Optimising the hoof health of dairy cows with zinc

Hoof health can have a great impact on the profitability of dairy farms. In fact, lameness is the third most common reason cows leave farms, behind mastitis and reproductive challenges.

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Management techniques to prevent lameness involve keeping the hoof environment as close to ideal as possible, along with regular hoof trimming.

In confinement situations, this includes reducing the length of time cows are standing on concrete and in manure. For pasture systems, removing sharp gravel and reducing accessibility to areas with poor footing. Concrete can be abrasive to cows' hooves.

Confinement on hard surfaces increases the weight load on feet, while housing on more natural earthen surfaces helps to reduce these effects.

New or wet concrete is worse than dry or old concrete. Producers should allow their herd time to walk at their own pace and not 'drive' them so they can follow an ideal path on their own.

Another management technique that should be considered is proper hoof trimming. Regular hoof trimming can help to prevent lameness related to overgrowth, in addition to promoting proper loading and earlier detection of lesions. Heat stress is often a seasonal contributor to hoof health problems and related lameness.

As cows pant and drool to keep cool, they can lose a lot of saliva, thereby losing some of their rumen buffer and potentially contributing to acidosis. Rumen acidosis increases the risk for laminitis and poor hoof health.

The role of trace minerals in dairy cow hoof health

Lameness in dairy cows can also be influenced by inadequate trace element supplementation, which can play a significant role in the production of quality hoof.

Trace minerals, such as zinc, have important roles in production and maintenance of healthy keratinised tissues. Keratin, the fibrous protein substance that makes up hoof tissue, requires zinc to form the bonds that strengthen its structure.

Zinc is a key mineral in the processes of keratinisation, where it is involved in three functions of the keratinisation process – catalytic, structural, and regulatory.

- **Catalytic role:**
Carried out by zinc metalloenzymes.
- **Structural role:**
In zinc finger proteins.
- **Regulatory role:**
Through its effects on calmodulin, protein kinase C, thyroid binding hormone and inositol phosphate synthesis.

When nutrient supply to keratin-forming cells is compromised or interrupted, inferior quality horn is produced, leading to increased susceptibility to claw disorders and lameness.

Baggott et al. (1988) reported the concentration of zinc in the horn of lame cows was less than in normal animals. They also noted that the harder keratin on the hoof wall contained a greater zinc concentration than the softer keratin of the heel.

Supplemental zinc can be offered to dairy cows in many chemical forms. Examples of inorganic sources of zinc include zinc oxide and zinc sulphate. However, organic sources of zinc, such as zinc proteinate, are more easily absorbed and retained, thus establishing adequate tissue reserves for the production and regeneration of keratin

This also supports overall disease defence and reproductive function in today's high-producing dairy cow.

The impact of supplemental zinc on hoof health

In a trial in Switzerland by Kessler and coworkers (2002), the researchers examined the effects of supplemental zinc on hoof horn quality. Sixty male Holsteins were separated into balanced groups and fattened over a period of 40 weeks.

The diet consisted of a mixture of corn and grass silage fed ad libitum, concentrate and a mineral/vitamin complement. Zinc supplementation among the groups was supplied as zinc oxide or zinc proteinate (Bioplex zinc) and was adjusted daily on an individual dry matter intake basis.

Macroscopic clinical evaluation of the hoof was conducted at the beginning, middle and end of the trial and were graded from 0 (no change) to 3 (severe changes).

After slaughter, coronary horn tissue was sampled for microscopic evaluation and tensile strength testing. In all three parameters (macroscopic clinical evaluation, microscopic coronary quality and tensile strength) the cows fed Bioplex zinc produced better responses with improved claw quality and increased tensile strength (Table 1).

These results confirm earlier work from the University of Illinois. Researchers found that cattle fed zinc proteinate had harder and more elastic hooves than cattle fed zinc sulphate.

In the study animals were fed 180 milligrams of zinc per day as either organic (zinc proteinate) or inorganic (zinc sulphate) for 45, 60 or 75 days. From the trial it was concluded that zinc proteinate appeared to enhance the overall strength of hooves collected from heifers.

A recent publication from France showed the effect of trace mineral source and amount on lameness in lactating Holstein dairy cows. All groups were fed the same basal diet

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Table 1. Claw quality.

	Treatment		
	Control	Zn oxide	Zn proteinate
Macroscopic-clinical claw examination[1]			
Initial	0.87±0.36	0.95±0.32	0.88±0.43
Final	1.10±0.40[a]	1.08±0.31[a]	0.88±0.39[b]
Histological examination[1]	0.87±0.36	0.89±0.38	0.69±0.20
Tensile strength (kp/mm)[2]	5.81±0.73	5.72±0.80	6.16±0.67

[1]Scoring scheme: 0 = unchanged, 1 = slight alteration, 2 = moderate alteration, 3 = severe alteration.
Different superscripts within the same row indicate significant differences (P<0.05)

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with the only difference being the composition of the trace mineral component.

The three treatment groups were industry standard levels of inorganic trace minerals (zinc, copper and selenium), reduced levels using organic trace minerals as proteinates and selenium yeast (Bioplex/Sel-Plex) and reduced levels using inorganic sources.

Lameness and locomotion evaluations were done for each cow by the same evaluator throughout the trial. The overall locomotion score was based on three parameters:

- Back posture, standing (score of 1 – flat back; score of 2 – arched back).
- Back posture, walking (score of 1 – flat back; score of 2 – arched back).
- Stride (length and evenness).

Cows supplemented with inorganic trace minerals, at either amount, suffered more leg and hoof issues compared to the organic group. The trial demonstrated that the use of locomotion scoring was effective for early detection of hoof issues and comparing the incidence and severity of lameness in cows.

Locomotion scoring is not new to the dairy industry. The first lameness scoring system, which is still in use today, was published by Sprecher and colleagues at Michigan State University in 1997 (Table 2).

Lameness score	Clinical description	Assessment criteria
1	Normal	The cow stands and walks with a level-back posture. Her gait is normal.
2	Mildly lame	The cow stands with a level-back posture but develops an arched-back posture while walking. Her gait remains normal.
3	Moderately lame	An arched-back posture is evident both while standing and walking. Her gait is affected and is best described as short-striding with one or more limbs.
4	Lame	An arched-back posture is always evident and gait is best described as one deliberate step at a time. The cow favours one or more limbs/feet.
5	Severely lame	The cow additionally demonstrates an inability or extreme reluctance to bear weight on one or more of her limbs/feet.

Table 2. Lameness scoring system developed by Sprecher and colleagues (Michigan State University, 1997).

Their system was a 5-point classification programme with a normal cow assigned a lameness score of 1 (the cow stands and walks with a flat back and normal gait) up to a severely lame cow assigned a lameness score of 5 (inability or extreme reluctance to bear weight on one or more of her limbs/feet).

Similar to the scoring system used by Pomport described above, cows in the Sprecher scoring system elevated their score based on an arched back while walking (score of 2) and arched back while both walking and standing (score of 3). Gait and stride assessment were also part of the Sprecher scoring system. Taking a short stride supported a score of 3, while taking a deliberate step increased lameness to a score of 4.

Additionally, there were differences in other measures of economic importance for the dairy. Energy corrected milk yield was greater for the cows supplemented with Bioplex and Sel-Plex compared to the other two groups (31.5kg vs 31.0kg and 31.5kg, respectively).

The organic group tended to have lower somatic cell counts (SCC) overall compared to the other two groups.

Some 71% of cows supplemented with mineral proteinates and selenium yeast were pregnant after 10 weeks compared to 53% of cows supplemented with reduced inorganic levels and 47% of cows supplemented with industry inorganic levels.

As the price of feed continues to increase, keeping our herd healthy becomes even more important to maintaining economic profitability and sustainability. Lameness can create severe economic losses.

However, there are many ways to prevent the disabling condition. By providing a safer environment and a proper diet, producers can work to avoid such extreme cases and maintain healthy hooves in their herd. ■

References are available from the author on request