Roche

Vitamins

Biotin for Dairy Cows
Hoof Health and Milk Production

Biotin, what is it?

Biotin is water soluble B-group vitamin and is an essential nutrient for all animals. It is present in milk together with other vitamins. For over 25 years, biotin has been included in diets for pigs and horses to help improve horn quality.

Functions

Biotin plays a key role in the synthesis of glucose (an important energy source), protein and fat, and is involved in a diverse array of critical metabolic pathways. Biotin is necessary for synthesis of keratin, a hard structural protein involved in horn production. The first signs of biotin deficiency appear as dermatitis and softening of normally hard tissues such as horn.

Natural Sources

Biotin is present in many foods and feedstuffs. However, not all of this biotin is bioavailable. In ruminants, microbial synthesis of biotin occurs in the rumen and digestive tract. Historically, it has been assumed that rumen synthesis provides the dairy cow with sufficient biotin to meet its requirements. However, results from recent scientific studies show positive effects from dietary supplementation. This suggests that rumen synthesis may be insufficient, particularly around calving or during early lactation.

Effect of diet on rumen synthesis

The cow is particularly vulnerable to rumen acidosis during the transition phase and early lactation. This may be due to a general reduction in rumination around the time of calving followed by the feeding of high energy diets (often rich in starch), to promote milk production. Results from a study in Germany *(Figure 1.)* reveal that compared to an 83% forage 17% concentrate diet, biotin synthesis halved when a typical dairy diet of 50:50 forage/concentrate was fed.

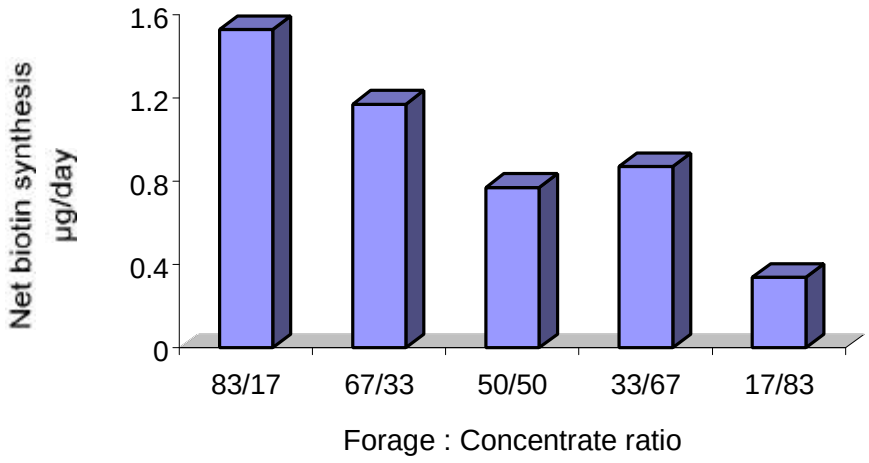

Figure 1. Rumen synthesis of biotin – an in vitro study
(Da Costa Gomez et al., 1998)

The influence of biotin on hoof strength

The hoof of cattle is similar to our own fingernail. Both contain the structural protein keratin, which forms an internal support lattice, similar to steel girders inside a building. Likewise, the cells that form the hoof horn are bonded together by a cementing substance similar to mortar in a brick wall. Biotin is specifically required for production of keratin and the cementing substance of hoof horn. The supply of nutrients during the horn-forming process has a major influence on horn quality. If the supply of nutrients to the corium is sub-optimal for whatever reason, horn quality will be compromised.

The incidence of many common hoof disorders are strongly influenced by the strength of the horn capsule. The aim is to achieve horn of good quality that has good biomechanical properties. Poor quality horn with an impaired, weakened structure, increases susceptibility to hoof disorders.

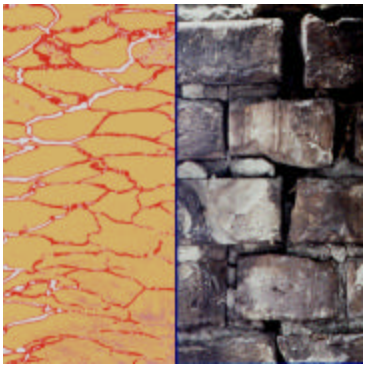

Figure 2.

Poor horn quality: These magnified horn cells are poorly connected due to decay of the intercellular cementing substance. This defect increases the risk of horn lesions and subsequent lameness. This horn can be compared to a weak crumbling brick wall.

Figure 3.

Optimal horn quality: Correct nutritional management is known to have a critical influence on horn quality. The architecture of these cells is typical of strong, durable horn. Biotin, a B-group vitamin, is a key nutrient that positively influences horn quality.

(Photos courtesy of C. H. Mülling)

How biotin supplementation can help

Over the past five years, a total of at least 10 controlled research trials have been published on the effects of supplementary biotin on the incidence of hoof disorders in dairy and beef cattle. These studies show feeding 20 mg biotin per day to dairy cows results in a reduced incidence of several of the most common hoof disorders including sole ulcer, white line disease, sandcracks and digital dermatitis. Feeding supplementary biotin did not completely eliminate hoof disorders but did reduce the overall incidence compared to unsupplemented controls. Two recent studies are of particular interest.

In an Australian trial, over 2700 cows in 20 herds were studied over a thirteen month period. Cows in half of the herds received 20 mg biotin per day, whereas the remainder received a normal unsupplemented diet.

Trial Results

- The biotin supplemented herds exhibited better locomotion scores compared to the unsupplemented herds.
- The biotin supplemented herds had significantly fewer lame cows during the summer period and required less antibiotic treatments. There was also a significant reduction in somatic cell count during this period. *See Figures 4 and 5.*

In a UK study (Hedges et al., in press) involving over 900 cows, in each of five dairy herds, half of the cows received 20 mg biotin supplement and half were unsupplemented. All lame cows were identified by the herdsman but examined and treated by a vet. There was no difference for the first 120 days, but from approximately 130 days onwards, in the biotin-supplemented group there was almost half the incidence of lameness caused by white line disorders. In addition, only 17 percent of the cows in the biotin treatment group needed a repeat treatment, compared with 30 percent in the control group. This suggests that biotin also improves the rate of healing of white line lameness lesions.

Figure 4. Reported monthly incidence of lameness in cattle with and without biotin supplementation (Fitzgerald et al., 2000).

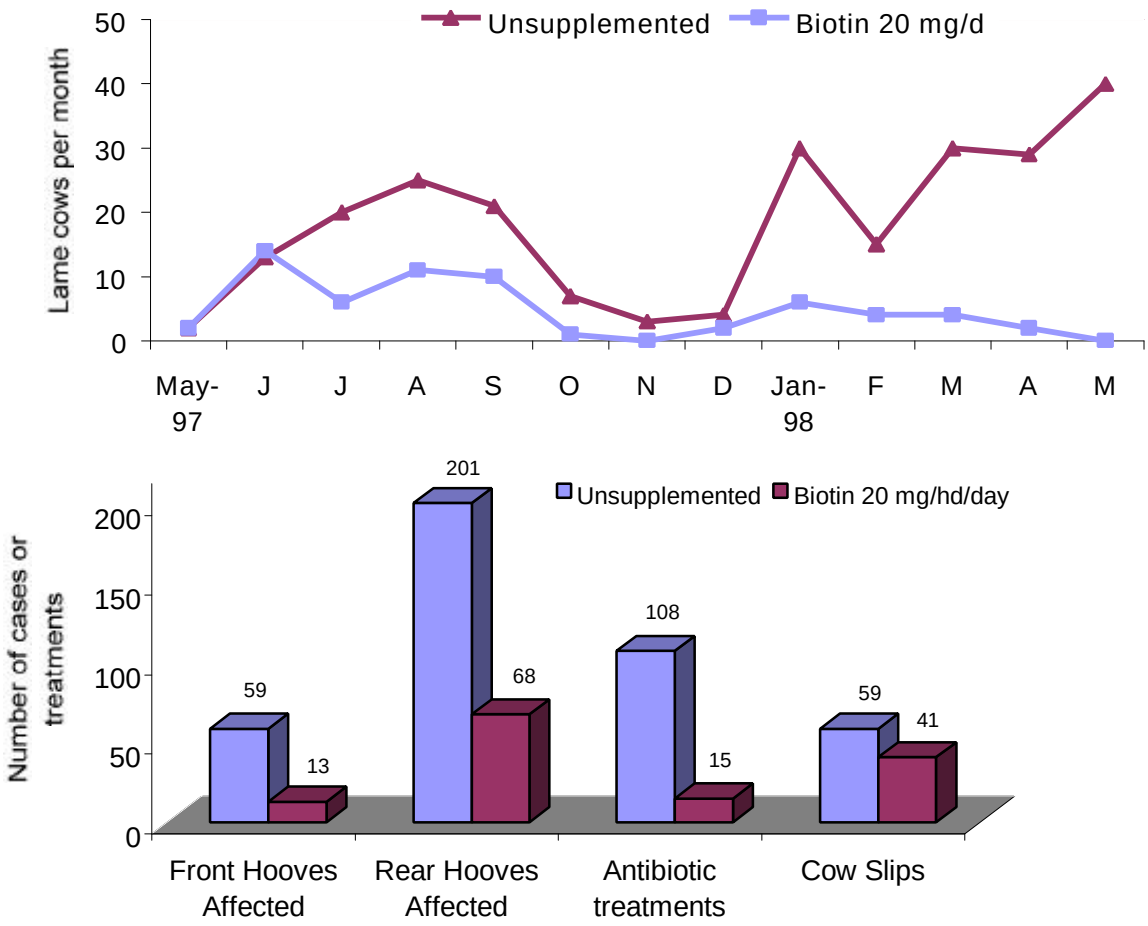

Figure 5. Influence of biotin supplementation on hoof disorders and treatments (Fitzgerald et al., 2000).

Biotin and milk production

Available data, although limited, consistently shows increased milk production (between one and three litres per cow per day) when high producing cows are fed 20 mg of supplementary biotin. This effect is independent of improvements in hoof health. The actual mode of action is not known but increased fibre digestion and increased glucose synthesis may be responsible.

Figure 6. Effects of Supplementary Dietary Biotin on Performance of Holstein Cows During Early Lactation (Zimmerley and Weiss, 2001)

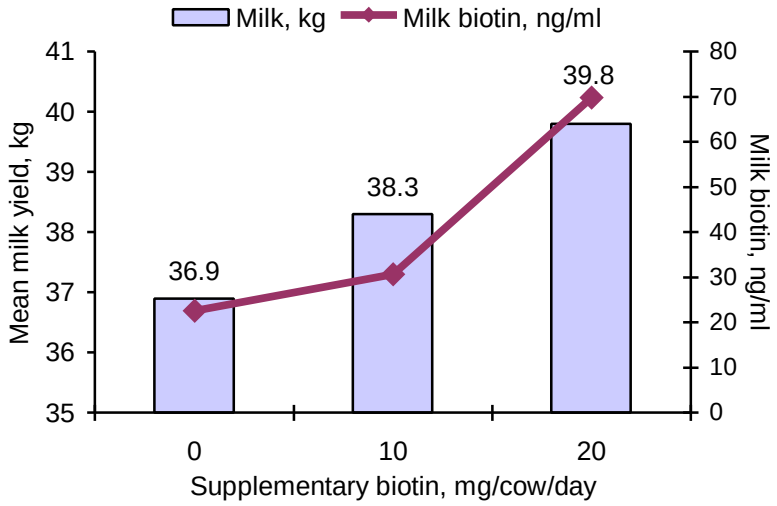

Figure 7. Effects of Supplementary Dietary Biotin on Performance of Holstein Cows During Early Lactation (Zimmerley and Weiss, 2001) ▲= control; ○= 10 mg biotin; ∇ = 20 mg biotin

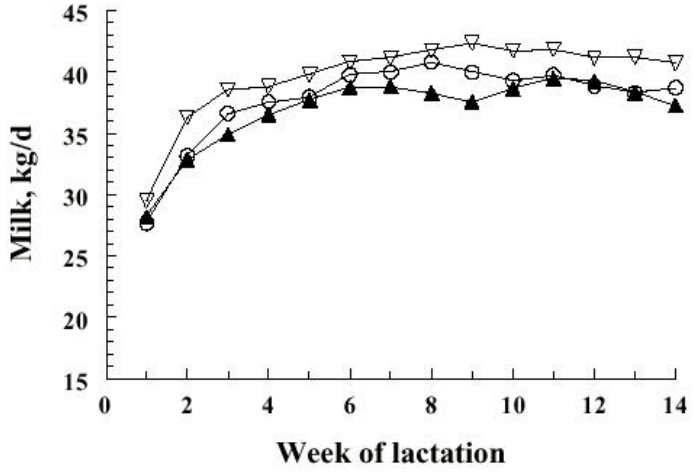

Table 1. Summary of experimental results on the effect of supplementary biotin on milk production

Reference	*Treatment*	*Design*	*Response*	*P*
Bonomi et al. (1996)	0 or 10 mg/d	Field study, 15 cows/treatment, first 150 d of lactation	33.6 and 35.1 kg/d for 0 and 10 mg treatments	P<0.05
Midla et al. (1998)	0 or 20 mg/d	Field study, pen fed, one farm	+320 kg d mature equivalent milk (12,110 kg for treatment v. 11,790 for control)	P<0.05
Bergsten et al. (1999)	0 or 20 mg/d	Field study, supplement via computer feeder, one farm	+878 kg of adjusted 305-d milk yield. Rolling herd average = 9800 kg	P<0.01
Fitzgerald et al. (2000)	0 or 20 mg/d	Field study, 10 farms per treatment, pasture fed	No effect on milk yield. Yields were approx. 18 kg/d for control and 19 kg/d for treatment	
Zimmerly and Weiss (2001)	0, 10, or 20 mg/d	Controlled study, 15 cows/treatment, first 100 d of lactation	Linear effect. 36.9, 37.8 and 39.7 kg/d for 0, 10, and 20 mg treatments.	P<0.05

Biotin - recommended supplementary amounts for Hoof Health & Milk production

Biotin (ROVIMIX H-2), may be added to compound feed or minerals at a concentration dependant on the average feed rate and the target dose of biotin required. E.g. a dairy compound fed @ 6kg/hd/day should contain 3.3 mg/kg, dry cow compound @ 2kg/day = 10mg/kg, mineral @ 150g/day = 133mg/kg biotin respectively.

	Biotin dose mg per head per day	
Dry/Transition cows	20 mg	Daily, or at least 1 month prior to calving
Lactating dairy cows	20 mg	Daily
Heifers	20 mg	From service, or at least 3-4 months prior to calving

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