases (including any cow that has died suddenly for no apparent reason) until a blood smear has proved negative).
- If a carcass is opened accidentally, the spleen is usually swollen and there is bloodstained fluid in all body cavities.

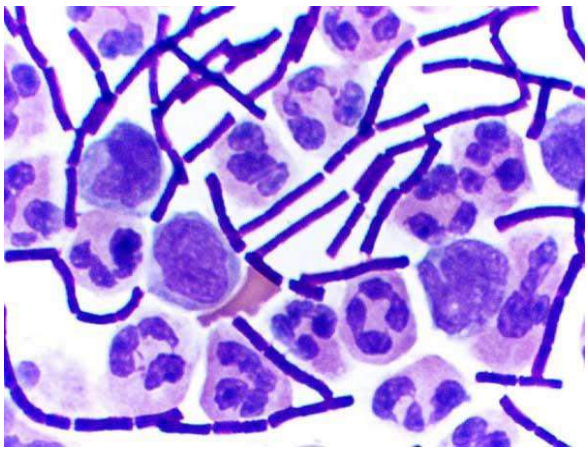


Fig.1Gram-positive anthrax bacteria (purple rods)

Fig.2 Blood discharge from nose in infected animal

Fig.3 Skin lesion caused by anthrax in human

MODE OF INFECTION

Anthrax can enter the human body through the intestines (ingestion), lungs (inhalation), or skin (cutaneous) and causes distinct clinical symptoms based on its site of entry. In general, an infected human will be quarantined. However, anthrax does not usually spread from an infected human to a non-infected human. But, if the disease is fatal to the person's body, its mass of anthrax bacilli becomes a potential source of infection to others and special precautions should be used to prevent further contamination. Inhalational anthrax, if left untreated until obvious symptoms occur, may be fatal.

TREATMENT

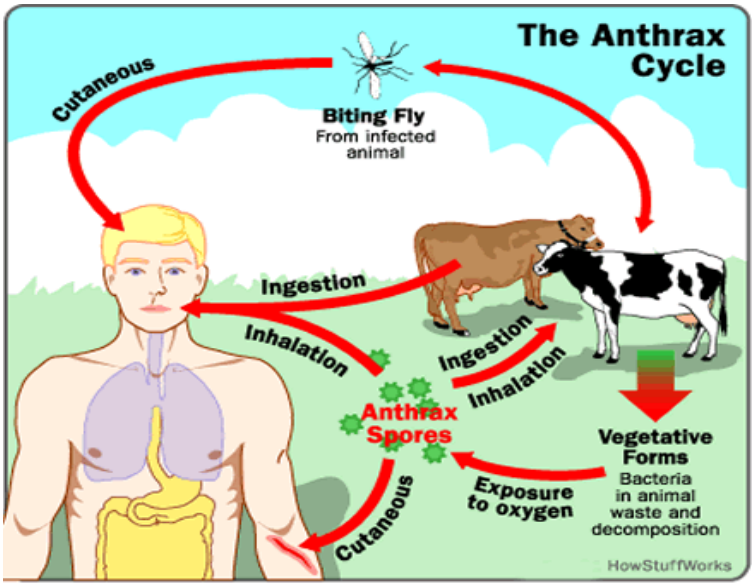
Anthrax is controlled through vaccination programs, rapid detection and reporting, quarantine, treatment of asymptomatic animals (post-exposure prophylaxis), and burning or burial of suspect and confirmed cases. In livestock, anthrax can be controlled largely by annual vaccination of all grazing animals in the endemic area and by implementation of control measures during epizootics. The non-encapsulated Sterne-strain vaccine is used almost universally for livestock immunization. Vaccination should be done 2–4 wk before the season when outbreaks may be expected. Because this is a live vaccine, antibiotics should not be administered within 1 wk of vaccination. Before vaccination of dairy cattle during an outbreak, all of the procedures required by local laws should be reviewed and followed. Human anthrax vaccines currently licensed and used in the USA and Europe are based on filtrates of artificially cultivated *B. anthracis*.

CONTROL AND PREVENTION

In addition to therapy and immunization, specific control procedures are necessary to contain the disease and prevent its spread. Contaminated soils are very difficult to completely decontaminate, but formaldehyde will be successful if the level is not excessive. The process generally requires removal of soil.

Human infection is controlled through reducing infection in livestock, veterinary supervision of animal production and slaughter to reduce human contact with potentially infected livestock or animal products, and in some settings either pre- or post-exposure prophylaxis. In countries where anthrax is common and

vaccination coverage in livestock is low, humans should avoid contact with livestock and animal products that were not inspected before and after slaughter. In general, consumption of meat from animals that have exhibited sudden death, meat obtained via emergency slaughter, and meat of uncertain origin should be avoided. Routine vaccination against anthrax is indicated for individuals engaged in work involving large quantities or concentrations of B anthracis cultures or activities with a high potential for aerosol production. Laboratory workers using standard Biosafety Level 2 practices in the routine processing of clinical samples are not at increased risk of exposure to B anthracis spores. The risk for workers who come into contact with imported animal hides, furs, bone meal, wool, animal hair, or bristles has been reduced by improvements in industry standards and import restrictions. Routine pre-exposure vaccination is recommended for people in this group only when these standards and restrictions are insufficient to prevent exposure to anthrax spores. Routine vaccination of veterinarians in the USA is not recommended due to the low incidence of animal cases. However, vaccination may be indicated for veterinarians and other high-risk persons handling potentially infected animals in areas where there is a high incidence of anthrax cases.



For humans, post-exposure prophylaxis against *B anthracis* is recommended following an aerosol exposure to B anthracis spores. Prophylaxis may consist of antibiotic therapy alone or the combination of antibiotic therapy and vaccination, if vaccine is available, as most human vaccines are not live. Though there is no approved regimen, the CDC has suggested that antibiotics may be discontinued after 3 doses of vaccine have been administered according to the standard schedule (0, 2, and 4 wk). Because of availability and ease of dosing, doxycycline or ciprofloxacin may be chosen initially for antibiotic chemoprophylaxis until the susceptibility of the infecting organism is determined.

Contagious Diseases of Cattle and Buffaloes

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Contagious diseases or transmissible diseases comprise clinically evident illness (i.e., characteristic clinical signs and/or symptoms of disease) resulting from the infection, presence and growth of pathogenic biological agents in an individual host organism. Infectious diseases that are especially infective are sometimes called contagious and can be easily transmitted by contact with an ill person or their secretions. Transmission of pathogen can occur in various ways including physical contact, contaminated food, body fluids, objects, airborne inhalation, or through vector organisms. Contagious diseases usually take a heavier toll of purebred and crossbred cattle than indigenous. With the introduction of exotic animals in the country, the crossbred cows have increased in number. These crossbred animals are highly susceptible to tropical diseases and climatic variations. Buffaloes are more resistant to contagious diseases than cows. For example, the disease "black quarter" is seldom found in buffaloes but takes a heavy toll of milch cows every year. On the other hand, there are a few diseases like haemorrhagic septicemia which attack both cows and buffaloes but the infection is much heavier in buffaloes. The common contagious diseases that are likely to attack dairy cattle are:

1. Bacterial diseases such as anthrax, black quarter, brucellosis, haemorrhagic septicaemia, mastitis and tuberculosis
2. Viral diseases such as cow pox, foot and mouth disease, rinderpest etc.

I. ANTHRAX

Anthrax is an acute disease having rapidly fatal course. It is the oldest disease known in the cattle. This disease is also known as "splenic fever" due to the fact that there is extensive enlargement of the spleen (splenomegaly). The disease is characterized by septicaemia and sudden death with the exudation of tarry blood from natural orifices of dead animals. This disease has a world-wide distribution. Sporadic cases occur almost throughout India. However, it is more prevalent in certain hot and humid regions of the country. The causative agent of this disease is *Bacillus anthracis*. The organism is relatively large, rod shaped and non-motile. Sporulation occurs outside the body in the presence of oxygen. The spores are highly resistant and are not killed by heat, light and disinfectants. The spores remain viable and infective for several years. The animals get infection by ingestion of food and directly from animal to animal.

SYMPTOMS

1. Shivering fits with rise of temperature. Temperature of animal body may go up to 106° F.
2. Rumination stops, eyes become red, extremities get cold.
3. Breathing is difficult.
4. Abdominal pain and tympanitis.
5. Dung is stained with blood and rectum protrudes.
6. Bloody discharge from mouth, nostrils and rectum. The discharge is tarry in colour.
7. Staggering gaits, convulsions and animal dies within 24 hours, if the disease is in acute form.
8. Oedema may predominantly notice under the neck, brisket region, thorax, abdomen and flank.

Fig1: Bloody Discharge from Nostrils in Anthrax

TREATMENT AND CONTROL

- Periodical and regular vaccination should be done. Alive spore vaccine prepared from a virulent strain of *B. anthracis* is safe for all species.
- Strict quarantine measures in anthrax prone areas.
- Preventing the introduction of infected animals into disease free areas.
- The treatment is usually not possible in acute cases. Sub-acute cases are treated With antibiotics and anti-anthrax serum. Penicillin and streptomycin in large doses are recommended. Annual vaccination of the animals is recommended in the endemic areas.
- Carcasses should not be opened as it may contaminate the pasture.
- Care should be taken to destroy the dead body by deep burial with quick lime.
- Persons handling the anthrax infected animals should adopt adequate sanitary measures.
- The adjacent areas of the dead and infected animals should be thoroughly disinfected by 3% per acetic acid or 10% caustic soda or 10% formaline.
- The fodder from infected pasture should be destroyed and not to be given to the other animals.
- Destruction of contaminated material and disinfection of equipments and animal shed is also necessary.

2. BLACK QUARTER

Black quarter is an infectious disease of cattle which may affect even healthy young animals, 6 months to 2 years of age. The name 'blackleg' derives from the fact that the site of infection is often a leg muscle, and that the affected muscle is dark in colour.

It is rapidly fatal disease caused by a bacterium *Clostridium chauvoei* and, less frequently, C. septicum . Spores produced by the clostridia can lie dormant in the soil for years without losing their potency.

It is an anaerobic bacterium which grows only in the absence of oxygen. So bacteria entering the animal body through minute punctured wounds which exclude air get favorable environment to grow. The infection usually takes place through food, water and soil contaminated with black quarter organisms.

SYMPTOMS

1. Gas is detectable under the skin and this produces a crackling sensation when the skin is rubbed with the hand. The rapid accumulation of gas under the skin and in the body cavity gives the carcass a bloated appearance, with the limbs spread apart and pointing upwards. There may be a frothy, blood-stained discharge from the mouth, nostrils and anus.
2. Swelling of the muscular portions usually the quarters, thighs, shoulder, etc.
3. Rise in the temperature of animal body and animal becomes dull and goes off-feed.
4. Disinclination to move due to swelling. The affected muscle is black in color.
5. Pulse and respiration are accelerated.
6. During a necropsy, a diagnosis is usually made very quickly, as the affected muscle is usually mottled with black patches, which are dead tissue, killed by the toxins the bacteria release when they infect live tissue. If viewed under a microscope, small rod-like bacteria can be seen to confirm the diagnosis.
7. The animal is not able to stand or walk i.e. deadly lame.

TREATMENT AND CONTROL

Animals can be protected by suitable vaccination. The vaccine produces immunity in 10 -12 days that lasts for about one year. Animals which are showing symptoms should be isolated and treatment done for those showing early symptoms. Penicillin and tetracycline's if given promptly and inoculated into the site of lesions are of value and should be given in normal therapeutic dose. Sulphathiozole and antitoxic sera are also effective. Carcasses of animals known to have died from blackleg should not be opened. Opening the Carcass can liberate bacteria which will form spores that will contaminate the ground and subsequently infect other cattle. Also, do not drag carcasses along the ground. If possible, burn or deeply bury the carcasses where they lie.

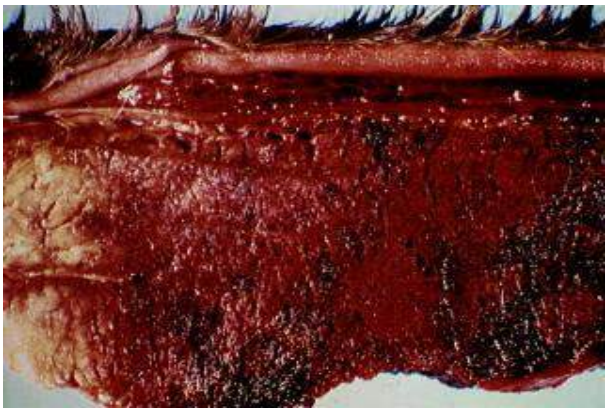

Fig2: Black Quarter lesions in the muscle of ox.

3. BRUCELLOSIS, BANG'S DISEASE, CRIMEAN FEVER, GIBRALTAR FEVER, MALTA FEVER, MALTESE FEVER

The disease in cattle, water buffalo, and bison is caused almost exclusively by *Brucella abortus*; however, *B suis* occasionally is isolated from seropositive cows but does not appear to cause clinical signs and is not contagious from cow to cow. In some countries, the disease in cattle is caused by *B melitensis*. The syndrome is similar to that caused by *B abortus*. *B melitensis* is not present in the USA. Infection spreads rapidly and causes many abortions in unvaccinated cattle. In a herd in which disease is endemic, an infected cow typically aborts only once after exposure; subsequent gestations and lactations appear normal. After exposure, cattle become bacteraemia for a short period and develop agglutinins and other antibodies; some cattle resist infection, and a small percentage of infected cows spontaneously recover. A positive serum agglutination test usually precedes an abortion or a normal parturition but may be delayed in ~15% of cows. The incubation period may be variable and is inversely related to stage of gestation at time of exposure. Organisms are shed in milk and uterine discharges, and the cow may become temporarily infertile. Bacteria may be found in the uterus during pregnancy, uterine involution, and infrequently, for a prolonged time in the non-gravid uterus. Shedding from the vagina largely disappears with the cessation of fluids after parturition. Some infected cows that previously aborted shed brucella from the uterus at subsequent normal parturitions. Organisms are shed in milk for a variable length of time—in most cattle for life. *B abortus* can frequently be isolated from secretions of non-lactating udders. Natural transmission occurs by ingestion of organisms, which are present in large numbers in aborted fetuses, fetal membranes, and uterine discharges. Cattle may ingest contaminated feed and water or may lick contaminated genitals of other animals. Venereal transmission by infected bulls to susceptible cows appears to be rare. Transmission may occur by artificial insemination when *Brucella*-contaminated semen is deposited in the uterus but, reportedly, not when deposited in the mid-cervix. Brucella may enter the body through mucous membranes, conjunctivae, wounds, or intact skin in both people and animals. Brucella have been recovered from fetuses and from manure that has remained in a cool environment for >2 months. Exposure to direct sunlight kills the organisms within a few hours.

SYMPTOMS

1. Brucellosis in animals is generally typified by late-term abortions and inflammatory lesions in the male reproductive tract. The cow throws out a dead foetus prematurely but the placenta does not fallout.
2. The cow gets sick and there is blood tinged discharge from the vagina.
3. Milk yield drops in a lactating cow and the cow goes down in condition.
4. There are signs of pregnancy and signs of calving will be noticeable much earlier than the due date and the calf will be thrown out prematurely. In subsequent pregnancies, the foetus is

usually carried to full term but second or third abortion may take place in the same cow.

5. In the bull, orchitis and epididymitis occur. One or both the scrotal sacs may be affected with acute, painful swelling.
6. Testicular abscesses may occur. Longstanding infections may result in arthritic joints in some cattle.

TREATMENT AND CONTROL

The antibiotics are effective in making the organisms disappear, but they may reappear when the treatment is stopped. Therefore, the treatment is not very successful. Vaccination with *Brucella abortus* strain 19 is helpful in the control of brucellosis in a herd. The vaccine is inoculated in the calves aged 91 -100 days. It stimulates the development of high level of immunity which lasts till fifth pregnancy. The general practices for the control of brucellosis in cattle are hygienic measures, identification and elimination of infected animals from herds. Hygienic measures include isolation of infected animals, disposal of aborted fetuses, placental and uterine discharges and disinfection of contaminated area.

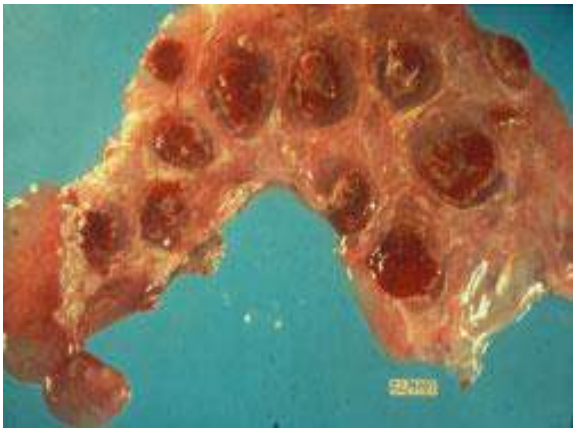

Fig3: Bovine placenta containing numerous hemorrhagic cotyledons.

Fig4: The carpal bursa is markedly swollen and fluctuant as a result of brucellosis.

4. HAEMORRHAGIC SEPTICAEMIA

This disease is widely prevalent in India among cattle and buffaloes. It occurs mostly in acute septicaemic form. Buffaloes are more susceptible to this disease than cattle owing to their greater liking for water and swamps. The disease occurs generally in low lying humid areas and is often seasonal. Outbreak occurs during the periods of highest humidity such as during monsoon. The disease is mainly caused by *Pasteurella multocida*. However, stress due to exhaustion because of excessive work, starvation, chilling or change from rail or road journey may also pre-dispose animals to infection. This accounts for the name "shipping fever", by which the disease is known in certain countries.

Haemorrhagic septicaemica is carried on through the carriers season after season. The organisms are maintained by carriers during the inter-epidemic period. The infection may occur due to ingestion of polluted grass or water while feeding, grazing and drinking in such places. The organisms get into the blood

through wounds inside the mouth gullet, stomach or intestine and sometimes through wounds in an animal's feet or legs. They may also be conveyed from a diseased animal to a healthy one by biting insects. The disease may attack throat, lungs or intestines and, as such, three forms of the disease are recognizable namely throat form, lung form and intestinal form.

SYMPTOMS

1. Off-feed, high temperature (105 to 108^{o} F) disinclination to move with the herd, shivering, starring coat, and dry hot muzzle.
2. Hurried breathing and no milk.
3. Drooling of saliva, pain in throat and swelling in the space between jaws, neck, fore limb and brisket.
4. The swelling is hot, tense and painful
5. One may notice a suffocating cough, difficult breathing and swollen and reddened eyes.
6. Colicky(stomach) pain, animal groans and strains when passing feces which first may be hard and glazed and later on watery, containing blood and mucus shreds. Mortality is very high even 90 per cent.

TREATMENT AND CONTROL

Treatment can be effective if it is carried out in the early stages of the disease but the rapidity of the disease often prevents it. Sulphadimidine and broad spectrum antibiotics are effective. In an endemic area prophylactic vaccination should be carried out annually about a month before the onset of rains. Healthy animals should be isolated from the sick ones and dead animals must be buried six feet deep with lime. Everything connected with the suffering animals such as ropes, brush, baskets, etc. must be scrubbed, washed with phenyl or even burnt.

5. MASTITIS

Mastitis is a disease of udder which usually occurs in heavily milking cows and buffaloes usually after third calving when the milk secretion is at its peak. There is inflamation in the udder due to the infection with micro-organisms. The most important bacterial organisms causing mastitis are *Staphylococcus aureus; Str. agalactiae; Str.zooepidemicus; Str.faecalis; Str. pyogenes; Klebsiella spp; Mycobacterium bovis; E.coli; Brucella abortus; Pseudomonas pyocyaneus; Leptospira pomona; Pasteurella multocida.* The fungal organisms responsible for mastitis are *Trichosporon spp; Aspergillus fumigatus; A.midulus; Candida spp.* The infection usually occurs due to insanitary conditions of the cattle shed or due to spreading of infection from other infected cows through the hands of the milker. This may occur in anyone quarter of the udder in more than one quarters.

SYMPTOMS

The first symptom is the tendency to kick while being milked in an otherwise quiet animal. Other symptoms are as follows:

1. Very severe if the udder gets affected immediately after calving and the teats become swollen.
2. Udder is hard and painful with a yellow serum-like fluid to start with, then flocculent material with blood and later on pus.

3. There may be slight rise of body temperature. The animal rests her head on her chest or stretches out on the ground.
4. Milk is very watery and blood tinged, often curdled, and comes out in clots or shreds, later on as pus.
5. The udder loses its normal shape due to swelling of the quarters and displacement of the swollen teats out of position. Milk from the affected udder should not be used for human consumption. But if milk looks clean, healthy and without clots and shreds, it can be boiled and used for calf feeding.

Fig5: Teat affected due to mastitis

TREATMENT AND CONTROL

The treatment of mastitis is done by antibiotics. Special preparations of antibiotics for infusion into the teats are available. The effectiveness, however, depends on the stage of development of disease. Before infusion of the medicine, the udder is completely milked out. The medicine after introduction into udder is allowed to spread properly by massaging the udder.

The control of mastitis depends on sanitary precautions and early detection of affected cases. Small white clots of milk which may appear before the swelling is evidenced can be detected by a "strip cup". This is a wide mouthed cup with a black platform. A black cloth tied over the cup should also be used. Milk from the suspected quarters may be milked directly over the black surface to find out the presence of clots. Another method of testing for mastitis is by using special test papers, which are filter paper strips impregnated with indicators like bromothymol blue. As mastitis milk is slightly alkaline in reaction when a drop of milk is poured over the paper, the color changes to dark green.

In order to prevent the spread of the disease, the affected cow should be isolated. She should be milked separately by a separate milkman. If a separate milkman is not available, let the available milkman milk healthy cows first and then milk the affected cow last in a separate vessel. Also, keep cattle shed and surrounding clean.

7. JOHNE'S DISEASE

Johne's disease is a serious disease of cattle and buffaloes. It constitutes a potent source of threat to the dairy industry and livestock trade in many countries. It is also known as paratuberculosis as it is produced by Mycobacterium paratuberculosis.. Its insidious nature, protracted and irregular period of incubation, rather vague and indefinite symptoms in the early stage and lack of accurate methods of diagnosis defy the steps to check the indiscriminate

movement of the affected animals. The infection bas thus rapidly spread all over the globe. The causative organism is excreted with feces and will remain alive for a long period. This will cause the spread of disease to other animals.

SYMPTOMS

The disease is very insidious at the onset, and the animal may show clinical symptoms after months or year of infection. In the early stages there is hardly any symptoms which may lead to a positive diagnosis. However, the principal symptoms are given below.

1. The affected animal becomes emaciated and bas persistent diarrhea with bad smell.
2. The feces may often be mixed with flakes of mucous and gas bubbles and are usually passed without straining.
3. The appetite is not impaired and there is no fever or pain, the animal has normal body temperature.
4. The coat becomes starring and the skin leathery with the progress of the disease.
5. Anemia becomes more marked and on edematous swelling (containing fluid) may develop in the sub-maxillary region.
6. The animal goes on loosing condition and at last death occurs due to exhaustion and dehydration.
7. In some cases, however, diarrhea may be absent and deatl1 may occur due to debility only.

CONTROL AND TREATMENT

At present there appears to be no practical and reliable method of treatment of this disease. The organism is very resistant to chemotherapeutic agents. Because of this the practical utility of treatment in clinical cases is poor. A live vaccine has been developed. It reduces the incidence of clinical disease. It consists of a non-autogenic strain of Johne's bacillus with an adjutant. The calves soon after birth are inoculated with the vaccine subcutaneously. The vaccinated animals become reactor of John. The vaccination is generally done in heavily infected herd. General hygiene, test and segregation, slaughter of clinical cases, provision of clean water supply, proper disposal of infected animals improving the general nutritional level, supplementing the rations with minerals, etc. are some of the steps to prevent the spread of the disease. The carcasses of affected animals should always be burnt or buried deep into the ground with lime.

8. FOOT AND MOUTH DISEASE

The foot and mouth disease is highly communicable disease affecting cloven footed animals. It is characterized by fever, formation of blisters in the mouth, udder, teats and on the skin between toes and above the hoofs. Animals recovered from the disease present a characteristically rough coat and deformation of the hoof. In India the disease is widespread and assumes a position of importance in livestock industry. It is caused by a virus Apthous of the family Picornaviridae. It has seven immunologically distinct serotypes namely O, A, C, Asia1, SAT1, SAT2, SAT3. The virus is quickly inactivated outside the pH range of 6.0 - 9.0 and by desiccation and temperature more than 56˚C, although

virus may survive a considerable time when associated with animal protein such as in infected milk the virus will survive pasteurization at 72˚ C for 15 seconds. The virus is resistant to alcohol, ether and chloroform. It spreads by direct contact or indirectly through infected water, manure, hay and pastures. It is also conveyed by cattle attendants. Foot and mouth disease occurs in relatively mild form in India and is seldom fatal. It occurs practically all the year round. The disease has been existing for years and, in view of the frequent opportunities for exposure to natural infection, most of the indigenous animals have a great degree of resistance to the disease. Of late, significance is being attached to the airborne transmission of the virus.

SYMPTOMS

The virus gains entry into the blood stream of animals through injury to the lining membranes of, tongue, intestines, clefts of hooves and other similar parts. The incubation period in natural infection is 2.5 days, whereas in artificial infection it is 24 to 48 hours only. After incubation period is complete, following symptoms may be observed.

1. Rise of body temperature, dry muzzle, dullness, depression, shivering, staring coat, loss of appetite and stoppage of rumination.
2. Slight constipation.
3. Dribbling of saliva from tile mouth.
4. Formation of blisters on the tongue, gums and cheeks.
5. Shaking and kicking of legs and lameness.
6. Vesicles at the cleft of the hoof become ulcer like and may get fly blown. .
7. Vesicles may be seen on the udder and teats also.
8. The milk yield comes down in quantity and quality, and the milk coagulates on boiling.
9. Tendency of the hooves to get deformed and sometimes the horns of the hooves may be shed. Consequently the animal becomes permanently lame.
10. The infected animal cannot be put to hard work, especially in the sun, and it gasps from breath, a condition known as "panting". Panting is more severe in the cross-bred animals than in the indigenous ones.

Fig6: Drooling of saliva

Fig7: Foot and mouth disease lesions

Fig8: FMD lesions in cattle foot

TREATMENT AND CONTROL

No therapeutic agents have been found till now to cure foot and mouth disease. The use of drugs by field worker is resorted to only as a measure of acidity in the material process of recovery. Thus, the external application of antiseptics contributes to the healing of ulcers and wards off attack by flies. A common and inexpensive dressing for lesions of feet is a mixture of coal tar and copper sulphate in the proportion of 5.

1. Some other measures to treat the disease are given below.

1. Clean the wounds and ulcers in the mouth, udder, teats and feet with 2% potassium permanganate lotion or alum water.
2. Decoction of *babool* bark for gargling the mouth and washing the ulcers may also be effective.
3. Apply boric acid mixed with glycerin to ulcers in the mouth.
4. Foot bath with a disinfectant solution such as cresol or phenol (1 : l00) may be used.
5. When maggots are found, custard apple leaves ground into a paste may be applied or a few drops of turpentine are let in.
6. Sores on the udder and teats of milch cows should be kept clean and dressed with boric ointment.

9. RINDERPEST

Rinderpest is also known as "cattle plague". It is the most serious contagious viral disease of cattle in the country. It is a rapidly fatal disease affecting larger number of annuals and causing enormous losses in infected herds. It affects mainly cattle and other cloven footed animals including buffaloes. Unless special precautions are taken a very large percentage of the affected annuals may die. Rinderpest is caused by an ultra-visible virus ,morbillivirus. The virus is present in the blood corpuscles of affected animals. It is excreted through the saliva or discharges from the nose, eyes and the urine and feces of the affected animals. Outside the body the virus is rapidly destroyed by the sunlight and disinfectants. The disease spreads through air, contaminated utensils, attendants, etc. It may be introduced in a herd by the inclusion of infected animals.

SYMPTOMS

The incubation period of the disease is 3 -7 days. After the incubation period is complete following symptoms are observed.

1. High fever, dullness, staring coat, shivering, dry muzzle, and drooping of head and ears.
2. Loss of appetite and no rumination.
3. Milk secretion in cows stops.

4. Salivation, eruptions like bran particles on the inside of lips, gums, dental pad and roof of the mouth.
5. Eyelids are swollen, mucus membranes light red and there is lachrymation and nasal discharge.
6. Urine becomes dark colored and scanty.
7. First there is constipation which lasts for 2 -3 days followed by profuse diarrhea mixed with mucus and blood with very offensive odor.
8. The animal gets exhausted by this time and usually dies after a long period of agony.

TREATMENT AND CONTROL

In earlier days anti-rinderpest serum was used on a large scale for the treatment of the clinical cases of the rinderpest. This practice is now of little value. Anti-rinderpest serum has little or no curative properties once the virus has produced the clinical symptoms in the animal. Hence, the use of this serum is not recommended. Symptomatic treatments with penicillin, streptomycine, sulphadimidine and intestinal antiseptics have no action on tile virus, but may help in tile recovery of tile less severe cases of the rinderpest. It is beneficial to keep the animal on light diet, such as rice gruel with kaolin which acts as intestinal astiguents to reduce the intestinal effusions and control diarrhea. Advanced preventive vaccination if done with freeze dried rinderpest vaccine gives immunity for five years.

As there are chances of spreading the disease through Common grazing grounds and at cattle sheds, sufficient precautions should be taken. The affected animals are to be segregated and the newly added animals are to be quarantined for at least 10 -15 days.

10. COWPOX

Cow-pox attacks both cows as well as buffaloes and causes great loss by a rapid fall in the milk yield and by spreading the infection to other animals and human beings. Basically this is a viral disease but secondary infection may be caused by bacteria. The occurrence of cowpox has frequently been associated with the incidence of small-pox in human beings. Instances are on record in which cow-pox in all stages has been transmitted through the milkers. However, conclusive evidence is still lacking as to the existence of any relationship between small pox with outbreaks of cow pox. Under natural conditions the infection takes place through inoculation by the cutaneaus route and readily spreads from one animal to another through the agency of milkers. The occurrence of this disease is not often reported since it is localized only to the teats and udder, and occasionally to the hairless parts of the body. It does not assume a serious form unless the lesions are infected with pyogenic (pus producing) organisms.

SYMPTOMS

1. The first symptom is the tendency to kick while being milked, by an otherwise quiet cow.
2. Teats get swollen, hard and painful.
3. There is rise of body temperature, loss of appetite and stopping of rumination.

Table 1 Vaccines for contagious diseases

S. No.	Disease	Types of vaccine	Time of vaccination	Duration of immunity	Time of revaccination
1	Black quarter	Alum precipitated vaccine	Before onset of rainy season	One year	Before onset of next rainy season
2	Anthrax	Anthrax spore vaccine	do	do	do
3	Haemorrhagic septicaemia	Oil adjuvant	do	do	Do
4	Brucellosis*	Calf hood vaccine with cotton stain19	6 months of age	Life long	---
5	Tuberculosis	B.C.G. Vaccine	do	life	---
6	Rinderpest	Caprinised vaccine	do	do	---
7	Foot and mouth disease	Polyvalent vaccine	In October-November	For one season	Next October-November

* vaccination should not be carried out in a herd which is absolutely free from brucellosis.

4. Eruptions appear on the skin of the udder and teats developing into vesicles, pustules and scabs by stages, sometimes on the thighs and abdomen
5. Reduction in milk yield.

TREATMENT AND CONTROL

The lesions heal by themselves in the normal course and the adoption of special measures is not generally required, only the usual rules of hygiene need to be observed. The lesions should be cleaned with a 1 : 1000 solution of potassium permanganate followed by the application of an antiseptic ointment such as 1 : 10 boric acid. The affected animals should be isolated and milked by separate milkers. Milk from affected animals should be boiled before use. If the disease assumes serious proportions, vaccination may be undertaken.

CONCLUSION

Livestock has played a very important role in the Indian economy ever since civilization. With the increasing human population in India, demand for animal protein is increasing, due to social and economic reasons. Milk and milk products are important constituents of human diet. Some of the population also takes animal meat, especially of buffaloes, due to low cost and taste. Thus control and eradication of diseases of cattle and buffaloes are very important

considerations. Now with the introduction of some of the foreign breeds of cattle and their crosses, which are highly susceptible to diseases, tile demand for efficient health cover has increased considerably in order to maintain them in good health and production. For tins, control and eradication programme for these cattle diseases has become very important considering the economies of cattle and buffalo industry. Prevention, control and eradication are the three basic methods used in dealing with any disease in the cattle population. These three methods are applied depending upon the economic importance of disease and investment cost available for the control programme. For prevention, control and eradication of all contagious diseases (which are mainly caused by virus or bacteria), a potent vaccine is very essential. For most of these contagious diseases, vaccines are available (see table. 1). In susceptible areas or herds, vaccination programme should be carried out well in advance.

Bioenergy from Agriculture Waste

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There are mainly dry waste and wet waste for energy production

DRY RESIDUES

These include those parts of arable crops not to be used for the primary purpose of producing food, feed or fiber.

a. Field and Seed Crop

Field and seed crop residues are the materials remaining above the ground after harvesting, including straw or stubble from barley, beans, oats, rice, rye, and wheat, stalks, or stovers from corn, cotton, sorghum, soybeans, and alfalfa.

b. Fruit and Nut crop

Fruit and nut crop residues include orchard prunings and brushes. The types of fruit and nut crops include almonds, apples, apricots, avocados, cherries, dates, figs, grapefruit, grapes, lemons, limes, olives, oranges, peaches, pears, plums, prunes, and walnuts.

c. Vegetable Crop

Vegetable crop residues consist mostly of vines and leaves that remain on the ground after harvesting. The types of vegetable crops include such plants as artichokes, asparagus, cucumbers, lettuce, melon, potatoes, squash, and tomatoes.

D. Nursery crop

Nursery crop residues include the pruning's and trimmings taken from the plants during their growth and in the preparation for market. There are more than 30 different species of nursery crops (e.g. flowers and indoor plants, etc.) that are grown.

WET RESIDUES

These are residues and wastes that have high water content as collected. These include:

a. Animal Slurry

b. Farmyard manure

c. Grass silage

Waste Resources

Crop	Waste
Coconut	Fronds, husk, shell
Coffee	Hull, husk, ground
Corn	Cob, stove, stalks, leaves
Cotton	stalks
Nuts	Hulls
Peanuts	Shells
Rice	Hull/husk, straw, stalks
Sugarcane	Bagasse
Agricultura Crope	Mixed agricultural crops, not limited to crop waste
Mixed type	Agricultural crops and waste including non-organic wastes

PROCESSING TECHNIQUES

Besides several techniques there are some major techniques wich are used to convert biomass to energy given in table.

Table: 1 Technology Conversion

Technology	Conversion Process Type	Biomass Waste	Energy or Fuel Produced
Biodiesel Production	Chemical	rapeseed soy beans waste vegetable oil	Biodiesel
Direct Combustion	Thermochemical	agricultural waste mixed waste	Heat Steam Electricity
Ethanol Production	Biochemical (aerobic)	sugar or starch crops wood waste pulp sludge rice and corn straw	Ethanol
Gasification	Thermochemical	agricultural waste mixed waste	Low or Medium-Btu Producer Gas
Methanol Production	Thermochemical	agricultural waste mixed waste	Methanol
Pyrolysis	Thermochemical	agricultural waste municipal solid waste	Synthetic Fuel Oil (Biocrude) Charcoal

BIOLOGICAL CONVERSION

Biological conversion is well-established, with the two main routes being fermentation and anaerobic digestion

1. Combustion

Combustion is simply thermal processing, or burning of biomass, which in the simplest case is a furnace that burns biomass in a combustion chamber. Combustion technologies play a key role throughout the world, producing about 90% of the energy from biomass

2 Gasification

Gasification is another major alternative, currently one of the most important R & D areas in biomass for power generation, as it is the main alternative to direct combustion. The importance of this technology relies in the fact that it can take advantage of advanced turbine designs and heat-recovery steam generators to achieve high energy efficiency

3 Pyrolysis

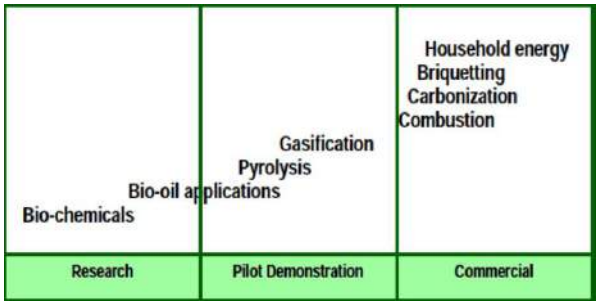
Pyrolysis of biomass generates three main energy products in different quantities: coke, oils and gases. Flash pyrolysis gives high oil yields, but still needs to overcome some technical problems needed to obtain pyrolytic oils. However, fast pyrolysis is one of the most recently emerging biomass technologies used to convert biomass feedstock into higher value products.

4. Chemical conversion from oil-bearing crops

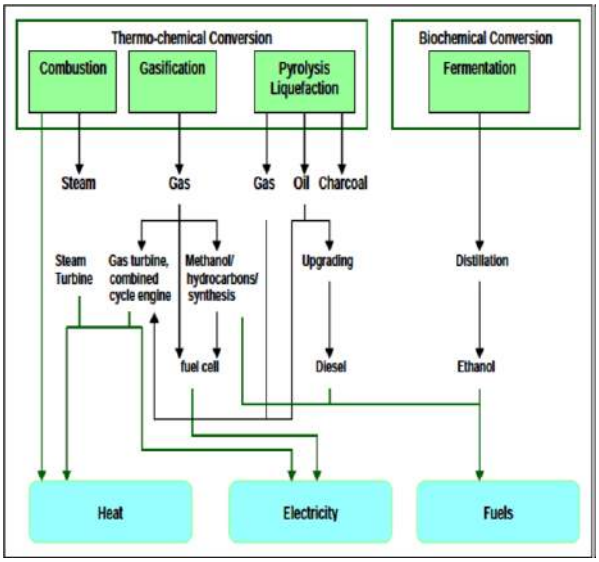
An interesting option for the future is the production of bio-diesel from algae. The production of algae to harvest oil for bio-diesel has not yet been undertaken on a commercial scale, but feasibility studies have suggested high yields, as some algae have oil content greater than 50%. The dried remainder after bio-diesel production can be

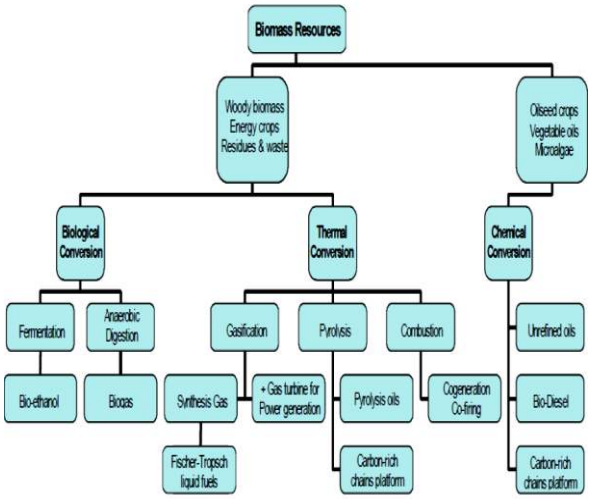
further reprocessed to make ethanol. The possibility to make both bio-diesel and bioethanol from the same feedstock could accelerate biofuels market expansion considerably.

Level of Use for Energy Conversion



Conversion Routes for Cellulosic Agricultural Biomass Waste





Conversion options for bioenergy and industrial biotechnology

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Integrated Pulse Beetle Management In Stored Pulses Seeds

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India grows a variety of pulses crops under wide range of agro-climatic conditions. The improved agricultural practices and introduction of high yielding verities increased the area and production of pulses. Pulse beetle are commonly occurring and considered to be the most serious insect pest of stored pulses viz., black gram, green gram, red gram and chick pea and beans, peas, cowpea and soybean. The pulse beetle attacks leguminous pods at field wherefrom they are carried to store godowns. The pulse beetle is not causing only quantitative loss but also losses germination, vigour and unfit for sowing. Farmer storing their produced pulses seed either in bag, locally available container and loose in the room where they are also living, unable to fumigate the produce for the control of this pest. There is no remedial measure to manage the pulse beetle. Under such circumstance, unprotected stored pulses seeds suffer heavy losses. They destroy completely the endospermic portion of seed and leaving only the seed coat thus seed losses completely its viability. It causes weight loss, decreased germination and reduction in commercial value of the seed.

Different species of pulse beetle

Order: Coleoptera, Family : Bruchidae
Callosobruchus chinensis, C. maculatus, C. a nalis, Bruchus affinis, B. phaseoli, B. emergin atus, B. pisorum , B. albocallosus.

Identification

Callosobruchus chinensis- The larva is recognized by its creamy white. Oval and flabby body. The adult beetle measuring 3-4 mm in length, oval, chocolate or radish brown and has long serrated antenne. There is a pair of the hind margin of thorax, a spine on each of the inner and outer edges of the inner and outer edges of the end of hind femur and truncate elytra, not covering the pygidium.

Callosobruchus maculatus- Cowpea bruchid adults are small (3-mm long) orange-brown beetles with a body that tapers towards the head. Their wing covers (elytra) are slightly shorter than their abdomen.

LIFE CYCLE

The pests breed actively from March to the end of November. It hibernates in winter in the larval stage. At the end of March, the adults appear and copulate immediately after emergence. A day after, the female starts laying small, oval, scale like eggs which are glued to grain. In C. chinensis, more than one eggs laid on a grain. The life

cycle is completed inside the seed with the mature larva excavating underlying seed tissue, leaving a visible 'window' just below the seed testa, within which it pupates and encloses. The average life span of an adult is 5-20 days, the insect passes through 7-8 overlapping generation in year.

NATURE OF DAMAGE

This is primary pest of stored pulses. Infestation starts from field and continues in the store. The grub penetrates grains and feeds on inner content. Infested seeds are not used as seed purpose. Maximum damage occurred when favorable condition i.e. optimum temperature 30^0C and relative humidity 70%. Bruchids in stored seed are a major problem because of their ability to re-infest stored seed.

Preventive Measures

- **Hygiene and sanitation-** Before storing the pulses seeds in an ideal storage/ godown, it is important to ensure that the seeds are dry, clean, cool, wholesome and free from any obnoxious odour. The storage structure should also be neat and clean and reasonably air tight so that control measures may be possible. Threshing floor or yard should be clean, free from any insect infestation, away from the vicinity of village or granaries to avoid horizontal and cross infestation, as bruchids move from these source to infest grains on threshing floor or yard.
- **Proper stacking-** Proper stacking also help in grain protection. Stack properly on the dunnage (wood/ plastic) 0.5 meter away from the walls and floor in the lines keeping 0.5 meter space between two lines and 0.2 meter open space toward the roof. Do not stack more than 10 bags vertically.
- **Disinfestations of storage container, structure and stores-** Clean and disinfest bags by dipping in the boiled water and drying under sun, when re-used. If one can afford, treat the old gunny bags by dipping in cypermethrin 0.01% or fenvarlerate 0.01% or malathion 0.1% for 10 minutes and dry them completely under sun. Treat all the inner surface and walls of the storage structures and godowns either by Malathion (50 EC) or Fenitrothion (50EC) using 5 ml of any insecticide in one liter of water. Fumigate with aluminium phosphide @ 21-30 g.

Curative Methods

- **Ecological method-**
- **a) Storage temperature-** Temperature ranging from 25- 35^0C accelerates the development of pulse beetle and above 40^0C and below 15^0C retards reproduction and development, while temperature above 45^0C and below 10^0C kills the pulse beetle/ bruchids. Heating of the pulses to 50^0C may be lethal to pulse beetle but it is not advisable because the seeds may lose their viability.

b) Seed moisture content- Pulses seeds should be stored below 12 percent moisture content escape from the attack of pulse beetle.

PHYSICAL METHODS

Use of Solar heat- The use of solar energy has long been practiced as one of the effective methods for minimizing pulse beetle infestation stored pulse seeds. All the stages of pulse beetle in infesting

mung, pea, gram seeds etc. could be killed by exposing to heat for varying period at temperature of or by exposing to solar heat for hr. with the diurnal temperature varying from 37 - 54^{0}C. It has also been observed that viability of the treated grains may not adversely affected. Ghaffar and Chauhan (1999) examined the level of accumulation of temperature in polythene bags and its effect on bruchid survival and infestation in the pigeon pea seed contained in them. Bruchids in all the solarized bags died without laying eggs whereas no damage recorded in the solarized bags. This indicated that seed solarization was effective as a means of protecting seeds from bruchid damage.

Mixing of inert dust and sand- Some inert dusts abrasive and scars the cuticle causing desiccation and starvation, but actual efficiency depends on the particle size, particle hardness, particle shape and form, humidity. Finer particles have higher the insecticidal efficacy because coarser particle do not stick to insect or the seeds. The farmers in village mix sand, clay ash etc. with the seeds which make difficult task and causes physical injuries; blocks mouth part, lodges in the joint of beetle. Sand as 40-60 mm top layer on seeds has most effective in reducing the oviposition as well as egg hatching. Inert dusts particularly based upon silica content are gaining importance as storage protectants. The main reason behind this is that they induced egg mortality by desiccation (Golob, *website).* Ash or any other fine dust block the spiracles of the insects and result into death due to suffocation. Insect die when they lose about 30 percent of their total body weight. Mahmoud *et al.* (2010) reported adults of *Callosobruchus maculatus* (F.) and *C. chinenesis* (L.) were exposed to broad been seeds treated with kaolin-based particle film dusts (powder) at different concentrations 1.0, 0.8, 0.6, 0.4, 0.2, 0.1, 0.05, 0.025% w/w and untreated control. After six months of storage of the treated seeds, kaolin powder still could protect the broad bean seeds against *C. maculatus* and *C. chinensis* attacks.

Mechanical cleaning

Broken and cracked grains promote attack of pulse beetle. Hence, screening and sieving out such seeds reduce the insect infestation and gives better appearance to it. Regular screening of seeds done away from the stores to avoid any reinfestation. Screenings should be destroyed immediately. Bags should be used for screening not be used again unless disinfestations.

RADIATION METHOD

The possibility of thermal disinfecting various products by ionizing radiation. In 1916 Ranner proved that X-rays prevent the development of embryo and young larvae of this beetle. Change in chemical composition of cell, disturb its normal functioning, metabolism division and consequently kill the cells. Ionizing radiation sterilizes the pests, lower their viability and finally lead to their death.

CHEMICAL METHOD

Under the many circumstances the easiest, most rapid, and economical method of

controlling pulse beetle is with insecticides, often in the form of fumigants. Among the methods chemical method of pulse beetle control is most popular and effective one. Surface spray of bags as and when the insect pest are visible are done with insecticides such as malathion, primiphose-methyl, DDVP, fenitrothion etc. Malathion 50% EC is sprayed over the bags in the ratio of 1:100 @ 3 Liter/ 100 m^2 also Deltamethrin 2.5 WP @ 3 mg a. I/ m^2 found very effective. Allay spraying of allays between two seed stocks with chemicals like dichlorovos (DDVP) @ 0.05 percent has been found very effective in preventing the cross infestation. Seed treatment with chemical insecticide reduce the pulse beetle infestation in stored seeds. Dust formulation of insecticides are sold rarely for use and contain 0.1 to 5.0 per cent active ingredient. Dust formulation contain additives, which increased the adhesion to stored seeds. Dust formulation of chemical insecticides suitable for the mixing with seeds and for applying in layers in the stored produce by sandwich method as well as for surface treatment of individual bag. Pathania and Thakur (2012) reported Malathion (0.5%), Deltamethrin (0.1%), and cypermethrin (0.0025%) were found most effective resulting in 100 per cent adult mortality after 7 days of exposure. Malathion (0.5%) was also proved to be the best in minimizing the oviposition (1.33/eggs/100 grains), seed damage (1.07%) and weight loss (0.28%).

USE BOTANICAL PRODUCTS

Traditionally many of the plants are used against stored grain pest. Although promising results have been achieved in laboratory test with botanicals. the efficiency under practical storage conditions varied as lot. Most methods have limited effect but it provides satisfactory protection of the stored products when they applied properly. There are many plant species, which have toxic properties against pulse beetle of stored pulses seeds. The most commonly used plants are *Neem*, *Karanj, Undi*, Castor, lemon grass, mustard, coconut, sesame, groundnut, *Dharak, Aak, Datura, jathropa* etc. Jacob and sheila (1990) reported that neem oil at rate of 1.0/100 g seeds caused cent percent mortality of *C. chinensis* and inhabit the oviposition and hence prevented development of subsequent generations. Seed treatment with botanicals protect the seeds without phytotoxic effect on seed and without affecting germination and seed vigour. The plant extract, oil and plant part powder are used admixture with stored commodities to protect them from insects. Kshirsagar (2010) examined insecticidal activity of *Jatropha* seed oil against *Callosobruchus maculatus* has been carried out. The eggs of *C.maculatus* were more susceptible to *Jatropha* oil and shows mortality to all selected dosage. *Jatropha* seed oil was highly toxic to the eggs of *C. maculates.*

Botanical product act as

- Antifeedant
- Ovipositional deterrent
- Larvicide

- Growth regulator

a. Deformation of different developmental stages

b. Delay in development

c. Hormonal changes

RESISTANT VARIETIES

The resistance of some lines of varieties to the bruchid *Callosobruchus* spp. was found to be due to the presence of variant vicilins in these seeds. The mechanism of resistant seems to involves lower rates of hydrolysis in the insect mid gut coupled with a higher capacity of binding to chitin in mid gut structures as compared to vicilins from susceptible seeds. Vyas (2004) studied different cow pea genotypes screened for their susceptibility against *C. chinensis* on the basis of overall rank values of resistance parameters, Pusa phalguni and GC-9708 were found resistant, while GC-9742, GC-4 and GC-9311 were found highly susceptible. Raghvani (1998) reported on the basis of overall rank values of resistance parameters, pigeonpea varieties GAUT 88-6 and BDN-2 were found as resistant and ICPL-87 was highly susceptible to *Callosobruchus maculates*.

CONCLUSION

Pulse beetle (*Callosobruchus* spp.) is a serious pest of stored pulses seeds and grains. The white coloured eggs hatch out within 4 to 5 days and grub makes cavity inside the grain causes heavy damage in terms of seed weight and quality. This pest can be effectively managed by various physical and chemical methods along with application of botanicals also found effective against pulse beetle. The scientists / researchers also studied the variation in susceptibility in cultivars of the different pulse crops to pulse beetle in order to find out resistant varieties.

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Clean Milk Production On Dairy Farm

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Clean milk means milk drawn from the udder of healthy animals which is collected in clean, dry milking pail and free from extraneous matter like dirt, dust, flies, hay, manure. Clean milk has a normal flavour with low bacterial count and is safe for human consumption. Milk is the main product from a dairy farm produced basically as food for human consumption. From publics' health point of view, milk is a very good media for bacterial and other micro-organisms development. So disease hazard in public can easily be predisposed by infected milk during production, handling and marketing. Dairy animals like cattle, buffaloes are primarily reared for the production of milk which is a nutritious food. Milk is a complete food as it contains almost all nutrients except vitamin C. Milk can be consumed either fresh or as fermented milk or other products such as yoghurt, ghee, butter, cheese and cream. Good quality clean milk is essential for production of good quality dairy products and should always be free from pathogens and have a long keeping quality.

Characteristics of good quality clean milk:-

- Free from debris and sediments
- Free from off-flavours
- Low in bacterial count
- Free of antibiotics and chemical residues
- Should have normal composition and acidity

Hygienic milk production at the dairy farm

Good quality dairy products cannot and can never be made from poor quality milk. Clean

milk production at the farm is the foundation of good quality milk. Therefore for the farmer to produce clean milk at the farm following points must be kept in mind:

- A healthy dairy cow or buffalo.
- Provision of clean feed and water to the cow
- Proper milking shed/unit/parlour
- A healthy milker
- Milkers' hands and clothes should be clean
- Appropriate milking and storage equipment and in good condition (Not cracked/dented making it difficult to clean)
- The milk should immediately be cooled

FACTORS RESPONSIBLE FOR CONTAMINATION OF MILK

External factors

- Cow/animal's body
- Udder and teats
- Milker – hygiene and habits
- Method of milking
- Milking Utensils
- Milk Storage utensils
- Feed and water
- Milking environment

Internal factors

- Udder infection – Mastitis
- Foremilk – contains large number of bacteria

Various levels to avoid contamination

1) Animal Management at farm level
   - Animal Health
   - Housing
   - Feeding
2) Cleanliness of Milking equipments and utensils.
3) Hygienic milking practices
4) Handling of milk
5) Cooling
6) Personal hygiene
7) Proper storage and transport

1) ANIMAL MANAGEMENT AT FARM LEVEL

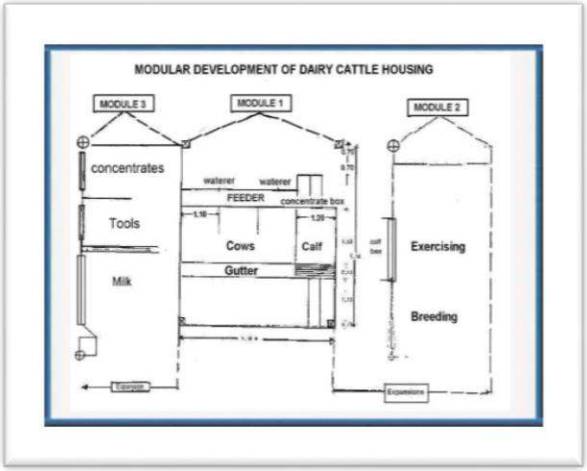
- Milk from healthy udder – relatively free from harmful bacteria
- High bacterial count reduces the keeping quality of milk
- Animal management involves feeding, housing and health.

ANIMAL HEALTH

- Pre-requisite for Clean Milk Production – A healthy herd.
- Routine examination of cattle for diseases like TB, Brucellosis etc.
- Diseased animals should be kept separate.
- Sanitary precautions to prevent and control diseases should be adopted.
- Use of inducer drugs should be avoided.
- Check for udder wounds and mastitis.
- Vaccination of animals against FMD, Anthrax etc. should be done regularly.

HOUSING

- Animal shed - main source of contamination.



- Protects animals against micro-organisms, wind, rain, heat etc.
- Mud, urine, faeces and feed residues should be regularly removed from the shed.
- Shed should have proper drainage, sufficient ventilation and lighting facilities.
- In very wet areas, slaked lime is used for drying.
- Sufficient water facility should be available for drinking as well as washing the shed and animal.
- Shed: well-roofed, well ventilated, dry and comfortable with adequate elevation.
- Appropriate arrangement for disposal of animal waste (manure pit or biogas plant) and left over feed & fodder.
- Protection from flies and insect which are potential sources of contamination.
- Piggery and poultry farming should be avoided near the animal premises.

FEEDING

- Balanced feed with appropriate quantities of green fodder, straw and

concentrates having essential nutrients and minerals is important.

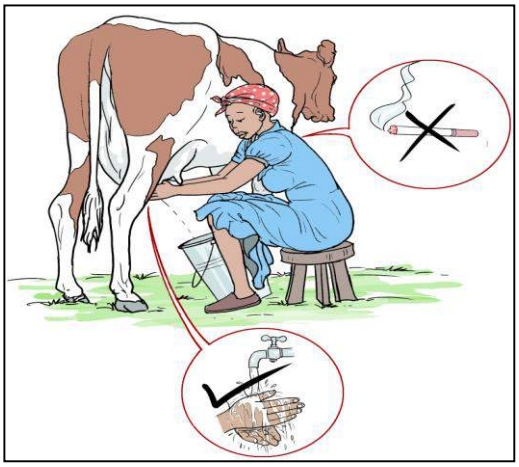
- Feed ingredients should be stored in moisture-free conditions.
- Feed and fodder should be free from industrial and environmental contaminants, pesticides, insecticides, fungicides, fumigants, pathogenic agents, aflatoxins as well as heavy metals.
- Good quality straw and supply of adequate minerals and vitamins.
- Feeding should be made one hour before milking.
- During milking, non-dusty concentrate can be provided to keep animals busy.
- Silage and wet crop residues should not be fed at milking place as it may impart foul odor to the milk.

2) CLEANLINESS OF MILKING EQUIPMENTS AND UTENSILS

- Milking equipments: Milking pails, milking machine, milk cans, milk pipeline recorder, strainer, chiller, Bulk tank and storage tank etc. should be neat and clean.
- Residual milk in utensils leads to growth of microorganisms so it should be avoided.
- Proper cleaning removes germs and dirt.
- Milk vessels should be cleaned before and after each milking – rendering bacteria-free.
- Detergents/chemicals used for cleaning should be non-injurious, non-toxic to health like Teepol.
- Use of ash or mud not recommended.
- Cleaned and sanitized vessels should be kept in inverted position.
- Milking pail - dome shaped top should be used.
- Open buckets should not be used.
- Sterilize with boiling water or steam if available or use dairy sanitizing solutions e.g. hypochlorite
- Dry the cans on a drying rack. Exposure of the cans to sunlight during drip drying will enhance killing of the bacteria.

HYGIENIC MILKING PRACTICES

- Hygienic practices during milking contribute to produce safe and



suitable milk.

- Milkers' Hygiene
  a) Free from communicable diseases
  b) Should wear clean clothes, nails trimmed
  c) Should neither eat or spit anything
- Before milking, milker should clean his hands with soap, potable water and then wipe with clean cloth or towel.
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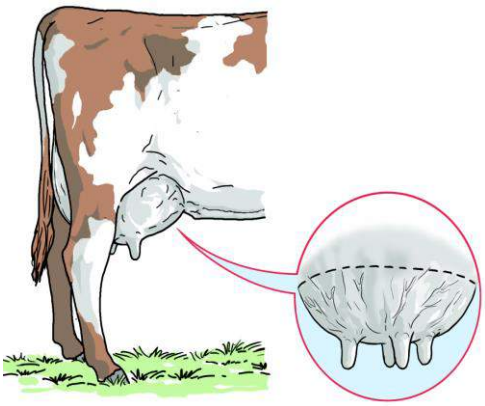
der and teats with lukewarm water and wipe with clean cloth or towel.

- The fore stripping should be collected in separate utensil/cup and should be discarded to avoid flies and insects.
- After milking, teats should be dipped in antiseptic solution to minimize risk o



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- Wet milking (moistening hand in milk or water or oil) is not recommended.
- Milking should be completed within 6-8 minutes.
- Milk should be strained using a clean cloth or a strainer. The cloth should be washed and dried daily.
- Floor sweeping just before milking should be avoided.

3) HANDLING OF MILK

- Filter milk immediately after milking: Use a white filter cloth or strainer. Disinfect, wash and dry the cloth/strainer after use.
- Always handle milk in clean preferably metal containers.
- When transferring milk between containers, pour the milk instead of scooping because scooping may introduce spoilage bacteria.
- Do not store milk at high temperatures.
- Do not handle milk if you are sick. Seek medical treatment and resume work only when the doctor says you are fit to do so.
- Store milk in a cool clean place preferably lockable room set aside for milk only. If storing overnight, keep the milk in cold/ chilled water.
- Deliver milk to the market as soon as possible preferably in the cool morning or evening.

4) COOLING

- Advantage of producing clean milk is lost if post milking handling is not carefully done.
- To preserve the keeping quality of milk, it should be cooled as soon as possible to a temperature below 5°C in a refrigerator.
- The sooner the milk is cooled after removal, the better is the quality.
- Bacterial growth is retarded by cooling the milk within 2 hours of milking.
- Delivery of milk to the factory or consumers should be as frequent as possible.

5) MILK STORAGE AND TRANSPORT

Store the milk without chemicals in a lockable cool and clean place. Do not mix warm (morning) milk with cool (evening) milk; deliver it to the collection centre separately or cool the warm milk before mixing. Milk transport vehicles often get dented during loading and offloading. Milk cans are designed with rims at the bottom to resist deformation during rough handling. Milk should be transported as quickly as possible to the milk cooling centre or processing factory to avoid spoilage.

BASIC MILK QUALITY TESTS

❖ Organoleptic test

This should be the first test to be performed and it involves assessing the milk with regard to its smell, appearance and colour. This test is quick and cheap to carry out, allowing for segregation of poor quality milk. No

equipment is required, but the tester should have a good sense of sight and smell.

❖ Clot-on-boiling test

This test is quick and simple. It allows for detection of milk that has been kept for too long without cooling and has developed high acidity, or milk that has a very high percentage of colostrum and hence protein. Such milk does not withstand heat treatment hence this test could be positive at a much lower acidity.

❖ Alcohol test

The test is quick and simple. The specific type of alcohol used is known as *"ethanol".* This test is more sensitive to lower levels of acidity and can therefore detect bad milk that may have passed the previous two tests. It also detects milk that has kept for long without cooling, colostrum or milk from a cow with mastitis. Because this test is quite sensitive, milk that passes this test can keep for some hours (at least two hours) before it goes bad.

❖ Lactometer test

This test is used to determine if the milk has been adulterated with water or solids. Addition of anything to milk can introduce bacteria that will make it spoil quickly, is dishonest and is therefore illegal. The lactometer test is based on the fact that milk has a heavier weight or density (1.026–1.032 g/ml) compared to water (1.000 g/ml). When water or other solids are added to milk, the density either decreases (if water is added) or increases (if solids are added). If milk fat (cream) is added to milk, the density decreases. The equipment used to measure milk density is called a lactometer. Most lactometers are usually marked from "0" (representing density of 1.000 g/ml) to "40" (representing density of 1.040 g/ml).

Recommended milking techniques

Milk can be extracted from the cow either by use of hands or through a milking machine. However, under smallholder dairy farms, hand milking is the most common practice. In order to ensure hygienic milk production at the farm level, farmers are required to observe the proper procedure while doing hand milking. This procedure involves the following steps:

Milking place and equipments

- Maintain a clean quiet milking place.
- Use utensils which are clean and used for milking only.

Restraining the cow

- Put feed/concentrates into the trough of the milking cubicle.
- Bring the cow into the milking place.
- Restrain the hind legs and tail of the cow with a rope.

Check for mastitis

- Milk the first draw into a strip-cup or any improvised black surface to check for mastitis. Throw away all the first draws.
- Check for mastitis and in case of abnormalities, milk the affected quarter LAST.
- Do NOT mix the abnormal milk with the good milk.

Udder preparation

- Clean your hands, the udder and the teats of the cow preferably using warm water.
- Wipe the udder dry with a clean damp towel.
- Always use one towel per cow and do NOT share one towel for more than ONE COW.

Proper milking techniques

- Take hold and squeeze the base of the teat with the thumb and forefinger.
- Close the other three fingers squeezing downwards in turn.
- The milk in the teat is squeezed downwards and not pulled.
- Squeezing progressively downwards expels the milk. Pulling can cause *MASTITIS.*
- Milk quickly, quietly and evenly and make sure you empty the udder at each milking. At most take 7 – 10

minutes to complete milking each cow or buffalo.

- Try to establish a calm regular routine – even milking twice a day, make it regular.

CONCLUSION

Milk is the main product from a dairy farm produced basically as food for human consumption. Good quality clean milk is essential for production of good quality dairy products such as yoghurt, ghee, butter, cheese and cream. A dairy farmer must therefore aim at maximising on milk output from his/her dairy farm. By producing the clean milk dairy farmer increases the milk output as well as their income. Secondly, milk is the major component of human diet. Milk contains almost all essential nutrients except vitamin C. Therefore by production of clean milk producer is contributing a lot to the health of the people.

Antioxidants and their Role as Therapeutic Agents

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Oxidation reactions are crucial but very harmful reactions if in excess. They produce free radicals as intermediates. These free radicals are produced in a chain and very dangerous for human body. Antioxidants are the reducing agents that stop the oxidation reactions. Plants are the potential source of these antioxidants, and used as medicine since very old time. Now days these drugs are modernize to increase benefits from them. Plants carry a wide variety of antioxidant molecules, such as glutathione, polyphenols, vitamins and endogenous metabolites. Plant-derived antioxidants have been shown to function as singlet and triplet oxygen quenchers, peroxide decomposers, enzyme inhibitors and synergists (Larson, 1988). Antioxidants prevent cellular damages like, protein, lipid, and DNA oxidation.

Some main types of antioxidants are given below:

Vitamins: vitamins are very important as antioxidants, as they prevent peroxidation damage in biological systems. These are mainly vitamin A, C and E.

HIGH MOLECULAR WEIGHT COMPOUNDS

These compounds restrict the formation of metal catalysed free radical. These are proteins like transferrin, ceruplasmin, and albumin.

LOW MOLECULAR WEIGHT COMPOUNDS

These are of two types, water soluble antioxidants like uric acid, ascorbic acid etc. and lipid soluble antioxidants like quinines, bilirubin, and tocopherol.

Enzymes: the enzymes present in plasma and they convert free radicals into stable molecules. Most common enzymatic antioxidants are Superoxide dismutase (SOD), Catalase (CAT), Peroxidase (POD) etc.

Minerals: some minerals like selenium, copper, manganese, zinc etc. are well known antioxidants. (Shirwaikar *et al.*, 2004).

Carotenoids: carotenoids can be an effective antioxidant, as they remove the free radicals from the system either by reacting with them to yield harmless products or by disrupting free radical chain reactions. The electron rich conjugated double bond structure is primarily responsible for the excellent ability of p-carotene to physically quench singlet oxygen without degradation and for the chemical reactivity of b-carotene with free

radicals and for its instability toward oxidation (Britton, 1995)

Various diseases in human being are the result of oxidative damages in macromolecules viz. Cancer, Cataracts, Atherosclerosis, Arthritis and inflammatory diseases, Diabetes, Renal disease and hemodialysis, Parkinson's disease, Skin lesions, Aging etc. Epidemiological evidence consistently related low antioxidant intake or low blood levels of antioxidants with increased cancer risk (Block, G., 1992). Antioxidants are believed to reduce oxidation of DNA, by regulating cell division process.

Free radicals present in polluted air, results i the development of pulmonary disorders like asthma. Cellular damage caused by free radicals, thought to be partly responsible for the bronchi inflammation characteristic of this disease. It has been suggested that increasing antioxidant intake may help to reduce oxidant stress and help i prevent or minimize the development of asthmatic symptoms (Greene, L.S., 1995). Vitamin C, vitamin E and beta carotene supplementation has been associated with improved pulmonary function (Hatch, G.E., 1995; Bendich, A., 1994). Plant derived compounds like phenols also acts oxidant. Flavonoids show anti-allergic, anti-carcinogenic and anti-aging property. These therapeutic effects of flavonoids ran be due to their antioxidant properties. Reactive oxygen species can also cause mitochondrial disfunctioning and results fatigue and muscle pain. Some of the mitochondrial disorders are fibromyalgia syndrome, myofascial pain syndrome (MPS) and chronic fatigue immunodeficiency syndrome (CFIDS). These are due to abnormality in energy production by mitochondria. Finally these damages increase ageing. This condition can be altered by nutritional supplements having antioxidants, N-acetyl cysteine, acts as an antioxidant which is clinically beneficial mitochondria. Diet rich in Vitamin E decreases the chance of heart diseases, Although antioxidants are beneficial for us, as they protect the body from various severe diseases and their deficiency can also cause disease, but their excess is also very harmful in the body. So there should be a balance of antioxidant molecule within the body.

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Peanut Bud Necrosis Disease

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Peanut Bud Necrosis Disease (PBND) is an important disease of peanut in south & southeast Asia. PBND caused by *Peanut Bud Necrosis Virus* (PBNV) and transmitted *by Thrips Palmi Karny.* PBNV is presumably a distinct member in the genus *Tospovirus* of the *Bunyaviridae.* In India, PBND was first recorded in the year 1949. The name "Bud Necrosis" was given in 1968 and the disease was considered to be distinct at that time because none of the groundnut viruses reported until 1968 were known to produce the bud necrosis symptom. PBND has been described in India since 1962 under at least seven different names, groundnut mosaic, groundnut rosette, bunchy top, chlorosis, ring mottle, bud blight and ring mosaic. Plants infected with PBNV has strongly reduced yield or do not yield at all. In India and Thailand have shown that PBNV occurs recurrently on groundnut in these countries, sites with more than 50% infection are not uncommon (Wongkaew, 1995). Besides Peanut, PBNV infects chili, potato, tomato, tobacco, mung bean and urd bean (Readdy *et al*., 1991, 1995). The International Crops Research Center for Semi-Arid Tropics (ICRISAT) estimated the losses caused by the virus at more than 89 million US dollars per year (Anonymous, 1992).

CAUSAL VIRUS

In 1979, Ghenekar *et al*. concluded that the disease was caused by *Tomato Spotted Wilt Virus* (TSWV), as positive results were obtained in a haemagglutination test with TSWV-antiserum. After that in 1991 Sreenivasulu *et al*. described, the isolate causing peanut bud necrosis failed to react with antisera developed to TSWV. Reddy *et al*. (1991) showed that the virus was indeed distinct from TSWV and it was named *Peanut Bud Necrosis Virus* (PBNV). PBNV contains three RNA species of about 9.0 kb (1RNA), 5.0 kb (mRNA) and 3.0 kb (sRNA).

SYMPTOMS

On plant: Symptoms produced by PBNV in groundnut are difficult to distinguish, if at all, from those caused by TSWV. Initial symptoms appear on young quadrifoliolates as mild chlorotic mottle or spots, which develop into necrotic and chlorotic rings and streaks. Necrosis of the terminal bud, a characteristic symptom, occurs on crops grown in the rainy and post rainy seasons, when ambient temperatures are relatively high. Secondary symptoms are stunting, axillary shoot proliferation, and malformation of leaflets. If plants are infected early, they are stunted and bushy. If plants older than one month are

infected, the symptoms may be restricted to a few branches or to the apical parts of the plants. Due to the severity of the symptoms, the virus causes severe losses to the peanut crop, especially when plants are infected before they are a month old.

On seed: Seeds from such plants are small, shriveled, mottled, and discolored. Late-infected plants may produce seed of normal size. However, the testae on such seed are often mottled and cracked.

TRANSMISSION

Sap transmission

PBNV can be transmitted by mechanical sap inoculations if care is taken to extract the virus only from young infected leaflets with primary symptoms. Extracts should be prepared in neutral phosphate buffer containing an antioxidant such as merceptoethanol, and must be kept cold throughout the inoculation process.

Thrips transmission

T. palmi could acquire PBNV as larvae and transmit it as adults. Maximum transmission (100%) was obtained when there were 10 adults per plant. The majority of individual adult thrips transmitted the virus for more than half of their life period, indicating the degree of erratic transmission. Cowpea was found to be the best host for rearing and multiplying *T. palmi* under laboratory conditions.

DIAGNOSIS

Several methods can be used for the diagnosis of PBNV. The following are recommended,

- Sap inoculations on to cowpea and *Petunia hybrida*. Cowpea produces concentric chlorotic and necrotic lesions; Petunia produces necrotic lesions.
- ELISA using polyclonal antibodies. They clearly distinguish PBNV from TSWV and INSV.
- Presence of typical tospovirus particles in leaf extracts. Even in leaf dip preparations, if young tissues showing initial symptoms are used, PBNV particles can be observed. They are 80-100 nm in diameter, and are surrounded by a double membrane of protein and lipid.

Management of PBND:

- Several cultural practices such as adjustments to sowing dates, sowing at the recommended rate, adopting measures to maintain plant population, intercropping with fast-growing cereal crops such as maize and pearl millet can reduce the incidence of PBND. These practices have been shown to reduce infestation by *T. palmi*.
- Roguing of infected plants, especially during early stages of plant growth, should be avoided because this practice creates gaps in the field and can increase PBND incidence.
- Although many high-yielding PBNV resistant varieties have been developed, they are medium-maturing types.

FUTURE RESEARCH

Future research will focus on epidemiology, development of early-maturing resistant cultivars, sequencing of the entire viral genome, the production of high quality diagnostic aids, and

assessment of biodiversity among PBNV isolates.

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Calf care: Making of a Healthy Replacement Stock

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A healthy calf is the starting point for a profitable dairy farm business. It is from day one that the foundation for the high milk-yielding animal is laid and proper rearing of the young ones greatly influences the future production. The first few months in the calf's life are much more important. Proper attention should be paid to the rearing of young calves and there should be no lacunae. The person in charge of calf rearing has one of the most responsible jobs on the farm and he/she must be fully aware of this responsibility. The main purpose of rearing young ones is to raise well–developed heifers and well capable bulls, which will be able to achieve a desired weight for first insemination to calve at an early age to satisfy the farmer's own breeding herd getting a successful replacement stock.

With the advent of commercial dairy farming there is tremendous increase in cow/buffalo cost, hence every organized farms are focusing their strategy to maintain progeny. Efficient dairy herd replacement can be attained by improved management strategies related to calving as lower calving intervals, higher calving rates, reduced still born and pre-weaned calf mortalities and fewer non pregnant heifers. Such strategies can increase the number of replacement heifer calves in the herd from current 15% to over 35%, this will allow farmers to increase their herd sizes through natural increases. In a commercial dairy farming nowadays it has been necessary to separate newborn calves' form their dams as soon as possible. It has become mandatory for the advance dairy system as there is no space for calves in milking system/facilities. Health and vigor of calves at birth depend on the nutrition of the cow during the last 60 days or so of gestation; developing about 70% of birth wt. of the calf during that time and it turn decides the success of dairy farm in future.

POSTNATAL CARE OF THE CALF

After delivery, attention shifts to the newborn calf from the dam. Process starts from the calf stimulating it to breathe, check its general health status and dip the navel in a strong (7%) iodine tincture solution. Calf should be removed from the dam and provide a clean, dry resting surface to ensure its hair coat stays dry, helping insulate against the cold ground, low air temperatures and sudden temperature changes. Provide at least 6 inches of bedding as a cushion to minimize physical trauma. House calves in individual pens to reduce the spread of disease.

Colostrum can be defined as the secretion from the mammary gland of the mammals during the first few days of parturition. Colostrum not only provides antibodies that a newborn calf lacks, but also "laxative" to help starting digestive functions. A sound colostrum program is essential in raising healthy calves, which are born without an immune system. Colostrum allows a calf to develop an immune system, protecting it from disease until it can produce its own antibodies within four weeks. Because colostrum is essential to a healthy calf, farmer should be ready to feed colostrum for 24 hours a day up to seven days after calving. Feeding of high quality (at least 50 grams immunoglobulins per liter) fresh, refrigerated, or frozen colostrum from a second or later lactation Johne´s-negative cow may also be helpful if there is any incident of death of dam during calving. Feeding of a colostrum replacement product with 50 or more grams of immunoglobulins per liter may also be helpful in these cases. Under commercial conditions, calves rarely receive colostrum from their own dams, but no apparent difference in the effectiveness among "fresh, frozen/thawed, and fermented" colostrum.

It is essential that the calf receives about 1.5 – 2.5 liters of Colostrum (depends upon the birth weight of the calves) within the first half an hour of birth. On the first day fresh Colostrum can be fed 3 – 4 times. From day two, twice daily feeding should suffice. With each feeding 2 liters of Colostrum should be given.

Three days after the birth there should be a gradual change to twice daily feeding of whole milk or milk replacer. Whole milk with a fat content of approximately 4 percent can be fed @ 2 – 2.5 liters per feeding (4 – 5 liters daily). Milk Replacer with a lower fat content of 2 percent will have to be fed @ 2.5 – 3 liters in each feeding (5 – 6 liters / day). Ideally, milk feeding should be adjusted to the size and health of the calf and climatic conditions. In cold conditions, higher quantity may be required as the calf requires 25-30 percent additional solids and a third feeding may be required. While feeding too little milk at an early stage depresses growth, too much milk for longtime will depress calf starter intake. An ideal calf starter should be about 16-17% digestible crude protein and should be highly palatable.

After the colostrum´ s period, whole milk should be provided to the calf until 15 days

of age @ a level of 1/8th to 1/10th of the calves' body weight (Table 3). Milk replacer can be fed along with the whole milk provided that it has a certain composition of nutrients. It is not advisable to completely substitute whole milk with milk replacer. Milk and/or replacer should be offered to the calf on at least two occasions per day. The milk and/or replacer should be served at body temperature (38-39°C).

The feeding should be done at regular intervals. Ideally milk should always be fed at body temperature. However, daily variations in the temperature of heated milk may cause more digestive disorders than cool milk.

Feeding high quality liquid feed will lead to better early growth, higher rates of calf survival and early dry feed intake. Without adequate nutrition, the calf and its immune system will not grow. Thus it is predisposed to disease, particularly scouring and respiratory problems. The calf must begin to grow it is to have an adequate calf starter intake to promote the necessary Volatile Fatty Acids (VFA's) for rumen development.

If the zero day weaning is not in practice then it should be done at a weight of 85 kg or when the chest circumference is 95 cm. A young calf must attain at least 70 percent of calving time weight (24 months) at the time of first insemination (15th month) and the average weight gain from third month to 14/15th month should be about 800 g/day.

Table 1: Feeding of calves

Age (days)	Daily gain (kg)	DCP (g)	TDN (g)	ME (M Cal)	Ca (g)	p (g)	Vit A (1000IU))	Vit D (IU)
0-15	0.20	80	400	1.5	2.5	1.5	1.5	200
16-30	0.30	90	500	1.7	3.0	2.0	1.5	250
31-60	0.30	125	800	2.4	3.5	2.5	1.7	250
61-90	0.35	150	100	3.6	4.0	3.0	2.0	260

Table 2: Feeding schedule of calves

Age (days)	Whole milk (l)	Skim milk (l) / milk replacer	Calf starter (g)	Hay (g)
0-14	4*	-	-	-
15-21	3.5	-	50	300
22-28**	3.0	-	300	500
29-35	1.5	1.0	400	550
36-42	-	2.5	600	600
43-49	-	2.0	700	700
50-56	-	1.5	800	800
57-63	-	1.0	1000	1000
64-70	-	-	1200	1100
70-77	-	-	1300	1200
78-84	-	-	1400	1400

CALF HOUSING

The main objective in planning and designing of calf housing is to provide an environment which will minimize the requirement for veterinary aid, minimize calf mortality and encourage the production of healthy calves. The calf housing should provide a suitable environment to both the calf as well as the stockman for their care.

Provide dry bedding. Well ventilated environment is necessary for the calf. They also need a specific minimum cubic air capacity per calf to avoid suffocation and other respiratory symptoms. Dry bedding is also important to reduce heat loss to the floor and minimize the use of straw. Moisture removal from a calf house is usually accompanied by a combination of drainage and ventilation. Good ventilation also removes the products such as ammonia, hydrogen sulphide, carbon dioxide and methane. The cubic air capacity per calf is important in all calf housing designs because it dilutes the intensity of disease producing organism in a building thus reducing the danger of cross infection. Height and space provided in the housing allows the air to be introduced into a calf house well above the level of calves thus, minimizing the risk of draught at calf level during winter months. If all-in all-out system is practiced proper disinfection and cleaning operation between batches should be ensured. A minimum period of 3 weeks between batches should be allowed. The age range in a group of calves should be narrow. Only calves from the similar background should be grouped together wherever practicable.

Table 3: Housing standard for the calves

Age of Calves (months)	Floor space requirement covered area(m2)	Floor space requirement open area(m2)	Number of calves per pen
0-3	1.0	2	24
3-6	1.5	3	16
6-12	2.0	4	12

In India, high level of calf mortality amounting between 30 to 40% in many farms can be attributable to this kind of housing and management of calves. Individual pens should be constructed so that they can be easily cleaned and disinfected. Individual pens provide effective separation for each calf. This prevents naval sucking and prevents the spread of disease through facial or other contact. If railed pen divisions are used, contact is not completely prevented so that they can able to see each other. But in other types of housing, the contact is completely prevented. It is better to keep the calves in individual pens at least 1 month, if possible, up to 3 months. After 3 months, 3 to 5 calves are kept in single pen. After 6 months to breedable age, the animals are kept in singles. After 6 months of age the male calves are usually disposed for either breeding or slaughter purpose. For ease of management, calf shed or calf unit should be placed adjacent to the dairy unit.

CALF HEALTH MANAGEMENT

Table 4: Vaccination schedule of cattle and buffalo calves

Vaccination	Primary vaccination	Booster	Revaccination
FMD vaccine	6 - 8 weeks of age	6 months after 1st dose	Annually
HS vaccine	6 months and above	_	Annually
BQ vaccine	6 months and above	_	Annually
Anthrax vaccine	6 months and above	_	Annually in endemic areas
Brucella vaccine	4-8 months female calf	_	_

A calf rearing is essential as it represents future replacement stock. Mortality of neonatal calves is attributed to conditions like diarrhoea and pneumonia (Shimizu & Nagatoma, 1978). However, environmental and management factors hasten the occurrence of such conditions (Khan & Khan, 1991).

Main and most important constraint in our dairy farming is the neonatal calf mortality. Calf mortality is generally associated with the type of housing, feeding, management practices, weather conditions, external & internal parasitic infestation and bacterial infestation especially those causing septicemia and Enteritis (Blood *et al.*, 1994). Neonatal calf mortality varies from 8.7 to 64 per cent throughout world. Martin and Wiggins (1973) estimated that 20% calf mortality resulted in reduction of 38% profit of a livestock farm. Neonatal calf mortality in the first month of age is accounted to be 84 per cent of the total mortality (Jenny *et al.*1982) and is particularly high in the third week of life (Umoh.1982). According to Afzal *et al.* (1983) the mortality in cattle and buffalo calves ranged from 29.1% to 39.8%. Furthermore, 25% average early calf mortality hardly provides any chance for regular replacement of low production animals. A minimum mortality rate of 5% is usually acceptable to dairy farm standard managemental conditions. Scope of the subject is beyond the article so this is an attempt to cover important issues.

The most common infectious ailments of neonatal buffalo calves are calf diarrhoea/enteritis (calf scours), navel-ill and pneumonia against which there are no vaccines available. These diseases are prevented through optimal hygienic measures especially up to first three months of age. Once the calf switches over to solid feeds usually there are fewer chances for the occurrence of calf scours. Common infectious diseases against which buffalo calves need vaccination are FMD, HS and BQ, however, depending upon the endemicity or in the event of outbreak of infectious disease recourse to vaccination against other diseases might need to be adopted. Deworming should be started from the first week of calf. A single oral dose of 10 g piperazine adepate is

recommended for the calves preferably in the first week of life to control neonatal ascariasis especially in buffalo calves. Deworming should be done every month for first 6 months, thereafter once in three months. The deworming drugs and dose should be consulted with qualified veterinary doctor. Over dose and under dose of deworming drugs should be prevented to check the side effects.

Table 5: Deworming schedule of cattle and buffalo calves

Age of calf	*Medicine for deworming calf*	
3rd, 4th & 5th day	Sulmet 30 ml, 15 ml & 15 ml on respective days.	
7 days	Piperazine	5 gm
1 month	Sulmet	44 ml
1½ months	Piperazine	10 gm in two parts
2½ months	do	
3½ months	Phenovis	9 gm
4 months	Sulmet	90 ml
5 months	Piperazine	15 gm two parts
6 months	Phenovis	13-18 gm
7 months	Piperazine	20 gm in two parts
9 months	Phenovis	18 gm
12 months	do	

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Impact of Elnino on Indian Agriculture

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EL NINO a Spanish word meaning "Little Boy". It is a weather phenomenon that leads to increase in sea surface temperature above normal by 0.5°C. It results in heating up of water off the western coast of South America which in turn changes the wind pattern in central-Eastern equatorial pacific and trigger floods and droughts in different parts of the world. El Nino re-emerges after a gap of 3 to 5 years in central and East Pacific Ocean and remains in effect on an average for 12 months to 2 years.

SYMPTOMS OF EL NINO EFFECT

1. Weakening of trade winds allowing warm water of western pacific towards east.
2. Increase in temperature near Peru and Ecuador due to spreading of warm water from western pacific towards eastern pacific.
3. Shift of rainfall from tropical rain forest of Indonesia to deserts of Peru.
4. Drought in western pacific zone and floods at the coast off the eastern pacific.
5. Reduced upwelling of nutrient rich cold water off the west coast of South America

AGRICULTURE IN INDIA

Agriculture in India is largely rainfed that is, it is monsoon dependent. The erratic nature of Indian monsoon leads to the vagaries in the agricultural productivity. In order to make Indian agriculture monsoon-proof, irrigation is required. Even after undertaking large scale irrigation projects, only thirty percent of India's land has irrigation. Moreover, India cannot have all its agricultural land under irrigation. Fifty million hectares of agricultural land out of one hundred forty-five million hectares will always be dependent on monsoon. Hence, poor rainfalls affect agriculture and El Nino years inevitably lead to poor agricultural productivity.

Since Independence, India largely depends on its agricultural production which accounts for 16.6% of GDP in 2009 and constitutes about 50% of total work force and rightly India ranks second worldwide in agriculture output. In the era of globalization where secondary and tertiary sectors are given priority, the fact cannot be overruled that many industries depends on raw material output of farms such as sugar, food processing, cotton and jute. In India, there are two crop seasons i.e khariff crop and rabi crop. The El-nino may affect the khariff crop because these

crops mainly depend on oncoming monsoon, but it might be less effectible on Rabi-crop. Agricultural products also forms vital component for foreign exchange earnings for India and products includes jute, cotton, coffee, spices, tobacco, sugar, oil, cashew etc are foreign earning products for India. During the year 2013-2014, India earned $ 253.51 million from export of processed and value added agricultural products. The above data shows that inspite of shift of economy towards industrial era, agriculture still forms important part of India's growth and development.

IMPACT ON AGRICULTURE IN INDIA

Like other parts of world, India also becomes victim of El Nino which affects overall production and growth of agricultural sector of India. Below are the salient points in support of impact of El Nino:

1. Poor Monsoon in India: Year 2014 an El Nino year, as per the atmospheric and meteorological institutions, will see less agricultural production in India which is largely depends on Monsoon rain. The diversion of moist winds from Indian Ocean towards the eastern coast of South America will be the reason of poor Monsoon this year.
2. Drought conditions: El Nino may cause droughts in India but not necessarily. Historical data shows that about 65 % of El Nino year have brought below normal rainfall in India which leads to draught as was faced in year 2009. The drought prone regions of India include areas with rainfall less than 60 cm of rain like the plateau of peninsular India like Deccan plateau, the desert areas of Thar and Saurashtra in Western India and the upland regions of Tamil Nadu.
3. Impact on GDP: It is expected that there will be 5% deficit in rainfall due to El Nino effect which in turn will have negative bearing upto 1.75% in fiscal year 2014-2015. Due to less rain food prices will rise and leads to inflation which will affect the GDP by 0.35% during fiscal year 2014-2015.
4. Effect on Sugarcane production: India accounts the largest area under cultivation of sugarcane in the world and second largest producer of sugarcane in the world. Poor monsoon will surely effect the sugarcane productions because sugarcane can grow where plenty of water supplies are available and in some states like UP, Bihar irrigation facilities are not of high standards to support the production if there is no or less rainfall.
5. Impact on crop: India is the second largest producer of rice and wheat in the world. El Nino will certainly affect the production of rice, wheat, oilseeds and maize in India. In southern parts of India, El Nino has negative impact on production of crops such as pearl millet, rice, food grains and crops like coaster, pigeon pea, Rabi crops remains unaffected by El Nino.

FUTURE OF EL-NINO

In future, govt. can overcome the El-nino effect by utilizing efficiently the water of Himalaya flowing river which are perennial in nature by way of connecting

the large area of our country by interconnecting the river by river or river by canal. Due to this, the farmer's community will slowly reduce their dependency over the rainfall. In India when monsoon becomes normal or better than normal, the production of food grains will be doubled or tripled to the normal year but, we have limited arrangements to stock these grains for future use. Excess grain is almost stranded in open area and spoiled by the rain or fed by insect and gets wasted. By proper implementation of policies we can overcome with the effect of El-nino. In months to come, El Nino will certainly form a part of agenda for the new government of Mr. Narendra Modi and it will be a worthwhile to see how this new government who believes to work on policies will save our farmers and economy from EL NINO.

El Nino has some benefits also in terms of losing bumper crop lying with government in warehouses, particularly in case of India. Government can liquidate its piled tons of rice and wheat during El Nino season which will help in fighting food inflation. The Government had constructed Indira Gandhi Canal from the confluence river satluj and river Beas in Punjab to North West Rajasthan. By Indira Gandhi canal govt. has overcome the difficulties of North West Rajasthan where rainfall is scanty. Due to this they converted part areas of Desert into lush green agriculture fields.

CONCLUSION

EL NINO affects overall production and growth of agricultural sector of India but remedial actions available to face El Nino if we are ready in advance, such as:

1. Identifying the areas which will be affected and help farmers to understand which crop to grow during this season.
2. High quality seeds of alternate crop should be distributed in draught affected area at a minimum support price.
3. Educate the farmers on alternate cropping system and prevent hoarding.

Precision Dairy Farming: Opportunities and Limitations

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Precision dairy farming is the new technological innovation for today's dairy industry. It is defined as the information technology based farm management system to identify, analyze and manage variability within dairy farm management for optimum farm performance, profitability and sustainability. In precision dairy farming animal monitoring is shifted from human observation to automated technology. Here there is management of individual animal rather than group management. The advances in sensor based technology and user friendly software packages in livestock management have made the task easier to acquire and interpret the data continuously without human interventions. These technologies are used to measure the physiological, behavioral and production indicators. The aim of precision dairy farming is to improve management strategies like early detection of diseases, minimizing the use of medication through preventive health measures, increased efficiency, decreased cost, improved product quality, minimize adverse environmental impact, improved animal health and wellbeing.

Conditions to be fulfilled for precision dairy farming

For precision dairy farming three conditions should be fulfilled such as:

- Continuous measurement of animal variables as body weight, activity, behavior, feed intake, sound production, physiological variables, etc.
- Every moment a reliable prediction must be available on how the animal variable will respond to environmental changes.
- To integrate the prediction together with the measured value to get an analyzing algorithm to manage animals automatically to achieve monitoring of animal health, welfare or take control action like climate control or feeding strategy.

Precision Dairy Practice management Levels

There are three levels which are operational, tactile and strategic level. Operational level includes management by

exception like low milk yield, risk management and record keeping like breeding details and quality assurance. Tactile level of management includes proactive management strategies like predicted calving date, predicted date of heat and intraherd comparison. The strategic level includes long term decision making. Precsion dairy farming is an interdisciplinary process and involves different technologies as follows:

PRECISION IDENTIFICATION OF ANIMALS

From muzzle pattern

The grooves in muzzle of animal is unique to indivisual animals. In a study by Minagawa *et al*. (2002) from the 170 databases, 43 were sampled randomly in beef cattle. The 13 samples failed to extract due to their blurred images. The rest were all discriminated from the others using the 3 numerical indices of the joint pixels.

Retinal recognition technology

Retina can be used as a mean to identify indivisual animals.. An improved bimodal biometric system, i.e., two retinas, has been proposed in order to reduce both probabilities of false matches and false non-matches to near zero.

Precision detection of diseases

Different diseases like mastitis, ketosis can be detected on time. Milk temperature and electrical conductivity of sample can be used for precision detection. Through fuzzy logic the sensitivity and specificity of detection is found to be increased. Electronic β-hydroxybutyrate (BHBA) hand-held meter (Precision Xtra) can be used in dairy cattle for detection of subclinical mastitis. Lameness can be detected by use of accelerometer, recording the changed activity in affected animals. Weight -bridge can also be used for precision detection of lameness by measuring the weight of animal on indivisual leg. Non-uniform distribution of weight on different legs tells about leg problem of animal.

Precision detection of heat in dairy animals

With increase in production level of dairy animals the heat detection rate decreases due to subtle expression of heat symptoms. With technologies like use of pedometer the accuracy and efficiency of heat detection increase. The activity of animal increases during heat. Accelerometer detects the change in activity and thereby helps in detection of heat.

Precision detection of health status of animals

Using technologies like Infrared temperature monitoring of different body parts the health condition of animal can be known. Skin injuries can be clearly detected by their increased temperature. An analysis of reasons for death and culling of cows and a survey of available sensor techniques suggested that the most suitable cow health events for routine monitoring are parturition, mastitis, and the malfunction of energy, protein, and mineral metabolism. Parturition can be detected from image analysis and acoustic monitoring. Nutritional and metabolic disoreders can be known from chemometric techniques to detect analytes

such as acetoacetate or urea in milk and acetone in breath. Viral and bacterial proteins and hormones such as progesterone can be detected from antibody specific biosensors.

Precision milking management of animals

Assessment of milk quality of each cow is necessary for individual cow management. Automated milking system like forced cow traffic and free cow traffic can be used for dairy animals. Robotic milking can also be used for precision milking management of animls.

Precision assessement of animal welfare

Welfare of animal can be assessed from different factors like Social contact, freedom to move, suitable climatic condition, care given, floor design.

Precision feeding of animals

Depending upon the body weight, status of animal like in different stages of lactation and pregnancy, feeding can be done. RFID tag can be used for precsion identification and there by indivisual feeding of animals. Each animal carries an RFID mark holding a unique number written in a 64-bit binary code, placed under the skin, in the ear or around the neck. Feeding system is controlled by a microcontroller, containing a food dozer and the RFID tag reader. Computer processes the systems and proportions of food contents, calculating the quantity of feed for each animal.

ADVANTAGES OF PRECISION DAIRY FARMING

- Biosensors are non-invasive measurement tools, which cause less trouble to the animal.
- Automated systems are stress free due to less human contact.
- Time advantage is there due to early detection of the condition.
- Lesser adverse environmental impact due to precision feeding.
- Less skilled labor can be utilized.

LIMITATIONS OF PRECISION DAIRY FARMING

- False alerts may be there.
- Signals are always not specific of the disease condition.
- Dairy industry is small relative to other industries, so there is less interest of cooperative agencies for investment on development of technology.

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Animal Welfare: Concept and Assessment of Welfare

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The scientific study of animal welfare has developed rapidly during the last 15 years. *The **welfare** of an animal is its state as regards its attempts to cope with its environment* (Broom, 1986).The animal adapts various coping strategies to combat different environmental conditions like physical conditions, social influences and predators, parasites or pathogens so as to stay healthy. The World Organization for Animal Health defines an animal as being in good animal welfare if it is "healthy, comfortable, well nourished, safe, able to express innate behaviour, and is not suffering from unpleasant states such as pain, fear, and distress" (OIE, 2008). Hence welfare is a characteristic of the individual animal, which varies from poor to good. The attempts to cope and the results of failure to cope can be measured taking account of a wide variety of coping mechanisms, including positive and negative feelings and those minimizing pathology. Hence welfare can be assessed in a precise, scientific way using a variety of indicators.

ANIMAL NEEDS

The term 'needs' is often used in discussions on animal welfare, as needs are the things that should be provided to ensure an animal's welfare. A need is: "a requirement, fundamental in the biology of the animal, to obtain a particular resource or respond to a particular environmental or bodily stimulus." (Broom and Johnson, 1993; Broom, 2008). Needs may include a range of provisions such as food, water, comfort, avoidance of infectious disease and environmental enrichment. For animals under our care it is a human ethical responsibility to provide for their needs. Different needs have different levels of importance to animals. Observing effects after withdrawal of needs provides an indication of their relative importance. When the biological needs are not fulfilled, then the welfare of the animal is affected in a negative way. In this respect, the concept of 'freedom' in animal husbandry has been introduced and plays a key role. In fact the knowledge about the needs of animals is related to the proposal of giving animals some 'freedoms' which is called as the **'Five Freedoms'** formulated by **Farm Animal Welfare Council: FAWC (**1993) as follows: -

1. Freedom from thirst, hunger and mal-nutrition – by ready access to fresh water and diet to maintain full health and vigour
2. Freedom from discomfort – by providing a suitable environment including shelter and a comfortable resting area
3. Freedom from pain, injury and disease – by prevention or rapid diagnosis and treatment

4. Freedom to express normal behaviour – by providing sufficient space, proper facilities and company of the animal's own kind
5. Freedom from fear and distress – by ensuring conditions which avoid mental suffering.

ANIMAL RIGHTS VERSES ANIMAL WELFARE

Animal welfare is often contrasted with the animal rights and animal liberation positions, which hold that animals should not be used by humans, and should not be regarded as their property. Animal welfare denotes the desire to prevent unnecessary animal suffering that, whilst not categorically opposed to the use of animals, wants to ensure a good quality of life and humane death. Animal rights denote the philosophical belief that animals should have rights, including the right to live their lives free of human intervention. Animal rightists are philosophically opposed to the use of animals by humans although some accept 'symbiotic' relationships, such as companion animal ownership.

Table 1: Difference between Animal Rights and Animal Welfare

Features	Animal Rights	Animal Welfare
Morality	Using animals is morally wrong.	Using animals is morally right.
Benefits	We should not use animals to benefit ourselves	We can use animals to benefit ourselves
Interest	We should not invariably overrule the interests of animals with human interests	Our interests are more important than the interest of animals.
Pain	We should not inflict pain or death in animals	We should not cause animals 'unnecessary' pain or death.
Humane treatment	We should always treat animals humanely and eliminate the human made cause of animal suffering	We should treat animals as humanely as it is convenient to us

(Source: ARF (Animal Rights Fund) Newsletter)

ANIMAL WELFARE ASSESSMENT

Welfare assessment is often used as the basis for the reform of animal welfare legislation. It is also used to improve conditions for animals reared for food, used in research, kept in captivity or as companion animals. Three components are important in animal welfare assessment:

- The use of the 'Five Freedoms'
- The assessment of welfare inputs and welfare outputs, inputs being the factors that affect the animal's welfare and outputs being the actual impact of these factors on the animal's welfare
- The quantification of welfare problems found or measured using severity, duration and number of animals affected

In some situations, welfare outputs may be assessed physiologically by measuring an animal's heart rate, respiratory rate, blood cortisol levels, blood pressure, and

adrenaline, enzymes and metabolite levels.

THE RANGE OF MEASURES

The general methods for assessing welfare are summarized in the table below with a list of measures of poor welfare presented below.

Table 2: Summary of welfare assessment

General methods	Assessment
Direct indicators of poor welfare	How poor
Tests of avoidance	Extent to which animals have to live with avoided situations or stimuli
Tests of positive preference	Extent to which that what is strongly preferred is available
Measures of ability to carry out normal behaviour and other biological functions	How much important normal behaviour or physiological or anatomical development can or cannot occur
Other direct indicators of good welfare	How good

(Source: Domestic Animal Behaviour and Welfare, 4th ed)

MEASURES OF WELFARE

The measure of animal welfare includes the following (Broom, 2000)

❖ **Physiological indicators of pleasure**

Table 3: Physiological indicators of welfare: short-term problems

Stressors	Physiological variable(s)
Food deprivation	High Free fatty acids , High β-hydroxy butyrate, Low glucose, High urea
Dehydration	High osmolarity, High total protein, High albumin, High PCV
Physical exertion, bruising	High Creatinine kinase, High lactate dehydrogenase isoenzyme-5, High Lactate
Fear/arousal	High cortisol, high PCV, High heart rate, High heart rate variability, high respiration rate, high Lactate dehydrogenase isoenzyme 5 (LDH5)
Motion-sickness	High vasopressin
Inflammation ,large immunological responses	Acute phase proteins e.g. haptoglobin, C-reactive protein, serum amyloid-A.
Hypothermia /Hyperthermia	Change in body and skin temperature, prolactin

(Source: Domestic Animal Behaviour and Welfare, 4th ed)

❖ **Behavioural indicators of Pleasure**

Behavioural measures are also important in welfare assessment. The fact that an animal avoids an object or event strongly gives information about its feelings and hence about its welfare. The stronger the avoidance the worse the welfare while the object is present or the event is occurring. An individual which is completely unable to adopt a preferred lying posture despite

repeated attempts will be assessed as having poorer welfare than which can adopt the preferred posture. Other abnormal behaviour such as stereotypies (repeated, relatively invariate sequence of movements that has no obvious function e.g. Tail-chasing in dogs and crib biting and tongue-drawing in horses), self mutilation, tail-biting in pigs, feather-pecking in hens or excessively aggressive behaviour indicates that the perpetrator's welfare is poor. Other abnormal behaviours that can be quantified and used as indicators of long-term welfare problems include excessively aggressive behaviour and inactive unresponsive behaviour.

- Extent to which strongly preferred behaviours can be shown.
- Variety of normal behaviours shown or suppressed.
- Extent to which normal physiological processes and anatomical development are possible.
- Extent of behavioural aversion shown.
- Physiological attempts to cope.
- Immunosuppression.
- Disease prevalence.
- Behavioural attempts to cope.
- Behavioural pathology.
- Brain changes.
- Body damage prevalence.
- Reduced ability to grow or breed.
- Reduced life expectancy.

DIRECT MEASURES OF POOR WELFARE

Measures of Pain

One type of poor welfare is "Pain". Melzack and Dennis (1980) made these statements: 'The nervous systems of all vertebrates are organized in fundamentally the same way'; and the experience of pain is often inferred from the behaviours of mammals. Some methods for recognizing and assessing non-human pain have been used for a long time. For e.g. the tail-flick response of rats, the jaw-opening response, limb-withdrawal and self mutilation.

Disease, injury, movement and growth measures

Disease, injury, movement difficulties and growth abnormalities all indicates poor welfare. A specific example of an effect on housing conditions which leads to poor welfare is the consequences of severely reduced exercise for bone strength. The actual weakness of bones means that the animals are coping less well with their environment, so welfare is poorer in the confined housing. If such an animal's bones are broken there will be considerable pain and the welfare is worse.

DIRECT MEASURES OF GOOD WELFARE

Most of the indicators of good welfare are behaviours, but care should be taken in interpreting these. For example tail wagging in dogs and purring in cats are all behaviours which indicates more than one motivational state in the animals, and that may or may not mean that the welfare of individual is good at that time. It is also known that oxytocin concentration in the blood is higher during some pleasurable events for e.g. nursing the young in a female mammal. Oxytocin is synthesized in the Para-ventricular nucleus (PVN) of the hypothalamus and in supraoptic nucleus. It binds to receptors that regulate hypothalamic-pituitary-adrenal cortex axis (HPA) activity and its increase is associated with adrenocorticotrophic hormone (ACTH) and glucocorticoid

decrease, lymphocyte proliferation, brain Gamma – Amino butyric acid (GABA) increase and cardiac vagal tone increase.

CONCLUSION

Acceptance of the fact that the commonly farmed species are sentient, and that it is possible to gain information about what animals are feeling by indirect means, has greatly advanced animal welfare science in the past 25 years. A fairly solid body of information is being assembled about states of suffering experienced by farm animals such as pain, fear, frustration and deprivation. More research is now required on states of pleasure. There are also gaps in our knowledge about where on the phylogenetic scale and when in ontogenesis sentience emerges.

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Prevention and Management of Pneumonia in Dairy Calves

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Calf pneumonia is a major problem in dairy herds. It is a multifactorial disease, and it most commonly occurs in calves from one to five months of age. Many of the infectious agents commonly involved in calf pneumonia are actually present in healthy calves and on farms without causing pneumonia outbreaks. However, these agents can cause pneumonia if the resistance of the calf to disease is reduced. The environmental factors include low environmental temperatures and high humidity and poor ventilation. The relationship between season and outbreaks may also be related to management practices including calving pattern and mixing of different ages of calves.

Multifactorial nature of pneumonia is shown in following figure.

Sign and symptom of pneumonia in dairy calf:

Early diagnosis is very important for successful treatment. If calf suspect for pneumonia immediately consult veterinarian for early diagnosis and advice on treatment and prevention.

Initial signs of pneumonia may be non-specific such as:

- Dullness and depressed
- Reduced feed intake
- Hollow sides
- Raised breathing due to lung damage
- High temperature
- Water discharge from nose and eyes
- Coughing
- Nasal discharge and severe respiratory distress in later stage

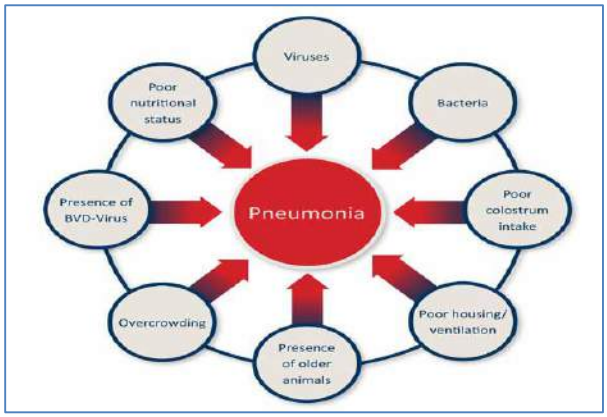

Figure 1: The multifactorial nature of calf pneumonia

CAUSATIVE AGENT OF PNEUMONIA

Viruses:

- Respiratory Syncytial Virus (BRSV)
- Bovine Herpes Virus 1
- Parainfluenza-3-virus (PI3)
- Bovine Coronavirus (BCV)

Bacteria:

The most common bacteria affecting dairy calves with pneumonia are following:

- *Mannheimia haemolytica*
- *Pasteurella multocida.*
- *Trueperella pyogenes*

PARASITES

Lungworms are of particular concern for respiratory problems for young calves.

TREATMENT OF PNEUMONIA

Veterinary advice should be necessary during treatment and control of suspected pneumonia outbreaks. Antibiotics are ineffective against viral infections. However, where bacterial involvement is suspected, antibiotic treatment is required. If antibiotics are not used appropriately (i.e. the correct drug for the disease and in the correct dosage), there is an increased risk of creating bacteria that are resistant to further treatment. No matter which antibiotic is used, the most important factor for treatment success is to start treatment very early in the course of the disease and to treat for long enough (at least for another two days after the signs of disease have disappeared). Treatment of calves with oral antibiotics is not recommended as diseased calves often have a reduced appetite and will not receive a therapeutic dosage of the drug. In this case, there is a likelihood of favoring the development of antibiotic resistance. Injectable antibiotics should be used instead. In rare cases, lungworm infection may cause the pneumonia in young calves and these will not respond to antibiotic treatment.

PREVENTION OF PNEUMONIA

1. **Ensure good colostrum intake:**

All calves must have one gallon of colostrum within four to six hours of birth to receive adequate immunity. Calves that are not given enough antibodies at birth are at increased risk for pneumonia and scours throughout the entire growing period. Colostrum is not only a good source of nutrients such as protein, carbohydrate, fat, vitamins and minerals, but also contains many biologically active constituents, which play an important role in the protection and development of the newborn (Kulkarni and Pimpale, 1989; Playford, 2001). The most important step in any calf health-management programme is a successful colostrum-management. Good colostrum intake is the first and most important step to provide the newborn calf with good immunity.

2**. Ensure good nutrition for growing calves:**

After the first feed with colostrum, good nutrition is vital for strong and healthy calves. In traditional feeding practices dairy calves with only about half of the milk they would normally suckle from the cow and result in calves that are marginally malnourished. It is now recognized that this low level of feeding is not sufficient for the health and future performance of

calves. Inadequate nutritional intake has a negative effect on the immune system of the calf that leads to a greater risk of developing pneumonia and other diseases. To ensure that calves grow well and are not marginally malnourished, they should get a daily amount of at least 13 - 15% of their birth weight (e.g. 6 litres per day for a 40 kg calf) in whole milk or a good quality milk replacer, mixed at 125 g/L water. To promote muscle growth, milk replacers should have high crude protein content.

3**. Prevent scour and manage outbreaks properly if occur:**

Calves that have suffered from scour (diarrhoea) are more likely to develop pneumonia later in life. Calf scour lowers the resistance of the calves. If calves develop scour, it is important to make sure that they get through the disease with minimum weight loss. Thus, it is important to keep the calves on normal levels of milk feeding throughout the period of diarrhoea. Additionally, oral rehydration solutions should be provided between milk feedings.

4. Minimise stress:

Any kind of stress will reduce the ability of the immune system to fight infection. In young dairy calves disbudding is a painful husbandry practice that is very stressful for the calf.

5. Prevent BVD:

The Bovine Viral Diarrhoea (BVD) virus in calf groups is a major contributor to outbreaks of pneumonia. Those calves which are suspected for BVD should be isolate from the group. All BVD virus positive calves are restricted from sale and culling is recommended.

6. Adequate ventilation:

Dust and noxious gases, such as ammonia, irritate the mucous membranes of the respiratory tract and make them more susceptible to infection. Humidity and warm temperatures enable bacteria and viruses to survive longer in the environment than under dry conditions. Adequate ventilation is necessary to remove excess humidity, heat, gases, dust and airborne infectious agents. The provision of adequate air space and ventilation in calf housing will decrease the risk of calf pneumonia and other diseases.

7. Vaccination:

Vaccine are available to reduce risk of infection, however vaccine must be used alongside with effective management programme. No vaccination programme will correct a poor colostrum management programme.

8. Housing management:

(1) Remove the calf early from the calving pen:

The most important sources of infection for the calf around calving are the cow and the calving pen. Cows not only carry infectious agents that cause scour, but also ones that cause pneumonia. In particular, the IBR virus can be latent in cows in the herd and they can shed it due to the stress of calving. To reduce exposure of the dairy calf to these infectious agents, remove the calf from the calving area immediately after born and bring it into clean calf house.

(2) Good hygiene in the calving pen:

Hygiene at calving and in the calving pen is essential as the calf is most vulnerable to infection just after birth.

(3) Provide appropriate calf housing

No matter what system is used for calf housing, it is important that calves always have access to plenty of fresh air, without draughts, and a good dry well bedded lying area.

CONCLUSION

To prevent Pneumonia early diagnosis and treatment is essential. If calves are not treated early then the surviving harmful bacteria may start growing again and the calf may relapse with recurrent bouts of pneumonia. The calf should be kept on normal levels of milk feeding throughout the period of diarrhea. It is important that calves always have access to plenty of fresh air, without draughts, and a good dry well bedded lying area. Older calves should not be housed with group of younger calves.

Healthy and Environmentally Safe Kitchen Garden for Tribal Farm Family

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A vegetable garden (also known as a vegetable patch or vegetable plot) is a garden that exists to grow vegetables and other plants useful for human consumption, in contrast to a flower garden that exists for aesthetic purposes. It is a small-scale form of vegetable growing. A vegetable garden typically includes a compost heap, and several plots or divided areas of land, intended to grow one or two types of plant in each plot. Plots may also be divided into rows with an assortment of vegetables grown in the different rows. It is usually located to the rear of a property in the back garden or back yard. Many families have home kitchen and vegetable gardens that they use to produce food. In World War II, many people had a garden called a "victory garden" which provided food and thus freed resources for the war effort. The traditional kitchen garden, also known as a potager (in French, *jardin potager*) or in Scotland a kailyaird, is a space separate from the rest of the residential garden – the ornamental plants and lawn areas. Most vegetable gardens are still miniature versions of old family farm plots, but the kitchen garden is different not only in its history, but also its design.

A kitchen garden refers to raising of vegetable crops in the backyard of a house or Growing of vegetable crops in the residential houses to meet the requirements of the nuclear family all the year round. The main aim of kitchen garden is obtain maximum output and a continuous supply of vegetables for the table throughout the year. There are several benefits of kitchen garden as under.

- It supplies fresh vegetables and fruits from garden to kitchen which ensure a better balanced diet.
- Availability of nutrition fresh vegetables and fruits depending upon requirements.
- Waste can be decomposed to use as manure for kitchen gardening.
- Working in the garden, improve physical health.
- Vegetable gardening reduces daily kitchen expenditure.
- Waste land around the house can be made productive.
- It provides continuous training for the person and the family.
- The spare time of the family is well utilized.
- There is also a delicate psychology behind the taste as everyone will definitely appreciate the produce obtained by their own effort.

Table-1 Nutritional value of different vegetables

Vegetable	Nutritional Value
Asparagus	Good source of folate. Some vitamin C, vitamin E, thiamine, niacin and dietary fibre
Beans	Good source of folate. vitamin C, vitamin A, thiamine, dietary fibre, some protein, iron and potassium
Beet root	Good source of folate. dietary fibre, some vitamin C
Broccoli	Excellent source of vitamin A, vitamin C and folate.
Brussel sprouts	Excellent source of vitamin C and folate. Some vitamin E, niacin and potassium.
Cabbage	Excellent source of vitamin C and dietary fibre.Good source of folate.
Capsicum	Excellent source of vitamin C. Good source of vitamin A. Some vitamin E and vitamin B6.
Carrots	Excellent source of vitamin A. Good source of dietary fibre. Some vitamin C.
Cauliflower	Excellent source of vitamin C. Good source of dietary fibre. Some folate and potassium.
Chilli	Excellent source of vitamin C and vitamin A.
Celery	Some dietary fibre, small quantities of vitamins. Low calories.
Cucumber	Some vitamin C. Low calories.
Brinjal	Good source of dietary fibre. Small quantities of vitamins.
Garlic	Contain compounds that can help reduce cholesterol.
Leeks	Good source of vitamin C, folate and dietary fibre. Some vitamin A.
Lettuce	Good source of folate. Some vitamin A, vitamin C and dietary fibre.
Onion	Some vitamin C, vitamin B3, Potassium and dietary fibre.
Peas	Excellent source of vitamin C. Good source of protein, thiamine, niacin and dietary fibre.
Potato	Excellent source of vitamin C, Good source of dietary fobre and complex carbohydrate. Some thiamine and niacin
Pumpkin	Excellent source of vitamin A and Good source of vitamin C. Some folate, potassium, niacin and dietary fibre.
Reddish	Good source of vitamin C
Spanish	Excellent source of vitamin C, vitamin A and folatte. Some dietary fibre, potassium, magnesium, calcium and iron.
Summer squash	Good source of vitamin C and dietary fibre. Some vitamin A and niacin
Sweet corn	Good source of dietary fibre, floate and phosphorus. Some vitamin C, thiamin and niacin
Tomato	Good source of vitamin C, vitamin A, floate and dietary fibre. Some niacin and potassium

Some point to be considered for planning and management of kitchen garden:

Planning

The size of a kitchen garden depends upon the availability of land and number of persons for whom vegetables are to be produced. Wherever, possible rectangular garden is preferred to a square one. Normally for a family member of 5-6 person, (200 sq. m) may be adequate to get 1.5 kg of fresh vegetables throughout the year, for their balanced diet.

Principles in the layout of kitchen garden:-

The principles that are to be followed are as given below:

- Perennial plants such as drumstick, banana, papaya, curry leaf, gooseberry, mango, guava, custard apple, sapota *etc*., should be located on one side of garden, so that they may not shade other crops compete for nutrition with the culture of other vegetable crops.
- Adjacent to the foot path all around the garden and central foot path may be utilized for growing different short duration green vegetables like coriander, amaranthus, spinach, fenugreek, mint *etc*. These crops can be rotated in different seasons.
- The fence around the garden may be utilised for growing light creepers and gourds such as coccinia, sponge gourd, bitter gourd, snake gourd, basell. These may be also rotated in different seasons.
- The compost pits should be placed in two corners of the garden. They are meant for garden as well as kitchen wastes. Pandals may be erected over the compost pits and trained with the creeper vegetables like lablab, ribbed gourd, snake gourd. This will hid off the compost pits from view.
- Both the sides of the central foot path may be utilized to train tomato plants on single stemmed with the support of stakes. The bunds separating the beds may be utilized for growing root crops or onion or garlic or turmeric.
- The conveniently divided small plots may be utilized to produce as much as possible by following a very intensive method of cultivation. This is possible by following continuous crop pattern in the form of succession and companion cropping.

Vegetable and fruit crops which can be grown in kitchen garden:

- **Winter season vegetables:- (Sowing/Planting time:- October – November)**

(Harvesting:- (February - March)

Brinjal, tomato, chilli, cabbage, cauliflower, okra(off season), broccoli

Radish, carrot, beet root, turnip Palak, spinach, fenugreek, vegetable dill, asparagus. Sweet potato, potato, capsicum, onion, garlic, beans, pea, Indian bean, coriander, fennel, vegetable pigeon pea, french bean

- **Summer season vegetables:- (Sowing/Planting time:- February - March)**

(Harvesting:- June - July)

Brinjal, tomato, chilli, cowpea, cluster bean, okra, amaranthus, cucumber, bottle gourd, sponge gourd, ridge gourd, bitter gourd, pointed gourd, little gourd, watermelon, muskmelon, tropical tuber crops, spine gourd

- ***Kharif* season vegetables:- (Sowing/Planting time:- June - July) (Harvesting:- October - November)**

— Brinjal, tomato, chilli, cluster bean, tapioca, amaranthus, spine gourd, elephant foot yam, bottle gourd, sponge gourd, ridge gourd, bitter gourd, pointed gourd, little gourd, watermelon, muskmelon, okra

- **Perennial vegetables:-**

— Little gourd, spine gourd, pointed gourd, asparagus, curry leaf, drumstick, basella

- **Fruit crops:-** Banana, papaya, custard apple, jamun, acid lime, guava, aonla, phalsa *etc*.

Propagation methods of vegetables:-

— **Seed:-** Okra, cluster bean, cowpea, pigeon pea, Indian bean, pea, drumstick, bottle gourd *etc*.

— **Seedling:-** Brinjal, tomato, chilli, capsicum, cabbage, cauliflower, onion

— **Vine cutting :-** Little gourd, pointed gourd, spine gourd

— **Rhizome:-** Ginger, turmeric

— **Bulb:-** Onion, garlic

Good management of the garden needs knowledge of all these. Then we can make our kitchen garden more successful and remunerative.

1. Site selection:-

- Area should be near the house and must be protected with fencing
- Availability of well distributed sunlight and water to the site
- Select well drain, fertile Soil
- Good air drainage

2. Protection:-

The kitchen garden area needs protection from the very start. It should not be possible for livestock to enter the area. Thorny plants can be cut and used to make a fence, but the best method is to plant a ***living fence*** to protect the garden. Mixed cropping, rotations, liquid manure, *etc.* are all ways of protecting crops.

3. Water management:-

- **Irrigation**: Collecting and using waste water from the kitchen can be enough to water the garden. Also, direct water from communal tap stands can be used on kitchen gardens.
- **Mulching** : Organic mulches such as straw, hay, compost, newspaper or wood shavings, dry leaves , Sugarcane bagass (collect from juice vendor), Coco peat (buy from Nursery) will conserve soil moisture, incorporate organic matter in the soil and prevent desease proliferation by reducing direct contact between soil and the plant.
- **Windbreak** : Wind will dry out the soil, so stopping the wind helps to conserve soil moisture;
- **Green Manures** : Also cover the soil and so help in conserving water;
- **Provide shadow**: In the hot season trees can provide shadow to the kitchen garden. A few small trees, such as *Lucaena*, mulberry, *Moringa* (drumstick), Persian lilac, or even fruit trees in the fence or within the garden can be used for this.
- **Mist collection**: Mist collects on the leaves of trees around and within the kitchen garden and drips onto the soil to provide extra moisture.
- **Guidelines for Irrigation:** Irrigate less area with more water, so the moisture goes deeper in the soil. Then this area will not need watering again for a long time. In the hot season, irrigate in the

evening or at night, and not in the daytime.

4. Fertility management:-

- **Sweepings pit**:-Collecting everyday sweepings from the house and yard in one place, make enough compost for the kitchen garden.
- **Green manures**:- Sowing seeds of green manure helps to protect the soil and gives extra fertility for more production.
- **Mulching**:- Putting a thick layer of biomass mixed with compost on the soil helps to increase fertility.
- **Liquid manure**:- Liquid manure made in a pit or a drum gives nutrients to the plants as well as protecting them from pests and diseases.
- **Legumes** :- Planting legumes such as peas, beans, *Sesbania,* sun hemp, *etc.*, provides extra nitrogen to the soil which is good for other crops
- **Other sources** :- Ash, oil seed cake, hair *etc.* are all resources which can be added to the soil to increase fertility, as well as helping to prevent pests and disease.

5. Seed & seedlings:-

A kitchen garden can provide very good food from local, traditional vegetables, and it's important not to lose these local varieties. It is very important to save and protect any good seed. From good seed, it is important to be able to raise good, healthy seedlings for transplanting into the kitchen garden.

Seed Treatment Techniques:-

- Smear all types of seeds with a paste of ash and water and dry it under the sun before sowing. It will control the seed borne diseases and enhance seed vigour and germination percentage.
- Treating seeds with *Rhizobium* also enhances the nitrogen fixing capability of legume crops and their productivity. It also gives protection to the emerged seedlings from sucking pests.
- Treat the seeds with butter milk (125 ml / kg of seeds) to prevent fungal diseases in crops.
- Mix the seeds of cereals and legumes in cactus (*Euphorbia neriifolia*) milk solution (100 ml in 1 litre of water) and dry in darkness for 8 hours before sowing. This will enhance the protection from stem borer larvae, termites and other pests.
- Soak all kinds of vegetable seeds in biogas slurry for 30 minutes before sowing.
- Soak vegetable seeds in 2% *Panchagavya* (20ml of *Panchagavya* in 980 ml of water) for 30 minutes before sowing for the production of healthy seedlings.

6. Weed Control:-

Rotating the garden with cover crops or different types of vegetables may prevent the buildup of a single weed species.

- Till garden soil three or four weeks before planting and allow weeds to germinate and emerge several times before the crop is established.
- Mulches shade the soil and prevent weed seed germination as well as growth.
- Decreasing the spacing between plants or between rows so that the crop shades the soil rapidly can aid in weed management.
- Organic herbicides such as acetic acid (vinegar), citric acid and corn gluten meal to control weeds.

7. Insect management:-

- Plant a less desirable plant close to the garden to attract insects away from the important vegetables in the garden. Destroy the trap crop after it becomes infested with insects.
- Organic insecticides, including Bt (*Bacillus thuringiensis*), pyrethrums, rotenone, insecticidal soaps, diatomaceous earth, neem and horticultural oils.
- Create an environment favourable for natural enemies of harmful insects. More than 100 families of insects, spiders and mites contain species that are natural enemies of harmful insects

8.Disease Management:-

- Use disease-resistant varieties
- Vegetables that are in the same botanical family should not be grown in the same area for at least three years.
- By increasing the spacing between plants, air circulation and light intensity are enhanced, creating a less favourable environment for disease development.
- Baking soda can be used for disease prevention.
- High concentration (70 per cent) of Neem oil can be used to kill powdery mildew spores. Biological fungicides, which are beneficial bacteria or fungi, are available to organic gardeners.
- Adopt Integrated Pest and Disease Management modules.

Fencing around Kitchen Garden