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Role of minerals in Dairy animals

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Introduction

Feeding contributes 60 to 70 percent of the total cost of dairy farming, so forage based economical feeding strategies are required to reduce the cost of livestock enterprises. There is remarkable pressure of livestock on available total feed and fodder, as land available for fodder production has been decreasing (Pandey, 2010).

Thus, quality feed and feed ingredients are of prime importance for livestock sector. The minerals play major roles in various metabolic functions which affect immunity and reproduction (Sharma *et al*., 2011), growth, feed conversion efficiency (Sawant *et al*., 2013). At cellular level if hormones and enzymes affected can cause ill effects on reproductive performance of the animals (Kumar *et al*., 2011).At cellular level minerals helps to regulate reproductive steroids, nucleic acid metabolism, synthesis of enzymes and hormones. Requirement for minerals is influenced by several factors including age, stage of pregnancy and stage of lactation. Disturbed enzymatic activity and depletion of minerals cause by nutritional deficiencies can affect the normal reproductive behavior of the animals.

Importance of minerals in dairy animals

The minerals of prime importance are classified into macro elements (Ca, P, K, NaCl, and Mg) and trace elements (Cu, Co, Se, Mn, I, Zn, Fe Mo and Cr) depending upon the quantities (NRC, 1989).

Calcium

The role of calcium in sensitizing the tabular genetalia by the action of hormones (Moodie ,1965).Calcium and Phosphorus are located in the bone in high percentage and can be mobilized when needed for use in the metabolic events of body tissue. Calcium

requirements in dairy must be met within specified times to avoid production loss and reproductive problems between 1.5:1 and 2.5:1of Ca: P are adequate for lactating cows. The ration should contain 0.75 to 0.80 percent of calcium should be preferred on dry matter basis for dairy cows.

Phosphorus

Phosphorus play important role on onset of puberty, estrus and found that their deficiency may lead to delayed puberty in heifers and failure of estrus in cows(Roberts, 1971) Deficiency of phosphorus can also leads to reduced ovarian activity, uneven or anestrous and reduced conception rates. Deficiency of phosphorus leads to reproductive disturbances in animals, so adequate supply of phosphorus must be recommended in cattle to avoid fertility related problems. 0.45-0.50 percent of phosphorus should be preferred on dry matter basis in the dairy cow ration (Schweigert and Zucker, 1988).It is reported that general loss of appetite and decreased reproductive efficiency also observed in magnesium deficiency (Kumar, 2003).

Zinc

Zinc works as a cofactor for metalloenzymes (>300) which effects various biological functions (Chasapis *et al*., 2012).In addition to this, it plays chief role in antioxidant defense system (Oteiza, 2012), also in immune responses (Gruber *et al*., 2013) and also necessary for female reproductive system for its normal fertilization and ovulation. It also helps in reducing the oxidative stress from reactive oxygen species thus helps to protects the female reproductive system (Agarwal *et al*., 2012). It has also been noticed that, higher levels of Zn supplementation than recommended levels has beneficial effect on reproduction (Monem and El-Shahat, 2011).Sodium is essential in maintaining the osmotic balance, helps in cellular uptake of glucose and in amino acid transport (NRC, 1989).

Copper

Copper play important role as are active proteins ceruloplasmin and helps in RBC production by absorption and transportation of iron necessary for hemoglobin synthesis (Tuormaa, 2000).Deficiency of copper along with cobalt is having harmful consequences on the reproductive performance leading to delay in onset of puberty, low conception rate, early embryonic death and higher chances of retention of placenta (Nix, 2002). It is also necessary for melanin synthesis and interaction of copper and estrogen are also observed (Hidiroglou, 1979). Progesterone production by luteal cells is regulated by both copper and zinc by involving in the activity of super oxide dismutase (Sales *et al*., 2011).

The crops grown up on high organic matter are deficient in copper however high in molybdenum because copper and molybdenum act antagonistically. Zn:Cu(4:1), Cu:Mo (6:1) and Fe:Cu (40:1), these ratio of following minerals is helpful in retaining the normal copper

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level in blood (Hutjens,2000). Chelates of amino acid with Cu, Zn and Mn have been significantly useful in reduction of services per conception in dairy cows (Bosseboeuf *et al*., 2006). The ration should contain 10 ppm of Cu should be preferred however additional amount must be added in different stages of dairy cows (Puls, 1994).

Cobalt

Cobalt leads to prolonged uterine involution, irregular estrous cycle, and early calf mortality (Puls, 1994; Kumar, 2003).Non availability of cobalt leads to deficiency of Vitamin B12 in dairy animals, it helps in the synthesis of Vitamin B-12 in dairy animals (Miller and Tillapaugh, 1967).Cobalt deficiency may decrease by manganese, zinc and iodine (Patterson *et al*., 2003).

Selenium

Selenium aids in reduction of cystic ovaries, metritis, mastitis and incidence of retained placentas (Patterson *et al*., 2003). Selenium have direct link to the uterine involution (Arthington, 2005), improved conception rate at first service (McClure *et al*., 1986), and also helps in increasing the reproductive efficiency of the animals by enhancing the activity of glutathione peroxidase in blood and tissues so it is necessary to supplementation of Selenium in the diet of animals. Subclinical deficiency of selenium cause retardation of reproductive performance by increasing services per conception, delayed ovulation and high incidence of mastitis (Goff, 2005).It can be easily crossed placenta whether provide as in organic or inorganic form.

Manganese

Manganese helps in process of metabolism of carbohydrate, fats, protein and nucleic acids, it works as activator for many enzyme systems (Patterson *et al*., 2003) and also works as a co-factor in synthesizing of cholesterol which acts as a precursor for estrogen, progesterone and other steroidal hormone (Karkoodi *et al*.,2011). It is also needed for the synthesis of cholesterol which is liable for synthesis of estrogen, progesterone and testosterone like steroidal hormone (Kappel and Zidenberg,1999).Its deficiency may cause infertility, congenital limb defects in newborn, underdeveloped fetal growth, reduced follicular growth, decreased ovulation, cystic ovaries, increased embryonic death rate and lesser conception rates (Kreplin, 1992, Patterson *et al*., 2003).

Iron

Iron deficiency may cause anorexia, worsening in reproductive health due to anemia and deprived body condition. Iron deficiency may lead to repeat breeder, increased number of services per conception and can abort infrequently (Kumar *et al*., 2011), but iron deficiency is occurred rare in adult animals due to presence of sufficient amount of iron in feed stuffs.

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Iron is useful in synthesis of hemoglobin, myoglobin and formation of ATP through electron transport chain. In addition to this, it is also helpful in transportation of oxygen to tissues by synthesis of many enzymes and maintenance of various oxidative enzyme systems (Khillare *et al*., 2007).

Iodine

Deficiency of iodine cause infertility and rises the abortion rate (Hetzel,1990), frequency of retained placenta and post-partum uterine infections, respectively (Hemken,1960),Whereas subclinical deficiency of iodine is also characterized by increased stillbirths, suppressed estrous, increased chances of retained placentas and prolonged gestation periods (Hess *et al*., 2008).Iodine have action on thyroid gland thus disturbs the reproduction, it is considered as an important mineral for the growing fetus and helpful in maintaining the basal metabolic rate and benefits in stimulating the anterior pituitary gland by secretion of gonadotropin, thus affects the estrous cycle (Khillare *et al*., 2007).More than the requirement of animals cause harmful effect on reproductive health by inducing premature births of weak calves, abortions and depresses the immunity status of animal (Kumar *et al*., 2011).

Chromium

Chromium has chief role and essential for carbohydrate metabolism (Tuormaa, 2000).The occurrence of Chromium in nuclear protein is in greater amount thus help in gametogenesis and fetal growth and also an essential part of the pregnancy specific protein that is secreted by uterine endometrium which benefits to prevent the early embryonic death (Kumar *et al.*, 2011). It is having a crucial role in maturation of follicle thus maintaining the estrous cycle and also in LH release which triggers the ovulation. Unavailability of chromium will cause irregular estrous cycle, delayed ovulation, embryonic death and retarded fetal growth (Tuormaa, 2000),and ketosis and decreased milk production in lactating animals.

Molybdenum

Deficiency of Molybdenum delays onset of puberty, decreases conception rate and causes anestrus (Kumar, 2003) in animals. Molybdenum and copper are interweaved with one another as deficiency of one arises in the existence of toxic levels of another. Therefore correct balance of feeding of both must be followed for the prevention of reproductive problems (Randhawa and Randhawa, 1994).

Conclusion

Mineral components are measured to be compulsory for the normal metabolic and physiological processes of body functions, particularly micronutrients. Their importance in regulating biological systems, growth, production and reproduction (Underwood and Suttle,1999). Fodder crops are also deficient in many nutrients as a result of nutrient

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deficiency in soils. This leads to mineral deficiency in feed and fodder.. Even level of minerals in feed and fodder varies from region to region, thus mineral availability to the animal also varies. Mineral deficiency may lead to infertility in cattle which accounts for major economic losses in dairy farming.

This leads to mineral deficiency in feed and fodder. As feed and fodder fed to the dairy animals do not provide all the minerals in the required quantity, supplementation with adequate amount of good quality mineral mixture in their ration is always needed to fulfill their daily needs.

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