Stepping Out: Recent Advances in Detecting Lameness in Dairy Cattle

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Introduction

Lameness in dairy cows impacts negatively on herd welfare and productivity. It is thought to be closely associated with avoidance of pain caused by limb lesions and, particularly in dairy cattle, by hoof lesions (Dyer *et al*., 2007). Freedom from pain is one of the Five Freedoms of animal welfare (FAWC, 1997), so lameness is a sign of poor welfare. Besides this, there are treatment costs (Almeida *et al*., 2008) and reduced milk yields (Warnick *et al*., 2001). Consequently, prevention and treatment is a feature of many welfare and management quality assurance plans (Webster *et al.,* 2004). However, as prey animals, dairy cows tend to mask their pain, making it difficult to detect foot lesions with no overt lameness (O'Callaghan *et al*., 2003).

Discussion

Three recent studies focussed on developing novel methods for detecting lameness. Dyer *et al.* (2007) reported that more than one third of cows with painful claw lesions show no obvious deterioration in locomotion. Dyer *et al.* (2007) recorded a pain response when a cow withdrew its limb with particular force after pressure was applied to its lateral claw. Such pain responses were detected in 37% of cows with apparently normal locomotion, throwing doubt on the reliability of detecting lameness visually (Almeida *et al*., 2008). In search of a more sensitive method, Almeida *et al.* (2008) studied endocrine, immune and behavioural changes to gauge their potential as biomarkers for inflammatory foot lesions. Serum concentrations of the anti-inflammatory steroids cortisol and dehydroepiandrosterone (DHEA) were used as neuro-endocrine markers of stress and inflammation. Leucocyte activation was determined using real time PCR to measure candidate gene expression. Behaviour was observed for a total of 96 minutes over three days, particularly focussing on changes in resting, feeding, socialising and grooming.

Eight lame and eight sound Holstein cows were used in the study. Lame cows demonstrated an abnormal gait and had at least one visible hind hoof lesion. The results showed significant endocrine and behavioural differences between lame and sound cows. Hormone assays revealed that lame cows showed significantly lower DHEA serum concentrations than sound cows. In contrast to lameness studies in other species (Ley *et al*., 1991), but supporting findings for dairy cows (Ley *et al*., 1996), cortisol concentrations were not significantly different between the groups. Conversely, the serum cortisol:DHEA ratio was significantly higher in lame cows than sound cows. Almeida *et al.* (2008) attributed this to the antagonistic relationship between DHEA and cortisol. Lame cows spent significantly less time eating than sound cows, thus exhibiting a recognisable "sickness response" manifesting as behavioural and neuroendocrine changes. The results suggested that the anti-inflammatory and immune-protective properties of DHEA make it a potential treatment for lame cows.

Gonzales *et al*. (2008) also measured changes in feeding behaviour as a potential indicator of health disorders such as lameness. Rather than direct observation of feeding behaviour (Almeida *et al*., 2008), Gonzales *et al*. (2008) analysed previously collected feeding data and health records of 50 Holstein-Friesian cows. Gonzales *et al.* (2008) used computerised feeders to measure food intake, feeding time and number of daily feeder visits. The effects of acute and chronic disorders on feeding parameters were analysed using a mixed-effects linear regression model. Gonzales *et al.* (2008) expanded on the findings of Almeida *et al.* (2008) by noting that lame cows spent significantly less time eating than sound cows, but ate at a significantly faster rate. Gonzales *et al.* (2008) postulated that this might be how lame cows minimise their discomfort while standing to feed, as well as decreased frequency of feeder visits. This result supports the findings of O'Callaghan *et al.* (2003), that lame cows displayed decreased activity levels, which could be attributed to avoiding pain associated with movement. Lame cows may also minimise their activity levels to avoid becoming an easy target for predators. With regard to feeding parameters, Gonzales *et al.* (2008) concluded that a sudden decrease in feeding time was the most useful feeding parameter for detecting acute lameness.

In a third study, Almeida *et al.* (2007) aimed to determine the sensitivity of a pressure plate in comparison to a visual scoring system in detecting early lameness. An experienced veterinarian examined seven Holstein heifers visually and deemed all sound. A pressure plate was then used to measure the vertical ground reaction force of each hind limb as each cow walked over it. The heifers were then clinically examined, revealing hairy heel wart lesions in four of them. Analysis of the pressure plate data showed that the four heifers with lesions showed significantly less symmetry between the peak vertical forces of their right and left hind limbs than heifers with no lesions (i.e., the pressure plate detected gait abnormalities caused by hoof lesions that were undetected visually). Possibly the veterinarian was habituated to the sight of lame cows and was unable to perceive the subtle gait and posture changes present in the heifers with foot lesions. Almeida *et al.* (2007) found that pressure plate analysis provided more reliable lameness detection than subjective visual gait analysis. As in the study by Almeida *et al.* (2008), this study was limited by its small sample size. The authors concluded that future studies would require more subjects and trials to confirm the usefulness of using a pressure plate.

Conclusion

Improvements in detecting lameness will improve welfare for dairy cattle by prompting timely treatment and alleviating pain. While all three studies present promising developments in detecting lameness, their reliance on special equipment and trained personnel may be impractical for on-farm use. Nevertheless, such studies are useful in understanding the mechanisms of lameness. Almeida *et al.* (2007) confirmed that hoof lesions cause subtle locomotive changes that can remain undetected by visual means. Almeida *et al*. (2008) and Gonzales *et al*. (2008) found that lameness significantly decreases feeding time and this knowledge could be used in early lameness detection on farms with computerised feeding systems. Future studies could investigate the efficacy of DHEA as a treatment for lesions associated with lameness. While early intervention is beneficial, eradication of preventable lameness would be the best outcome for dairy cows.

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