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Nutritional management of mastitis in dairy animals

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Abstract
Dairy animals throughout the world are affected by mastitis leading to drop in total milk yield and economic loss to the farmers. Annually 15-20% cows are affected by mastitis severely in India. The udder tissues or mammary glands get inflamed as a result of injury or bacterial infection. The other reasons for inflammation include mechanical injury to teats/udder resulting in redness, then swelling and pain. Moreover this injury paves passage for bacterial entry leading to inflammation which may be visible or remain invisible. Early nutritional management can help in preventing clinical mastitis.

Keywords: Management, mastitis, nutrition

Introduction
Mastitis is common in dairy animal which may be mild or moderate or severe in nature. In early stage usually clots/flakes appear in milk which may also become watery with time. Regularly milk needs to be checked as it can affect whole milk lot. Mastitis suspected cows should be milked in end so that infection does not spread to healthy animals. Fore strip the cow before attaching milking unit to detect mastitis and see whether animal is healthy or not. In severe cases, symptoms start appearing in all three milk, udder and the cow (Ganguly, 2014) [8]. Affected animal gets off the feed, has fever, and looks depressed and pale. Acute mastitis is also referred as severe clinical mastitis although it indicates the duration rather than severity of mastitis which indicates clinical mastitis and may be acute (just start or in early stage) or chronic like in case of chronic E.Coli mastitis (Radostits, 1961; Erskine *et al.*, 1989) [24, 6]. In subclinical mastitis symptoms do not appear so it is very difficult to assess the problem which can get elongated. Therefore duration of sub-clinical mastitis exceeds the clinical mastitis. In subclinical mastitis, animal become source of infection for healthy herd with high somatic cell count and loss of milk production (Erskine *et al*., 1987) [7]. With passage of time sub clinical mastitis may change to clinical form if any change in weather occur or cow comes in heat. In such conditions, cow milk has high SCC with decreased milk output, cheese yield, shelf life of processed milk fetching low price to the owner of herd (Phelps, 1989) [20]. In normal circumstances, presence of >200,000 Somatic cells per ml of milk indicates that milk is abnormal but if 50,000 cells per ml are present, these indicate decreased milk yield with respect to genetic potential of cow(Daley *et al*., 1991) [3]. Therefore it is very essential to detect subclinical mastitis, although invisible in milk parlor. Mastitis can be detected through milk sampling and testing by California mastitis test/paddle test, somatic cell measurement, conductivity measurements or bacterial culture. Nutritional management has great role to play in spreading of infection. External factors (climate, air quality, stress) and internal factors (nutrition, genetics, housing, bedding) aggrevate the spread of mastitis (Klastrup *et al*., 1987; Klug *et al*., 1989) [13, 14]. Nutrition affects the immune system and capacity of animal to fight against infection. After parturition, animal comes in stress for increased milk production. If during this period lacunae occur in management or nutrition (deficiency of protein or energy) animal becomes easy prey for metabolic problems like mastitis due to modulated and depressed immune system (Barkema *et al*., 1999) [2]. Frequent sudden changes in diet and their composition with imbalances due to excess/deficiency of nutrients expose cow to mastitis risk (Pouden *et al*., 1952) [22]. Trace minerals and antioxidants do affect immune functioning and health status in transition phase of cow. While Zinc and Vitamin A has effect on epithelial lining health, udder physical defense barriers and can alter quantity and quality of keratin plug, phagocytic cell functions are affected by copper, selenium, zinc along with vitamins A and E. Neutrophil functions do improve due to enhanced immune cell killing ability on vitamin E supplementation in dairy animal (Politis *et al*., 1996) [21]. Imbalance of nutrients in ration of transition cow induces metabolic diseases (Grasso *et al*., 1990; Van Saun, 1991) [10, 30].

Importance of Energy Status in Mastitis Control

Mastitis affected cow should be fed with low level of concentrates and also for its prevention it is necessary as indicated by earlier studies conducted on 1038 cows in first lactation and 572 cows in successive lactations in Germany. In ration of cow with decrease of concentrate from 40 % to 25%, mastitis incidence level was decreased to 7% while it was 36% for cows in first lactation and 19% compared to 37% for other cows. High energy ration increased mastitis occurrence in first lactation cows while reverse trend was noted in case of dry cows.

Effect of Calcium –phosphorus ratio

Inadequate level of calcium: phosphorus ratio in ration of recently calved animal favour chances of occurrence of milk fever. If calcium is deficit in ration, in 50% cases coliform mastitis can be seen in animal. Hypocalcaemia developing in dry period is outcome of imbalanced calcium: phosphorus ratio in ration.

Preserved green fodder

Immune system is negatively affected by silage of poor quality. Usually the white blood cells which protect the udder get killed due to overheating of proteins and sugars. Animal fed with grains and hay has greater capacity to fight against infectious pathogens compared to cows which are offered silage. Proteuscan and Pseudomonas are able to withstand high temperature which is produced in silo and when silage with these microbes is consumed by animal it aggrevates mastitis. Mycotoxins and moldy hay can also weaken immunity by killing white blood cells.

Leguminous crops: These crops are rich source of estrogenic substances and protein which vary with plant maturity. If these crops, mainly alfalfa are used for silage preparation, chances of mastitis increase due to estrogenicity. It has been observed that intake of legume with estrogen enhances udder tissue‘s premature development promoting environmental mastitis incidence.

β-Carotene and Vitamin A: Supplementation with 300 to 600 mg of β -carotene or 70,000 International Unit of Vitamin A affects positively the functioning of lymphocytes and neutrophils in a cow (Oldham *et al*, 1991; Michal *et al.*, 1994) [19, 17] but not always as similar treatment in other experiment did not affect the health of mammary gland. It is difficult to judge correlation of Vitamin A or β-Carotene with mastitis**.** Although Jukola *et al*. (1996) [12] have suggested that for optimizing udder health, it is necessary to have β-carotene concentration more than 3 milligrams per litre in plasma. Vitamin A supplementation in excess of NRC (approximately 70,000 IU/d) recommendation is not suggested for improving mammary gland health status but beta-carotene supplementation has shown beneficial effect when cows are fed poor quality hay.

Zinc and copper:

Zinc has important role in maintaining skin integrity and health as it speeds wound healing process by repairing wear and tear of cell/ tissues (Sordillo, 2005; Erskine and Bartlett, 1993) [29, 4]. Zinc affects keratin formation and reduces somatic cell count. As component of different enzymes, zinc is associated with synthesis of RNA and DNA and possess antioxidant property being component of elements which are responsible for metallothionein synthesis which bind with free radicals (Prasad *et.al*, 2004) [23]. It also helps in stabilization of structure of cell membrane as it forms component of superoxide dismutase enzyme (Reddy and Frey, 1990) [25]. Soon after calving, decreased zinc level is noted due to reduced dry matter intake, secretion of zinc in colostrum, increased stress conditions but returns to normal level 3-5 days post partum (Goff and Stable, 1990) [9]. Whenever animal suffers from mastitis due to Escherichia coli infection, the concentration of zinc in blood decreases because of antibacterial mechanism in which less of zinc is made available for bacterial growth (Prasad *et al*., 2004) [23]. Besides zinc, copper is also reported to have immune booster capacity. Copper forms component of ceruloplasmin enzyme, synthesized in liver which assists in absorption and transport of iron. This element also forms component of enzyme superoxide dismutase which help in protecting cells from oxygen metabolites often released during phagocytosis. Above functions have major role to play in reducing mastitis incidence during periparturient period (Goff and Stable, 1990) [9]. In case of heifers, copper supplementation 60 days prior to calving and its continuation till 30 days post calving have helped in reducing severity of mastitis due to E.coli infection (Maddox *et al*., 1991; Scaletti *et al*., 2003) [16, 26].

Selenium and Vitamin E: Smith *et al*. (1997) [28] studied the relation between immunity and mastitis in dairy cows. Vitamin E and Selenium were supplemented to study their effect on clinical mastitis incidence and its severity. Increased activity and functioning of phagocytic cell was found on supplementation of Vitamin E and selenium. Most benefit was obtained when supplementation was done in dry cow diet for prevention of mastitis. As selenium is deficit in soil throughout the world, plants grown on that soil also contains less of selenium and this deficiency continue in animal when animals are fed on forages grown on this soil, therefore need of supplementation arises in animal (Smith *et al*., 1989) [27]. Vitamin E supplementation reduces risk of intra mammary infection by 14%, somatic cell count(by factor 0.7) and 30% chances of clinical mastitis(Weiss *et al*., 1990) [31]. Even when selenium levels are low, alpha –Tocopherol of plasma has role in decreasing chances of incidence of new intra mammary infections (Ndiweni and Finch, 1991) [18]. Based on research results, NRC (2001) recommended supplementation of 80 IU/Kg DM for dry cows and 15-20 IU/Kg DM for milking cows of Vitamin E. As per USFDA, dry cow should be fed 0.3ppm Selenium and 1000 IU/day vitamin E (Hemingway, 1999) [11]. Based on metabolic body size basis, pre-fresh heifers should be fed almost same dose as fed to adult dry cow. Selenium in organic form is more absorbed than inorganic form (Batra *et al*., 1992) [2]. Research indicates that if Selenium yeast is given as selenium source, immunity does not increase (Weiss *et al.*, 1990) [31] because of Se-methionine absorption into protein instead of Se-cysteine. Selenium supplementation in dairy ration gives fruitful results in prevention of mastitis as it helps in boosting immune system; reduce infection severity, increase white blood cell release and activity and efficiency of phagocytes. In combination, Vitamin E and selenium enhance the immune system (Erskine *et al.*, 1989) [6]. Daily dose of 1000 IU of Vitamin E is capable of reducing somatic cell count but uncertainty is there for control of mastitis incidence. Although selenium is useful in

treatment of sub-clinical mastitis mainly caused due to E.coli. Earlier research has proved that E.coli mastitis can be prevented by supplementation of 0.35mg selenium per Kg of dry matter (Batra *et al*., 1992) [2] and duration of mastitis can be reduced by supplementing 2 mg daily per kilogram of ration of cow. It is recommended that selenium level should be 0.2-1.0g per ml and vitamin E should exceed 4g per ml of blood. According to Kremer *et al*. (1993) [15] both lactating and dry cow needs to be given 1000 IU of Vitamin E daily. If Selenium is given in excess solely it can show toxic effects. Jukola *et al*. (1996) [12] reported that daily selenium intake @ 16mg supplementation increased mastitis incidence if not supplemented simultaneously with Vitamin E supplements.

Mineral and Vitamin Supplementation: Prior to use of mineral and vitamin supplements it is necessary to assess their content in natural grains and forages normally used for feeding of animals. Supplementation is essential when animal is being fed stored forages which usually are low in minerals and vitamins for enhancement of immunity and maintainenace of proper health to avoid problems at parturition. As nutrients do get stored in body tissues (muscles, liver) Which may get depleted with time, it is essential to supply them soon after calving (Kremer *et al*., 1993) [15]. Heifer ration should be rich with nutrients in balanced manner to avoid any deficiency in animal, mainly in first lactation and for also adequate transfer to colostrums (Jukola *et al*., 1996) [12].

Conclusion

Mastitis prevention and control requires adequate steps to be taken at each and every step whether it is dairy animal, pathogen like bacteria, managemental issue and/or environment. Nutritional management mainly of heifers is of prime importance for control and incidence of mastitis. Minerals and vitamins do have a role to play in enhancing immunity to fight infection for prevention of mastitis. Further research needs to be elucidated to fight mastitis in field conditions.

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