EFFECT OF DIETARY SUPPLEMENTATION OF ORGANIC CHROMIUM IN LACTATING COWS

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INTRODUCTION

The more intensive system of farming with the objective of raising the milk production has increased the stress factors on the dairy cows. The transition period of late gestation through early lactation is a particularly crucial time for high producing dairy cows and during this period the cows are under great physical, nutritional and metabolic stresses which are reflected in altered hormone profiles and increased disease or disorder susceptibility. During this period high yielding animals are in a negative energy balance and they require a large amount and rapid supply of glucose for milk lactose synthesis which results in lower plasma glucose and insulin, compared with later in lactation. The ability of insulin to control glucose utilization and partitioning determines milk production, fertility and health status of cows.

THE ROLE OF CHROMIUM

Chromium is an integral component of the Glucose Tolerance Factor (GTF) which is an organometallic molecule potentiating the effect of insulin binding to receptors at the cell surface. With chromium acting as a cofactor of insulin, it is required for normal functioning of the ß cells in the pancreas, preventing hyper responsiveness of insulin secretion to glucose stimulation. Glucose Tolerance Factor was first isolated from pork kidney and brewer's yeast and it has a much greater biological activity than do inorganic sources of chromium alone. Glucose Tolerance Factor consists of chromium (Cr^{+3}), organic components of nicotinic acid, glycine, glutamic acid and cysteine and without chromium at its core it is inactive.Chromium in plants is organically complexed with concentrations approximating 30 to 50 ppb reported in very limited studies. Good natural sources, in addition to brewer's yeast, include dark chocolate, black pepper and some processed meats. Higher concentrations of total chromium in diets would probably be due to contamination in feedstuffs, particularly forages, or high contamination in mineral supplements.

Circulating chromium is associated with the ß-globulin portions of plasma and in physiologic concentrations is transported to tissues bound to transferrin and possibly as a component of GTF. Unlike elements such as calcium and magnesium there is no equilibrium between tissue stores of chromium and plasma. Absorbed chromium is mainly excreted in the urine. Small amounts, however, are lost in perspiration, milk and bile.

Inorganic chromium is very poorly absorbed within a range of 0.4 to 2 % while the availability of organic chromium is more than 10 times higher. Also the inorganic chromium must be converted to an organic complex, such as GTF to enable the physiological functioning of chromium. Conversion of inorganic chromium in the liver or kidneys to the bioactive form may be slow and therefore supplying chromium in the preformed organic complex form increases absorption reduces variability in responses and negates the need for adequate dietary precursors like nicotinic acid, certain amino acids to aid inorganic chromium absorption and conversion to the bioactive form.

Chromium supplementation of cattle diets has affected carbohydrate and lipid metabolism in a number of studies using various forms of supplemental chromium which include chromium chloride, chromium tripicolinate, chromium nicotinic acid complex, chromium amino acid chelate, chromium propionate and high chromium yeast. The variation in responses observed between different studies may

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reflect differences in the bioavailability of these supplemental chromium sources and bioavailability of chromium in the control diet.

Supplemental organic chromium can increase the rate of gain anywhere from 0 to 30 per cent depending upon the level of stress or disease challenge. However, chromium does not actually increase the rate of gain; rather it prevents the depression in rate of gain which often occurs under stressful or other conditions leading to chromium deficiency. To be fully effective, supplementation at an adequate level must begin early in the disease challenge or stress period.

Supplemental organic chromium may be needed or economically beneficial in the following circumstances:

a) During heat stress periods.

b) With poorly managed animals subject to more pathogenic, environmental and even nutritional stress.

c) In borderline or lower protein diets.

d) Rations containing high level of silages particularly legume silages which have excess non protein nitrogenous substances or soluble nitrogen leading to stress due to nutritional imbalance.

e) In low effective fibre diets.

Fineness of silage or hay chop and level or type of non-structural carbohydrates have a major effect on rumen propionate, which may lead to mobilization of chromium from body stores and probably increase urinary chromium excretion. Another nutritional factor that may influence chromium depletion in ruminants is hyperammonemia or elevated blood ammonia concentration.

Chromium seemed to reduce blood cortisol concentrations during stress and promoted improved insulin or insulin like growth factor (IGF-1) sensitivity in target tissues such as muscle, mammary gland and the immune system. Supplemental organic chromium is found to improve the milk production of young dairy cattle during stress periods, reduce age related metabolic disorders like ketosis and also decrease the incidence of milk fever, retained placenta and even acidosis.

CONCLUSION

Organic chromium supplementation in the concentrate mixture improves the dry matter intake, total milk production and help to maintain the peak yield as well as persistency of milk production in early lactating crossbred cows. The postpartum reproductive performance will also be influenced favorably by the supplementation of organic chromium in crossbred cows.

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