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Factors Affecting Claw Integrity of Dairy Replacement Heifers

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Introduction
Because dairy replacement heifers generally do not generate revenue until after first parturition, the management and nutritional needs of heifers receive lower priority than those of the lactating cows. However, minimizing health disorders of replacement heifers decreases mortality before first parturition and increases the likelihood that they will enter the milking herd (Warnick et al., 1995). Furthermore, lessening the incidence of calfhood respiratory diseases has been correlated with decreased age at first calving (Warnick et al., 1994) while minimizing incidence of claw lesions in heifers has been associated with increased milk production during first lactation (Drendel et al., 2005). Clearly, improving health, including claw integrity ,of dairy replacement heifers has a positive impact on dairy profitability. This paper will focus on one of the factors affecting claw integrity of dairy replacements heifers, trace mineral status.

Development of Claw Lesions in Heifers Is a Risk Factor for Development of Claw Lesions in Lactation
According to the National Animal Health Monitoring Systems (2002) survey, 16.3% of dairy cows are culled due to lameness. However, this survey may underestimate dairy cows culled due to lameness because cows culled for low production (19.3%) or reproductive failure (26.5%) may have been lame, resulting in productive or reproductive failure. Lameness has been shown to reduce milk production (Hernandez et al., 2002b; Juarez et al., 2003) and reproductive performance (Sprecher et al., 1997; Hernandez et al., 2002a: Melendez et al., 2002). In addition, dairy producers tend to underestimate extent and severity of lameness within their herds (Whay et al., 2002).

Research indicates that mature cows that develop claw disorders are more prone to future reoccurrences of these claw disorders (Peterse, 1986; Raven, 1989; Enevoldsen et al., 1991). Recently Drendel et al. (2005) found that heifers, 12 months of age, that developed claw lesions were 27.7 times more likely to develop claw lesions in early lactation than heifers that did not develop claw lesions. At one month prepartum, heifers that had claw lesions were 15.1 times more likely to have a claw lesion at 2 months postpartum. It should be noted that the claw lesions in heifers at 12 months of age and at one month prepartum were of minor severity and the vast majority of heifers were not lame. Thus, preventing growing animals from developing even minor claw lesion must be a key management objective.

Incidence of Claw Lesions in Dairy Replacement Heifers
In a recent study, Drendel et al. (2005) found that at 12 months of age, 74.5% of heifers had a claw lesion (Table 2). The predominant claw lesions at 12 months of age were white line separation (42.5% incidence), sole hemorrhage (35.9% incidence) and heel erosion (23.4% incidence; Table 1). At one month prepartum, 85.7% of heifers had a claw lesion, with heel erosion (60.6% incidence), sole hemorrhages (40.3% incidence) and white line separation (22.8% incidence) being the predominant lesions.

Ohio State researchers found that 84% of 12- to 13-mo-old Holstein heifers had white line separation and 79% had sole hemorrhages, respectively (Hoblet et al. 2000). Vermunt and Greenough (1996) observed that 77% of 13-mo-old Holstein heifers had sole hemorrhages (Figure 1). Similarly, in a survey of 1141 females on 128 dairies in The Netherlands, researchers found that 70% of Friesian/Holstein heifers had sole hemorrhages at 40 week of age (Frankena et al., 1992). It should be noted that in this study, researchers observed sole hemorrhages in heifers as young as 11 weeks of age and that as age of heifers increased from 10 to 52 weeks of age, sole hemorrhages became increasingly more prevalent (Figure 2). Clearly, claw lesions are prevalent in dairy replacement heifers.

Risk Factors for Development of Claw Lesions in Heifers
In the survey of 128 dairies, Frankena et al. (1992) found that incidence of sole hemorrhages in heifers between 10 and 52 weeks of age varied substantially across herds. In approximately 17% of herds, less than 10% of heifers had a sole hemorrhage (Figure 3). In comparison, 14.1% of herds had a sole hemorrhage incidence rate in heifers of more than 70%. The variation in prevalence of sole hemorrhages across herds indicates that opportunities exist to reduce occurrence

Factors observed to be associated with increased incidence of claw lesions include purchasing heifers (Frankena et al., 1992), rearing heifers indoors on concrete (Vermunt and Greenough, 1996), raising heifers in free stalls or on slatted floors (Frankena et al., 1992), feeding only forage (Frankena et al., 1992), not feeding any dry hay (Frankena et al., 1992), feeding a diet composed only of wet silage (Offer et al., 2001; Offer et al., 2003) and not using an insecticide on heifers (Frankena et al., 1992).

Due to the dynamics of horn generation in the bovine claw, the effect of environmental and nutritional insults may not be evident immediately. Horn on the dorsal surface of the claw grows at an average rate of 2.5 mm per month in beef cattle and 5 to 6 mm per month in more intensively fed cattle, like lactating dairy cattle (Greenough, 1997). The length of the dorsal wall of the medial claw is approximately 7.5 cm when measured from the apex to the coronary band (Greenough, 1997). Based upon these measurements, the horn capsule of the claw is a composite of horn produced over the past 12 to 15 months. So, it is plausible that interactions of environmental and nutritional conditions during rearing would require a considerable length of time to be fully expressed as claw lesions.

This hypothesis is supported by Webster (2002), who observed that heifers housed in straw yards for the last 4 weeks of gestation and the first 8 weeks of lactation had fewer sole hemorrhages and white line lesions than heifers housed in free stalls during this same period. Critically, Webster (2002) observed that heifers housed in straw yards for the last 4 weeks of gestation and first 8 weeks of lactation had fewer sole hemorrhages, even 16 weeks after being moved into free stalls, than heifers housed in free stalls for last 4 weeks of gestation and first 8 weeks of lactation.

Similarly, Offer et al. (2001) found that feeding meadow hay instead of grass silage for a period of 98 days to growing heifers, early in gestation, reduced claw lesions in the first lactation (Offer et al., 2001). In a follow-up study, heifers were fed either a diet based upon grass silage or straw and concentrate (Offer et al., 2003). Heifers fed the grass silage diet had higher incidence of sole and white line lesions, not only during rearing but also during lactation. Even seven months after treatments were discontinued, heifers fed the grass silage diet during rearing had higher incidence of white line and sole lesions. Altogether, these results suggest (Offer et al., 2001; Offer et al., 2003; Webster, 2002) that dietary and environmental interactions related to claw lesions are complex and may extend over long time periods.

Effect of Improving Trace Mineral Status of Dairy Heifers on Incidence of Claw Lesions

Research examining the effect of improving trace mineral status on incidence of claw lesions in growing dairy replacements through the feeding of additional trace minerals in a more bioavailable form is very limited. Drendel et al. (2005) found that adding a combination of amino acid complexes of zinc, manganese and copper and cobalt glucoheptonate (Availa®4) to a diet fortified in excess of NRC (2001) requirements for zinc, manganese, copper and cobalt did not reduce incidence and severity of claw lesions during rearing. To the contrary, heifers fed the additional trace minerals in the form of amino acid complexes and a glucoheptonate salt actually had greater overall incidence and severity of lesions at one month prepartum (Table 3). In particular, incidence and severity of heel erosion and sole hemorrhages were greater one month prepartum.

The ineffectiveness of the combination of amino acid complexes of zinc, manganese and copper and cobalt glucoheptonate lack explanation. Previous research has shown that feeding this combination of trace minerals to lactating dairy cows decreases claw lesions (Ballantine et al., 2002; Nocek et al. 2000). One plausible explanation is that one month prepartum, heifers had not received the trace mineral supplement for a sufficient time period. As noted above, horn on the dorsal surface of the claw grows at an average rate of 2.5 mm/mo in beef cattle and 5 to 6 mm/mo in more intensively fed cattle such as lactating dairy cattle (Greenough, 1997), resulting in the horn capsule of the claw being a composite of horn produced over the past 12 to 15 mo.

This may explain why at two months postpartum, these Wisconsin researchers found that heifers fed the additional trace minerals in the form of amino acid complexes and a glucoheptonate salt actually had a decrease in overall incidence and severity of claw lesions (Table 2). In particular, incidence and severity of white line lesions and sole ulcers were decreased.

Furthermore, heifers not fed the additional trace minerals during the rearing phase that developed a claw lesion in early lactation had a 5503-lb reduction in their 305 Mature Equivalent milk yield (Table 3). In contrast, heifers fed the additional trace minerals during the rearing phase that developed a claw lesion in early lactation had only a 1901-lb decrease in their 305 Mature Equivalent milk yield. Based upon the impact of claw lesions on first lactation performance of heifers, feeding this combination of zinc, manganese and copper amino acid complexes and cobalt glucoheptonate to heifers for 12 months prior to calving at a cost per day of $0.035 per heifer yields a 24.1:1 return on investment (Figure 4). This assumes that primiparous cows have a claw lesion incidence of 73.8% at 2 months postpartum and milk price is $12/cwt. Even if incidence of claw lesions was only 8.8%, dairy producers would receive a 2:1 return on their investment in feeding Availa-4 to dairy replacement heifers (Figure 4).

Conclusions

Claw lesions are prevalent in dairy replacement heifers and dairy replacement heifers that have claw lesions are more prone to claw lesions in the future. Improving trace mineral status of heifers through feeding amino acid complexes of zinc, manganese and copper, and cobalt glucoheptonate can help dairy producers grow replacements that have fewer claw lesions. In addition, feeding amino acids complexes of zinc, manganese and copper and cobalt glucoheptonate to dairy replacement heifers has been shown to be highly cost-effective.

References available upon request.