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Continuing Education Article

Effect of Niacin on the Performance of Dairy Cows

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ABSTRACT

Niacin appears to have a positive role in minimizing both heat and nutritional stress in dairy cows. Niacin should be fed to heavy dry cows or those which are prone to ketosis and/or are high yielders (over 747 kg of 4% fat corrected milk) one to two weeks prepartum to maintain adequate blood niacin concentrations at calving. Supplemental niacin in conjunction with natural protein increased milk yield. If producers monitor herd health and nutritional needs carefully, a positive economic response may be realized from supplemented cows, as niacin helps maintain an adequate supply of pyridine nucleotides for tissue metabolism in the postpartum cow.

Key Words: Dairy Cows; Niacin; Milk yield; Ketosis; Energy

Energy demand and metabolic changes in high producing dairy cows must be managed for optimal milk production and health. During early lactation, increased dry matter (DM) intake and milk production; and decreasing body weight improve severe metabolic stress on the high producing dairy cows (Jaster *et al.*, 1983). A cow may mobilize 90.9 kg of body fat in the first six to eight weeks of lactation. However, if cow is unable to metabolize this energy resource, excessive lipolysis of adipose tissue may lead to increased hepatic ketogenesis. Moreover, the peak DM intake may lag behind peak milk yield by four to eight weeks, which may cause additional energy stress (Hutjens, 1987).

Recommended feeding practices for lactating dairy cows do not usually include supplementation of B complex vitamins because ruminal microbes synthesize these vitamins in relatively large quantities (Kung *et al.*, 1980). Niacin is a component of two important coenzymes namely nicotinamide adenine dinucleotide and nicotinamide adenine dinucleotide phosphate (Guyton, 1986). These coenzymes combine with hydrogen during degradation of food substrates and are essential for bacterial metabolism (Shields *et al.*, 1983). However, recent research suggests that supplemental niacin may control fat metabolism, increase milk production and stimulate microbial protein synthesis (Dufva *et al.*, 1983; Ruegsegger & Schultz, 1986; Doreau & Ottou, 1996; Rebecca *et al.*, 1997). The objective of this paper is to review the effects of supplemental dietary niacin on the incidence of ketosis and milk production in early lactating dairy cows.

Microbial Protein Synthesis

Riddell *et al.* (1980) stated that niacin synthesis by rumen microbes is considered adequate for optimum animal performance. However, niacin in cereals is of limited availability for some animals. Thus, niacin status of both host and rumen microbes may be suboptimal when cattle are fed high concentrate or low fibre diets. These authors also reported that niacin had a significant role in the utilization of urea by rumen microbes and that addition of 200 ppm niacin to a diet of corn, brome hay and 2.3% urea resulted in greater microbial protein synthesis and ruminal ammonia concentrations than in dairy cows fed diets containing no niacin. Buzissy and Tribe (1960) reported that substituting natural protein with urea depressed microbial synthesis of niacin and tryptophan in sheep. Likewise, Riddell *et al.* (1981) and Shields *et al.* (1983) reported that regardless of nitrogen source, 100 ppm supplemental niacin increased amount of net microbial protein synthesized per gram of substrate added.

Ketosis

Recent research suggests that niacin may be deficient during early lactation because of abrupt changes in diet after calving. Feeds are lower in niacin content and of varying niacin availability, while intake at parturition and immediately postpartum is reduced, and nutrient demands are elevated as a result of a higher milk production (Hutjens, 1987a). Blood samples of high producing cows exhibiting subclinical or clinical signs of ketosis reveals low concentrations of glucose and increased B- hydroxybutyric acid (BHBA) and nonesterfied fatty acid (NEFA) concentrations (Brent & Bartley, 1984). Fronk & Schultz (1979), Dufva *et al.* (1983), Brent & Bartley (1984), Johnson *et al.* (1986) and Ruegsegger and Schultz (1986) recommended niacin levels of 200 ppm for dairy cows that have calved recently and approximately 400 ppm for high producing

dairy cows to prevent incidence of ketosis. These authors reported that urinary ketones decreased from 20 to 4% when cows were supplemented with niacin. Likewise, plasma analysis revealed a trend of lower BHBA and NEFA levels. Thus supplementation of niacin reduced the incidence of ketosis in lactating dairy cows. Dufva *et al.* (1983) concluded that cows should be supplemented with niacin either before or immediately after calving because maximum effects on blood glucose, BHBA and NEFA occur two weeks after calving.

Heat Stress

When niacin was fed during the warm summer months, the typical reduction in milk fat was not observed (Muller *et al.*, 1986). The niacin feeding might have diminished the adverse effect of high temperature on DM intake by lowering the skin temperature of the cows (Ruegsegger & Schultz, 1986). Reduced skin temperature may be attributed to increased evaporative heat loss, thereby cooling skin, lowering temperature and increasing thermal gradient for heat loss. If heat loss had taken place then heat gain would have been controlled and would have allowed the cows to maintain a constant skin temperature.

Milk Production

Cows fed diets supplemented with niacin maintained a higher milk production when compared to those fed diets with no niacin supplementation. Muller *et al.* (1986) showed similar results when cows were fed diets supplemented with 6 g/day of niacin; the higher milk production for the group treated with niacin was reflected in higher 4% fat corrected milk yield. Dufva *et al.* (1983) reported that, for early lactating cows, supplementation of 6 or 12 g/day of niacin to the diet increased blood glucose concentration and milk production. This increased blood glucose concentration might have blunted the hormone sensitive lipase and thus, consequently reduced ketosis, resulting into increased milk production. Thornton & Schultz, (1980) indicated that administration of 6.5 to 17 g/ day of niacin to goats elevated blood glucose and insulin. This increased blood glucose might be due to the greater gluconeogenic activity promoted by the partial lipogenic suppression elicited by niacin at the cellular level (Ruegsegger & Schultz, 1986). An additional advantage of niacin supplementation is that with a reduction in ketosis, increased milk yield are often achieved because the energy status of the high producing cow is in balance. Jaster and Ward (1990) reported increased milk production by cows fed diets containing niacin. Similar findings were reported by Cervantes *et al.* (1996) and Drackley *et al.* (1998). A trend for increased milk production in primiparous heifers (Kung *et al.*, 1980) and significantly increased milk production in cows (Riddell *et al.*, 1981; Jaster *et al.*, 1983; Brent & Bartley, 1984; Muller *et al.*, 1986) were observed when fed niacin supplemented diets, compared with control animals. Milk fat, milk protein and fat corrected milk also was higher in cows fed niacin.

CONCLUSION

The niacin feeding has not only increased milk production and ruminal microbial protein synthesis but also reduced the heat stress and ketotic problems of dairy cows.

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