



IMMUNE AND METABOLIC INDICES IN DAIRY COWS WITH INFLAMMATION

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Summary

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This field study was aimed to determine if mastitis and claw inflammatory disorders are associated with changes in serum haptoglobin, NEFA, and β -hydroxybutyrate. Health condition of mammary gland and claws were examined in 232 Holstein dairy cows. Clinical mastitis, subclinical mastitis, and inflammatory claw disorders were found in 202 dairy cows. 30 dairy cows were found to be free of inflammations. Cows with inflammation and claw inflammation had higher serum haptoglobin than healthy cows. There were no significant group differences in concentrations of NEFA and BHB. In conclusion, results of our observation show that the inflammatory processes in dairy cows are associated with increase in the acute phase protein (haptoglobin) but not with lipomobilisation and hyperketonaemia.

Key words: BHB, dairy cows, haptoglobin, inflammation, NEFA

INTRODUCTION

The transition of dairy cows through the dry-period, calving, and commencement of lactation is a critical time and is a strong determinant of the health and performance success of the cow through the full lactation. A successful adaptation to both the onset of lactation and the resulting negative energy balance can provide for a healthy and productive lactation, whereas a poor adaptive response can lead to a multitude of problems including clinical disease and impaired milk production. The main consequences of negative energy balance are suppression of the immune system in the periparturient period (Hammon *et al.*, 2006), ketosis and sub-clinical ketosis and the related conse-

quences (reduced feed intake, displaced abomasum), reduced productivity possibly through reduced milk protein percentage, and reduced fertility performance (Allbrahim *et al.*, 2010; Walsh *et al.*, 2011). Metabolic stress can adversely affect immune responses in dairy cows (Contreras & Sordillo, 2011). However, there is sufficient evidence to suggest that inflammation can contribute to metabolic disorders as well (de Heredia *et al.*, 2012). Inflammatory response is associated with increase of acute phase proteins (APPs) which are discussed as a promising tool to detect inflammatory processes on herd level. The most studied APP is haptoglobin produced primarily in the liver in re-

sponse to pro-inflammatory cytokines. Increased haptoglobinaemia has been associated with several diseases in dairy cattle. The objective of this field study was to determine if common inflammatory diseases like mastitis and claw inflammatory disorders are associated with changes in serum haptoglobin, NEFA, and β -hydroxybutyrate.

MATERIAL AND METHODS

Holstein dairy cows (n=232) were included in the study; farm feeding management was based on TMR and the dairy cows were housed in free stalls with cubicles. Health condition of mammary gland and claws was examined in the crush. The subclinical mastitis was diagnosed by using California mastitis test. Blood samples were obtained from the jugular vein at the time of the clinical examination and treatment. Serum haptoglobin concentration was measured by colorimetric assay (Tridelta Development, Ireland), and serum NEFA and BHB were assayed with the kits supplied by Randox Laboratories Ltd. on spektrophotometer Alizé (Lisabio, France). For statistical analyses the dairy cows were divided into five groups: A (healthy), B (inflammation), C (claw in-

flammation), D (mastitis), and E (clinical mastitis). Group differences in analysed indices were tested by one-way ANOVA.

RESULTS

Clinical mastitis, subclinical mastitis, and inflammatory claw disorders, including digital dermatitis, interdigital dermatitis, sole ulcer, white line diseases, toe necrosis, interdigital hyperplasia, and subclinical laminitis were found in 202 dairy cows (B). 30 dairy cows were found to be free of inflammatory changes (A). Cows with inflammation (B) and claw inflammation (C) had higher serum haptoglobin than healthy cows (B: 0.21 ± 0.27 mg/mL; C: 0.35 ± 0.43 mg/mL; A: 0.06 ± 0.04 mg/mL; $p < 0.01$). There were no significant group differences in concentration of NEFA and BHB in the study (Table 1).

DISCUSSION

The effect of claw inflammation on transition cow behaviour and metabolic status has been widely studied (Calderon & Cook, 2011). Although no relationship between claw diseases and NEFA was found, lame cows suffered significantly higher BHB concentrations very soon

Table 1. Haptoglobin, NEFA and beta-hydroxybutyrate (BHB) in dairy cows with inflammatory diseases

	Healthy	Inflammation	Claw Inflammation	Mastitis	Clinical Mastitis	P value
Number	30	202	21	42	11	
Hp, mg/mL	0.06 ± 0.04^a	0.21 ± 0.27^{bc}	0.35 ± 0.43^b	0.11 ± 0.11^{ac}	0.19 ± 0.23^{abc}	$P < 0.01$
NEFA, mmol/L	0.47 ± 0.34	0.45 ± 0.30	0.49 ± 0.27	0.41 ± 0.21	0.40 ± 0.18	NS
BHB, mmol/L	0.58 ± 0.46	0.66 ± 0.48	0.65 ± 0.24	0.64 ± 0.15	0.55 ± 0.11	NS

^{a, b, c} – values with the different superscripts differ at $P < 0.05$.

after calving, which appeared unrelated to fat mobilization before calving. Although feeding behaviour was not monitored in this study, it is possible that lameness in the early postpartum period may affect DMI at this crucial time and increase the risk for ketosis. In other study, it was demonstrated that cows with claw diseases had higher incidence of ketosis in comparison to healthy animals (Heuer *et al.*, 1999). A non-significant difference in NEFA and BHB levels in dairy cows with or without inflammation observed in our study indicates no direct link between inflammation and development of severe negative energy balance resulting in high ketone bodies, even if, claw inflammation has already been shown to affect feeding behaviour in other studies with decreased feeding time and decreased DMI reported (Gonzalez *et al.*, 2008). The possible use of acute phase proteins in cattle has been investigated in various inflammatory and non-inflammatory conditions, as well as in experimental infections and natural diseases which provide data for veterinarians and farmers regarding the possible use of APPs as biomarkers of diseases in the field. In all cows with mastitis elevated concentrations of haptoglobin, ceruloplasmin and α -1 antitrypsin were found in comparison to cows without mastitis (Conner *et al.*, 1986). Higher concentrations of haptoglobin in the serum and milk of cows with clinical mastitis were observed also in the following study (Nielsen *et al.*, 2004). In agreement with previous results (Tothova *et al.*, 2011; 2014) the dairy cows with claw inflammations demonstrated elevated levels of serum haptoglobin in the present study.

CONCLUSIONS

In conclusion, results of our observation show that the inflammatory processes in

dairy cows are associated with increase in the acute phase protein (haptoglobin) but not with lipomobilisation and hyperketonaemia.

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