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A brief locomotion is stressful in lame crossbred cows*

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Lame cows cannot stand or walk properly, do not produce as much milk, have more reproductive disorders, higher labor costs and are more likely to be culled (Archer 2010). Lameness has a high prevalence in Indian cows (Sood 2005). As a part of management practices, lame cows need to compete and move along with healthy contemporaries. Lame cows have a reduced pain threshold (Whay *et al.* 1997) and it is unknown if a brief locomotion in such cows is stressful, which was therefore the intent of present study. If stressful, the centrally mediated changes could perpetuate a disturbed reproduction and production in the affected cows.

The experiment was approved by the Animal Experiments Committee of the Punjab Agricultural University, Ludhiana, and was conducted in the university dairy farm, Ludhiana.

The work was done on 12 apparently healthy and lactating Holstein Friesian predominated crossbred cows, either non lame (NL, n = 5) or moderately lame (L, n = 7) and in the post-voluntary waiting period of third to sixth lactation. Lameness was assessed as per Wells *et al.* (1993).

In the morning of experiment day, 2 heparinised blood samples were collected from each cow 1h prior to as well as immediately before subjecting the animals to a walk (hereafter designated as - 60 and 0 min sample, respectively; the latter was considered as basal plasma cortisol concentration). Subsequently, each cow was subjected to a walk of 5 min in the paddock. This was achieved by following the cow from its rear side so that it maintained gentle strides for the entire duration. Five more blood samples were collected at 5, 30, 60, 180 and 240 min after walk. The blood samples were collected through indwelling jugular vein catheter inserted at 48 h prior to experiment and maintained with 50 IU of heparin in normal saline solution. Each blood sample was immediately centrifuged to harvest plasma that was stored at –20°C pending analysis of total cortisol by RIA (Prakash and Madan 1984), non-esterified fatty acids (NEFA) (Folch *et al.* 1957) and glucose (Frankel *et al.* 1970). Glucose estimation was done on the same day. The assay sensitivity of cortisol was 0.2 ng/ml; the intra- and inter-assay coefficient of variation was 9.2 and 10.1%, respectively. Blood sampling was always done between 0900 and 1500h to avoid circadian and ultradian variations in plasma cortisol (Lefcourt *et al.* 1993).

The average cortisol, glucose and NEFA concentrations at different time intervals, average rise in cortisol concentration (difference between the basal and the highest post-walk concentration) and total amount of cortisol released following walk (assessed from the area under each respective curve (AUC) as per the Lagrange's formula (Grewal 2001)), were compared between the NL and L cows by Student's *t*-test using SPSS (12.0) for windows. Difference of $P<0.05$ (at least) was considered to be significant.

The basal plasma cortisol concentrations were nonsignificantly higher in the NL (16.4±4.3 ng/ml, range 5–28 ng/ml) than in the L group (6.3±2.9 ng/ml, range 1–22 ng/ml), which was due to consistently higher cortisol levels in 2 of the NL cows that remained nervous and aggressive during the study. Without these cows, the baseline concentrations of cortisol in the NL cows would have been 8.7±1.6 ng/ml (range 5–12 ng/ml), which resembled to the L cows. The range of basal plasma cortisol concentration (6.3–16.4 ng/ml) in the L and NL cows simulated to a previous study (Shutt and Fell 1985). Normal like basal cortisol concentrations in the L cows suggests their adaptation to chronic pain attributable to down-regulation of the ACTH receptors in pituitary during chronic stress (Ladewig 2000).

Following walk, cortisol concentrations attained peak of

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27.1±8.5 ng/ml in 66.0±26.0 min in the NL and 17.0±1.9 ng/ml in a lesser time of 23.6±7.1 min in the L cows, respectively. While walk of 5 min failed to significantly elevate the basal plasma cortisol concentration (16.4±4.3 vs 27.1±8.5 ng/ml, P>0.05) in the NL cows, the peak cortisol was significantly higher than the basal values (6.3±2.9 *versus* 17.0±1.9 ng/ml, P<0.05) in the L cows. The later finding reflects the brief locomotion to be stressful and is incriminated to a low nociceptive threshold (threshold response to a mechanical non-harmful pressure) in the L cows. Such a rise can exert a multilevel inhibitory effect on the GnRH/LH production (Morris *et al.* 2009) and could be a potential reason for a disturbed reproductive rhythm in the lame cows (Archer 2010). A similar rapid and increased hypothalamo-pituitary-adrenal response was observed after depriving of lying down in the cows already under a stress of social isolation (Munksgaard and Simonsen 1996).

The peak cortisol values declined gradually to 14.0±7.0 and 5.6±1.2 ng/ml at 240 min in the NL and L cows, respectively, the values resembling closely to the basal value in the corresponding group. The AUC of cortisol did not vary (P>0.05) between the NL (38.4±5.5 mm^2) and the L (30.1±3.8 mm^2) cows.

Average concentration of NEFA (30.0 to 100.0 mg/dl) and glucose (45.0 to 75.0 ng/dl) in the NL and the L cows were within physiological limits, their lowering indicates fatigue (Molony and Kent 1997).

SUMMARY

Response to a brief locomotion in chronically lame cows is unknown. The present study evaluated periodic change in plasma cortisol, non-esterified fatty acids and glucose before and after a 5 min walk in 7 lame and 5 non-lame crossbred cows. Normal like cortisol concentration before walk in the lame cows suggested a lack of alarming stress. However, a rapid and significant increase in the cortisol concentration after walk in the lame cows underscores a low nociceptive threshold and a hypersensitive hypothalamo-pituitary-adrenal axis. Hence, chronic lameness in cows needs to be alleviated till that the cows should be subjected to minimal locomotory activities to prevent hazardous effects of high cortisol.

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