

Metabolic status related to claw disorders

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The aim of this study was to evaluate the relationship between metabolic status and claw disorders. 122 Holstein cows from 2 farms in west Slovakia between years 2012 and 2016 were observed. Total 226 test-day records of milk yield of cows between 8 to 150 days in milk (DIM) were analysed. Maximum 2 test-day records before functional claw trimming were observed. The influence of *F/P* ratio to claw disorders (IDHE, DD, SU) was analysed with PROC GLM of SAS. The model included the fixed effect of breed, year of calving, calving season, number of lactation and the random effects of days in milk and *F/P* ratio. During the functional claw trimming was found that 27 cows were affected by IDHE, 9 cows by DD and 27 cows by SU. Observed cows in average produced 39.48 ± 9.53 kg of milk. The mean of *F/P* ratio was 1.17 ± 0.22 and the mean of days in milk was 78 ± 38.42 . The models described the occurrence of claw disorders from 13.20% in case of DD to 18.85% by IDHE. The prevalence of SU was described by model on 17.34%. The effect of *F/P* ratio increased significantly ($P > 0.05$) the occurrence of SU by 30.33%.

Keywords: Holstein, cow, test-day yield, fat/protein ratio, claw disorder

1 Introduction

Feet and leg diseases are a persistent, non-decreasing problem in modern intensive dairy production (Schöpke et al., 2013). Collard et al. (2000) reported that locomotion problems are unfavourably associated with measures of energy balance.

Duffield et al. (2009) reported that negative energy balance around calving caused the subclinical ketosis (SCK), which is a major dairy cow metabolic disorder.

Subacute ruminal acidosis (SARA) is a prevalent metabolic disorder of high-producing dairy herds (Gao and Oba, 2014). Nocek (1997) reported that the systemic impact of acidosis may have several physiological implications, including laminitis.

Subclinical laminitis as a consequence of subacute ruminal acidosis (SARA) has long been assumed to be a major cause of claw horn disruption lesions (Bicalho and Oikonomou, 2013).

Heuer et al. (1999) found that the first test day milk yield and the fat to protein ratio are more reliable indicators of disease, fertility and milk yield than is body condition score or loss of body condition score.

Metabolic stress may explain why most health problems occur at the beginning of the lactation; that is, between calving and peak yield. Following this, cows with good

persistence may have fewer reproductive and health problems than cows with the same total milk yield that are less persistent (Harder et al., 2006).

Buttcheriet et al. (2012) concluded that fat/protein ratio and body condition score are potential variables to describe how well cows can adapt to the challenge of early lactation.

Cook et al. (2004) reported that cow environment may be the final determinant of the degree of laminitis and lameness observed on dairy farm.

Early detection of the diseases is importance for reasons of animal welfare and the economics of the dairy operation (Schöpke et al., 2013). The aim of this study was to evaluate the relationship between metabolic status and claw disorders.

2 Material and methods

In total 122 Holstein cows from 2 dairy farms in west Slovakia were observed. Sample of cows was collected between years 2012 and 2016. In this study the test-day records of fat and protein yield of cows between 8 and 150 days in milk (DIM) and the results of evaluation of claw disorder occurrence were used. The data of test-day records were provided by the Breeding Services of Slovakia, s. e. Claw disorders as interdigital dermatitis and heel erosion (IDHE), digital dermatitis (DD) and sole

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Table 1 Summary statistics for milk yield, *F/P* ratio and days in milk

Variable	Mean	Std Dev	Minimum	Maximum	N
Milk (kg)	39.48	9.53	15.2	66.8	226
Fat (%)	3.59	0.68	2.1	5.78	226
Protein (%)	3.06	0.26	2.46	4.13	226
<i>F/P</i> ratio	1.17	0.22	0.61	1.97	226
Days in mik	78.00	38.42	8	150	226

ulcer (SU) were evaluate by 0 (absence) or 1 (presence). According to the methodology of Gantner (2015) the risk of metabolic diseases prevalence by the fat to protein ratio (*F/P* ratio) was evaluated. The values of *F/P* ratio were divided in to the 3 groups:

- K when $F/P \geq 1.5$ means ketosis risk,
- N when $F/P 1.0-1.5$ means normal conditions,
- A when $F/P < 1.0$ means acidosis risk.

The influence of *F/P* to claw disorders (IDHE, DD, SU) was analysed with PROC GLM of SAS (v 9.2, SAS Institute Inc., NC). The model included the fixed effect of breed, year of calving, calving season, lactation and the random effects of days in milk and *F/P* ratio. For statistical analyses calving season was grouped as winter (December to February), spring (March to May), summer (June to August) or autumn (September to November). Lactations were divided into the groups as first, second and third or higher.

3 Results and discussion

Into the study 122 Holstein cows from 2 farms in west Slovakia between years 2012 and 2016 were included. Some cows were observed more than once due to repeated evaluation of claw disorders occurrence on different lactation. Total 226 test-day records of fat and

protein yield of cows between 8 to 150 days in milk (DIM) were analysed. Maximum 2 test-day records before functional claw trimming were observed. During the functional claw trimming was found that 27 cows were affected by IDHE, 9 cows by DD and 27 cows by SU.

The model described the occurrence of IDHE on 18.85%. The effects of herd and lactation were high significant ($P < 0.01$). Year of calving has significant influence ($P < 0.05$) on occurrence of IDHE. *F/P* ratio increased non-significantly ($P > 0.05$) the occurrence of IDHE by 10.23%. The highest influence of *F/P* ratio was on first lactation and increased the occurrence by 32.44% ($P > 0.05$). According to the calving season *F/P* ratio had the highest influence in summer and increased the occurrence of IDHE by 47.3% ($P > 0.05$). In calving years 2011 and 2016 it was not possible to estimate the influence of *F/P* ratio on the occurrence of IDHE due to low number of observations. The highest influence was in year of calving 2012 with increase of the occurrence by 41.1% ($P < 0.05$).

The occurrence of DD was described by the model on 13.20%. Only the effect of calving season was high significant ($P < 0.01$). The effect of *F/P* ratio decreased the occurrence of DD by 7.32% and was non-significant

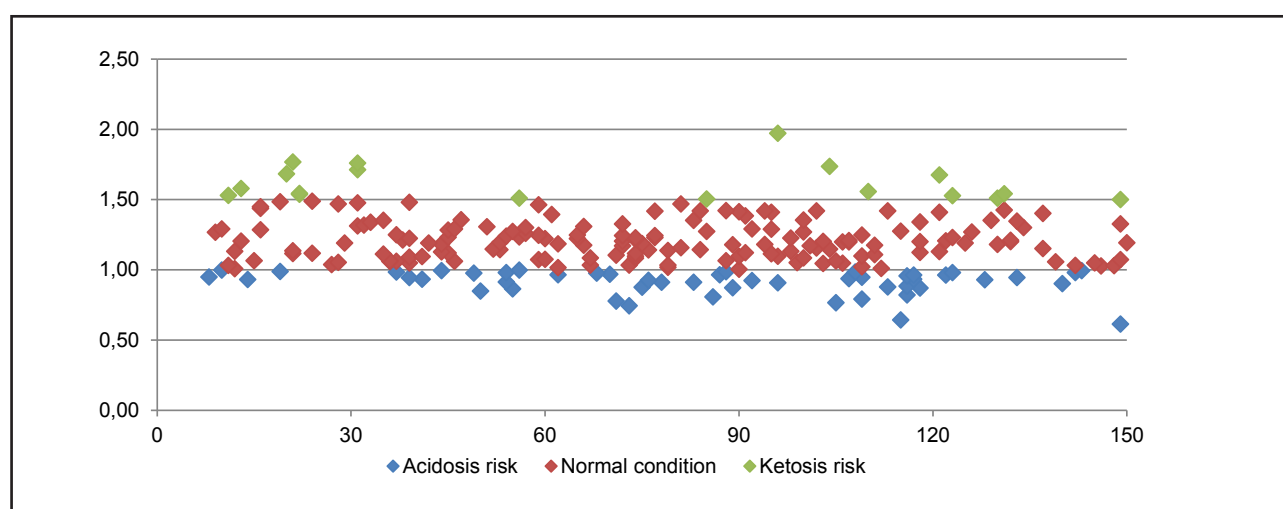


Figure 1 Metabolic status of observed cows from 8 to 150 days in milk

($P > 0.05$). The solutions of these results might be a low number of cows affected by DD (only 9 cows).

The model described the occurrence of SU on 17.34%. All the observed effects except the year of calving had significant influence ($P < 0.05$) to the occurrence of SU. The effects of herd and lactation were highly significant ($P < 0.01$). The effect of F/P ratio increased significantly ($P > 0.05$) the occurrence of SU by 30.33%. The influence of F/P ratio to the occurrence of DD on first and third or higher lactation increased the occurrence by 44.98% ($P < 0.01$) resp. 47% ($P < 0.05$). In years of calving 2011 and 2016 were low numbers of observation so it was not possible to make a relevant result. The highest influence of F/P ratio was in 2015 and increased the occurrence of DD by 48.70% ($P > 0.05$).

Results show that F/P ratio has influence to the occurrence of IDHE and SU. One of possible solutions might be that changes of metabolic status induce damage the stability of ruminal epithelium, what allows the absorption of histamine and endotoxins to blood. These compounds negatively influence the normal circulation and cause inflammation within the claw. This leads to the laminitis (Vermunt, 1992).

Schöpke et al. (2013) found that fat percentage and F/P ratio in the first month before trimming were significantly decreased for cows with a positive laminitis status and reported that this finding points to association of metabolic disorders with higher risk for claw diseases. Heuer et al. (1999) reported that cows with F/P of > 1.5 had higher risk for ketosis and lameness. This concluded Buttchereit et al. (2012), who found that genetic correlations among F/P ratio and claw and leg diseases were 0.14.

Zink et al. (2014) reported that the heritability of F/P is 0.42 and Buttchereit et al. (2012) reported the heritability of F/P is 0.30.

A low F/P ratio might serve as an indicator for metabolic stability and health of claws and legs (Buttchereit et al., 2012).

Zink et al. (2014) and Buttchereit et al. (2012) reported the possibility to use F/P ratio in selection against metabolic and other disorders.

4 Conclusions

In this study the relationships between F/P ratio as indicator of metabolic status and claw disorders were observed. Non-normal values of F/P ratio increased the occurrence of claw disorders as IDHE and SU. The deviations of F/P ratio from normal conditions can be used as cheap and non-invasive indicator of metabolic disorders and claw disorders in farm condition.

Claw disorder prevention is necessary for successful management of dairy farming systems and can markedly decrease the economical input of farmers. Further research with higher number of animals is important for increase of results significance.

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