

Biotin, an Essential Nutrient for Hoof Health and Milk Production in Dairy Cows

Biotin, a water-soluble, B-vitamin, is an essential nutrient for both rumen bacteria and the dairy cow. Symptoms of biotin deficiency include lesions and malformations of keratin-containing structures such as foot pads in poultry, hooves, hair coat and fingernails (McDowell, 2000). Biotin is required for the rumen fermentation of dietary carbohydrate to propionic acid and for the conversion of propionic acid to glucose by the liver. Hoof horn formation requires biotin for the production of structural proteins (keratin) and for the production of intracellular cement that bonds together hoof horn cells to form a semi-waterproof barrier to the environment (Mulling *et al.*, 1999). Both these factors affect the tensile strength and integrity of hoof horn, and ultimately the hoof health of dairy cattle.

High producing dairy cows transform large quantities of forages, grain and byproducts into milk. This requires a high rate of metabolism, which in turn increases the requirement for essential enzyme co-factors such as biotin. Dairy cows are also subject to significant hoof stress with resulting hoof lesions and lameness. Hooves under environmental and nutritional stress tend to grow and wear faster. This can reduce the structural integrity of hoof horn and increase its susceptibility to lesions.

Coupled with the lactating cow's high rates of feed consumption and metabolism and increased levels of hoof stress, is an apparent reduction in rumen synthesis of biotin when rations containing 50% grain or more are fed (Abel *et al.*, 2001). Therefore the biotin status of dairy cows appears to be diminished at the time when biotin demand is greatest.

Biotin and Hoof Health

A total of 10 controlled research studies have been conducted, in both university and commercial dairy herds, showing significant reductions in the incidence of common hoof lesions and lameness in dairy and beef cows fed 10-20 mg/day supplemental biotin. The average response across six of the largest controlled studies is a 50% reduction in the incidence of either hoof lesions, lameness or both (Table 1). These studies encompassed 28 herds and over 4,000 cows maintained in tie-stalls, free stalls, loose housing and pasture-based systems.

Summary of 6 studies on supplemental biotin and hoof health in cattle

Study	Hoof lesions, disorders	Percent reduction w/biotin
Distl and Schmid, 1994	Dermatitis, sole bruising	30% and 42%
Midla <i>et al.</i> , 1998	White line disease (WLD)	56%
Bergsten <i>et al.</i> , 1999	Sole hemorrhage, wall grooves	52% and 44%
Campbell <i>et al.</i> , 2000	Vertical wall fissures, coronary band lesions	55%
Fitzgerald <i>et al.</i> , 2000	Lameness, claw lesions	62%
Hedges <i>et al.</i> , 2001	Lameness due to WLD	43% and 58% @ 12,18 mo.

Biotin and Milk Production

Recent studies have confirmed that feeding supplemental biotin results in a significant increase in milk production in high producing dairy cows. Moreover this response has been shown to be immediate, prior to any secondary milk increase due to improved hoof health. As shown in Table 2, the average milk production has been increased an average of 4.2 lbs per day in cows fed 20 mg/day biotin. The responses ranged from 2.2 lbs/day in first lactation cows over 305 days of lactation to 6.2 lbs/day in mixed parity cows in the first 100 days of lactation.

Table 2. Summary of milk production response to supplemental biotin (20 mg/day)

Study	Control Milk Yield, lb/day	Milk increase due to biotin, lb/day	Percent increase in milk production
Midla <i>et al.</i> , 1998	63	2.2	2.7
Bergsten <i>et al.</i> , 1999	72.3	4.2	5.8
Zimmerly and Weiss, 2001	81.3	6.2	7.6
Majee <i>et al.</i> , 2002	82	3.8	4.6
Margerison <i>et al.</i> , 2002	82	4.4	5.4
Average	76.1 lb/day	+4.2 lb/day	5.2 %

Economic Return from Biotin Supplementation

In a dairy herd that treats 20 (or more) out of every 100 cows per year for lameness feeding 20 mg/day supplemental biotin to all lactating cows and 10 mg/day to dry cows year-round will be profitable under most circumstances. A milk increase of 1.0 lb per day or more will be profitable under virtually all circumstances. Responses will depend on the management environment and performance level of the dairy herd.

Rovimix H-2: The Proven Source of Biotin for Dairy Cows

All of the research studies listed above were conducted using Rovimix H-2 as the source of biotin. This spray-dried, stabilized product is designed for use in the feed industry with a high active particle count and excellent flow and mixing properties. Supplementing Rovimix H-2 significantly elevates plasma biotin levels in dairy cows (Frigg *et al.*, 1993) and has produced the significant results in hoof health and milk production shown above.

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