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Review Article

IMPORTANCE OF MINERALS ON REPRODUCTION IN DAIRY CATTLE

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Abstract: Cow requirements for minerals are influenced by several factors including age, stage of pregnancy and stage of lactation. Trace mineral absorption and use performs an essential role in dairy cow reproduction and hoof health. The trace minerals play critical roles in the proper functioning of enzymes, hormones and cells. Deficiencies can, and often do, result in less-than-optimal performance and lost opportunity cost.

INTRODUCTION

Trace element deficiency may be linked to problems such as retained foetal membranes (Gupta *et al*., 2005), abortion (Mee, 2004) and weak calf syndrome (Logan *et al*., 1990). Furthermore, Husband (2006) has recently reported combined selenium and iodine deficiency in a dairy herd with a high incidence of retained foetal membranes, milk fever and vulval discharge. In other cases, differences in the reproductive performance of cattle and sheep have been reported when comparing trace element supplementation strategies (Hemmingway, 2003; Black and French, 2004). Since many of the proposed reasons that trace element status reduces dairy cow fertility involve transition cow health and immunity, the trace element status of dry cows is very important for fertility in the following lactation. The trace elements likely to be of most practical significance are copper (Cu), selenium (Se) and iodine (I) (Rice, 1994). For an accurate diagnosis of Cu status, liver Cu samples obtained by biopsy are preferred to blood values. For Se status, blood, milk or liver Se concentration, as well as glutathione peroxidase (GSPx), give an accurate indication. For the assessment of iodine status, blood samples should be assessed for plasma inorganic iodine (PII) and not thyroxine (T4).

Calcium

Calcium related disorders (deficiencies) are mostly very common during parturition or within few days following parturition. The Ca: P ratio, alteration may affect ovarian function

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through its blocking action on pituitary gland. This results in prolongation of first estrus and ovulation, delayed uterine involution, increased incidence of dystocia, retention of placenta and prolapse of uterus (Sathis Kumar, 2003). Moreover low calcium level in blood is also associated with anoestrus where as excess of calcium can affect the reproductive status of animal by impairing absorption of phosphorus, manganese, zinc, copper and other elements from gastro intestinal tract. Ratios (Ca:P) between 1.5:1 and 2.5:1 for lactating cows should not result in problems.

Milking cows should always be provided adequate amounts of calcium to maximize production and minimize health problems. A major concern in the mineral feeding of dry cows relates to providing optimum levels of calcium and phosphorus in order to decrease the occurrence of milk fever. Prevention of milk fever is an important consideration in maximizing reproductive efficiency.

Phosphorus

This mineral has been most commonly associated with decreased reproductive performance in dairy cows. Inactive ovaries delayed sexual maturity and low conception rates have been reported when phosphorus intakes are low. In a field study when heifers received only 70-80% of their phosphorus requirements and serum phosphorus levels were low, fertility was impaired (3.7 services per conception). Services per conception were reduced to 1.3 after adequate phosphorus was supplemented. Other studies indicated that the NRC (2006) recommendations are adequate to maintain growth and reproductive function in heifers and cows. In another experiment, increasing phosphorus supplementation from 0.4% to 0.6% of the ration had no effect on days to first estrus or services per conception. However, in some instances, responses have been reported in the field when phosphorus supplementation was increased to 0.5% or 0.6%. The reason for these differences in response is unclear, but may be related to the availability of the phosphorus that is added to the ration or the actual amount of phosphorus consumed.

Phosphorus is stated to be one of important element for normal sexual behaviour (Sathish Kumar, 2003). Delayed onset of puberty and silent or irregular estrus in heifers, failure of estrus and long inter calving period in cows and still born or weakly expelled calves or even embryonic death due to lack of uterine muscle tone are reported to be some of important clinical manifestation exhibited by the animals from phosphorus deficient areas (Chaudhary and Singh, 2004). On the contrary the excess of phosphorus renders the endometrium susceptible for infection (Chaudhary and Singh, 2004). Reduced fertility and

reduced or delayed conceptions are the prime signs of phosphorus deficiency and this can be overcome with proper phosphorus supplementation. Whereas moderate deficiency may lead to repeat breeding condition and poor conception rate (Sathish Kumar, 2003).

Sodium and potassium

Both of these elements are indirectly related to reproduction in animals as the deficiency of sodium can affect the normal reproductive physiology by preventing the utilization of protein and energy where as deficiency of potassium is well known to cause muscular weakness and thereby affect the musculature of female genital tract causing impairment in the normal reproductive process.

Research suggests that feeding high levels of potassium (5% DM basis) may delay the onset of puberty, delay ovulation, impair corpus luteum (yellow body) development and increase the incidence of anestrus in heifers. Lower fertility was noticed in cows fed high levels of potassium or diets in which potassium-sodium ratio was too wide.

Magnesium

Magnesium usually does not have direct impact on the reproductive status of animals, since in body it remains in almost antagonistic relation with calcium and any disturbance in Ca-P-Mg homeostasis can impart some influence on reproduction. Moreover reduced reproductive efficiency encountered loss of appetite due to magnesium deficiency (Sathish Kumar, 2003).

Copper

Copper is one of the important mineral for reproduction point of view as such its deficiency is reported to be responsible for early embryonic death and resorption of the embryo (Miller *et al*., 1988), increased chances of retained placenta and necrosis of placenta (O'Dell, 1990) and low fertility associated with delayed or depressed estrus (Howell and Hall, 1970). In addition to this, proper copper supplementation is must for quality semen production (Puls, 1994). Copper treatment is reported to improve conception rate as the copper treated cow require 1 service and the untreated cow require 1.15 services per conception (Hunter, 1977).

Molybdenum

The reproductive processes affected due to molybdenum deficiency are decreased libido, reduced spermatogenesis and sterility in males and delayed puberty, reduced conception rate and anoestrus in females (Sathish Kumar, 2003).

Zinc

Zinc is known to be essential for proper sexual maturity (development of secondary sexual characteristics), reproductive capacity (development of gonadal cells) in males and all reproductive events (estrus, pregnancy and lactation), more specifically with onset of estrus in female. Among these decreased fertility and abnormal reproductive events are of prime importance in females (Sathish Kumar, 2003) where as in male poor semen quality, reduced testicular size and libido are the usual clinical findings (Mass, 1987). Apart from this zinc has a critical role in repair and maintenance of uterine lining following parturition and early return to normal reproductive function and estrus (Greene *et al*., 1998).

Selenium

The safety margin (difference between normal requirement and toxic dose) for selenium is so narrow that its deficiency is quite rare in farm animals than its toxicity, but causes weak, silent or irregular estrus, retained fetal membranes, early embryonic death, still birth or weak offspring and abortions in females (Randhawa and Randhawa, 1994) and reduced sperm mortality in males. Improvement in conception rate at first service following selenium supplementation (McClure *et al*., 1986). Selenium deficient animals are reported to be more prone for the incidence of retained placenta, cystic ovaries, mastitis and metritis which can be reduced by supplementation of selenium (Puls, 1994). Soils in some areas of the nation are deficient in selenium. Dairy producers have begun to rely more heavily on home grown grains and forages and less on purchased feeds, the need for selenium supplementation has been recognized. Selenium deficiency in dry cows has been reported to cause retained placenta.

Retained placenta decreased in an Ohio study when selenium deficient herds received supplemental selenium (50 mg) and Vitamin E (680 IU) injections at 20 days prior to calving or were fed with 1 mg of selenium per day concluded that retained placenta was reduced by selenium supplementation. Selenium deficiency also has been related to abortions, a high incidence of embryonic fetal loss, poor fertility, and increased incidence of metritis, a higher level of general infection and the birth of dead or weak claves in some problem herds. Blood selenium levels in these herds generally been extremely low (less than 5 mg/100 ml). Diets should contain at least 0.1ppm selenium on a dry matter basis. In some herds, feed sources must be supplemented with selenium injections to maintain blood levels above the recommended 8-10 mg/100ml. In herds where selenium levels are extremely low, injections are often required to rapidly return blood selenium levels to normal. After injection, feed

supplements may provide enough selenium to maintain adequate blood levels in the cow. Blood tests are recommended to confirm selenium status.

Manganese

Deficiency cause poor fertility problem in male and female. It is responsible for silent estrus and anoestrus (Corrah, 1996) or irregular estrus (Brown and Casillas, 1986) and decrease conception rate, birth of deformed claves and abortions in females and absences of libido and improper or failure of spermatogenesis in males (Sathish Kumar, 2003). Manganese is important in cholesterol synthesis (Keen and Zidenberg-Cheer, 1990) which in turn is necessary for the synthesis of steroids like progesterone, estrogen and testosterone. Decrease concentration of these steroids in circulation following manganese deficiency may lead to related reproductive abnormality. Post partum anestrus in dairy cows has proven to be reduced following manganese supplementation (Krolak, 1968) so thus the number of service required per conception increased (Rojas, 1965).

Cobalt

Infertility is likely to arise as secondary consequences of debility conditions such as severe cobalt deprivations through reduced general metabolism. Delay in onset of puberty, delay uterine involution and decreased conception rate (Sathish Kumar, 2003) and sub optimal conditioning of the offspring are noted in cobalt deficiency (Puls, 1994).

Iodine

Iodine is important in the development of fetus and maintenance of general basal metabolic rate. Signs of iodine deficiency include delay in puberty, suppressed or irregular estrus (Puls, 1994), failure of fertilization, early embryonic death, still birth with weak calves, abortion, increased frequency of retained placenta in females and decrease in libido and deterioration of semen quality in males (Sathish Kumar, 2003).

Reproduction is influenced through iodine's action on the thyroid gland. Inadequate thyroid function reduces conception rate and ovarian activity. Iodine supplementation recommended for cows consume 15-20 mg of iodine each day. Recently, the effects of excessive iodine intakes have been recognized. Excessive iodine intakes have been associated with various health problems including abortion and decreased resistance to infection and disease.

Chromium

Effect of insulin is potentiated by chromium by increasing the uptake of glucose and amino acids by the cells in the body (Stoecker, 1990) thereby improves the energy balance

which in early lactation leads to improved reproduction. Moreover chromium also exerts a significance influence on follicular maturation and luteinizing hormone release (Chaudhary and Singh, 2004).

CONCLUSION

Efficient production in domestic animals requires that the essential nutrients in a diet be provided in appropriate amounts and in forms that are most biologically useful. The minerals that affect reproduction in cattle are generally found within the trace element group, although deficiencies of calcium and phosphorus can also affect fertility.

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