Acta fytotechn zootechn, 24, 2021(Monothematic Issue: Problems and Risks in Animal Production): 102–104
http://www.acta.fapz.uniag.sk

Original Paper

The relationship between claw diseases of dairy cows and the protein and urea content of the milk

Pavel Slovák*, Vladimír Hisira, Paulína Marčeková, Pavol Mudroň
University of Veterinary Medicine and Pharmacy in Košice, Clinic of ruminants, Slovakia

Article Details: Received: 2020-10-14 | Accepted: 2020-11-27 | Available online: 2021-01-31

https://doi.org/10.15414/afz.2021.24.mi-prap.102-104

The aim of this study was to determine the effects of the claw diseases of dairy cows on the protein and urea content in milk. The study was conducted on 198 dairy cows, half of which was lame. Animals were divided into three groups according to their current phase of lactation. The cause of lameness was diagnosed in the claw crush. Milk samples were taken from all animals and the protein and urea content were determined. The content of protein and urea in milk of the lame cows in the first phase of lactation was reduced by 9.55% and 29.9%, respectively. Lame cows in the second phase of lactation had milk and urea content reduced by 6.94% and 18.9%, respectively. The cows in the third phase of lactation had content of milk protein and urea decreased by 10.3% and 18%, respectively. These results point to the fact that painful claw diseases affect the protein and urea content of milk.

Keywords: claw diseases, dairy cattle, milk, protein, urea

1 Introduction

The quality of the milk depends mainly on the proper nutrition, therefore the lack of knowledge about the relationship between nutrition and milk production leads to low milk yield and lower milk quality (Tyasi et al., 2015). Milk of the dairy cattle consists of water, protein, fat, lactose, minerals and other components such as vitamins and white blood cells. The percentage of individual milk components differs from breed to breed, but in general we can say that milk is composed of water 87.7%, protein 3.3%, fat 3.4%, lactose 4.9% and mineral salts 0.7% (Haug et al., 2007). Concentration and production of milk protein is affected by genetic potential of each dairy cow and quality of the diet. Daily intake and relative proportion of the protein degradable in rumen (PDR) and protein non-degradable in rumen (PNDR) is conditioned by the choice of feed and the total dry matter intake of the feed ration. Content and synthesis of milk protein is secured with the supply of metabolized amino acids to the mammary gland. This can be achieved with stimulation of the growth of rumen microflora (affected with the dry matter intake) or with addition of bypass protein. Feed has the main influence on the milk protein content. On the level of ruminal transformation of the protein, the main cause of the reduced growth of rumen microflora is disruption of the proportion of the feed saccharides (Vajda et al., 2016). Individual cow milk urea analysis provides current information about nutritional status of dairy cattle (Kohn et al., 2002). The mean milk urea concentration should be within a specific range. Values out of this range reflect nutritional problems (Jonker et al., 1998). The amount of urea in milk reflects the balance of protein intake of the feed ration and the intake of non-structural carbohydrates important for the optimal growth of the ruminal microflora. Low concentrations of urea in milk are the result of unbalanced intake of nitrogenous substances and low proportion of NH_3 in the rumen required for the growth of microflora (Vajda et al., 2016). Therefore, milk urea concentration and protein content in milk can be considered good indicators of the disruption of the feed intake of dairy cattle. Lameness is significant worldwide problem in dairy herds. Lameness has impact on welfare, milk yield and economy of the herd (Bradley et al., 2012). Most of the lameness is manifested on hind limbs and is caused by the claw lesions (~90%). The fact that animals change their gait indicates pain. Lameness leads to several behavioral changes, like

***Corresponding Author:** Pavel Slovák, University of Veterinary Medicine and Pharmacy in Košice, Clinic of Ruminants, Komenského 73, 041 81, Košice, Slovakia; e-mail: pavel.slovak@student.uvlf.sk

decrease of the animal´s activity (O´Callaghan et al.,2003), shorter time spent eating, which leads to the decrease of dry matter intake. Animals spend more time lying and they move around less (Bach et al., 2007). Lameness is usually a result of a long-term pain and more time is passed from the manifestation of the lameness to the treatment (Mudroň, 2015). Cows with claw disorders have reduced milk production in comparison with unaffected cows for several weeks, or months, before and after diagnosis (Green et al., 2010).

2 Material and methods

198 dairy cows were included in this study. 99 were lame and 99 represented control group of clinically healthy animals. Animals were divided into 3 groups according to their actual phase of lactation: 1st phase of lactation – up to 80 days after parturition (72 cows), 2nd phase of lactation – 81–160 days after parturition (70 cows), 3rd phase of lactation – 161–305 days after parturition (56 cows). Half of the animals in each group was lame and the other half represented control group of clinically healthy animals. Lame cows were examined in the claw crush to diagnose a cause of the lameness. All animals were clinically examined for the exclusion of diseases of other organ systems. Control group of animals did not show any clinical signs of any disease. All animals in each group were fed the same feed accordingly to their phase of lactation. Milk samples were taken from all animals during milking, from which the content of protein and urea was subsequently determined. The differences in the measured parameters between the lame cows and control group were evaluated by Student's *t*-test.

3 Results and discussion

In the group of animals in the first phase of lactation, the average amount of protein in non-lame animals was 3.35% and in lame animals 3.03%, which represents a difference of 9.55% (P <0.01) (Table 1). In animals in the second phase of lactation, the protein concentration in lame animals was 6.94% lower than in healthy animals (P <0.01) (Table 2). Animals in the third phase of lactation had the amount of protein lower of 10.3% (P <0.01) (Table 3). A lower amount of urea in the milk of dairy cows in all phases of lactation was also observed, by 29.9% (P <0.01) in the first phase of lactation, 18.8% (P <0.01) in the second phase of lactation, and 18% (P <0.01) in the third phase of lactation (Table 1, 2 and 3).

Table 1 1st phase of the lactation

	Protein (%)	Urea (mg/100 ml)
Healthy cows (36)	3.35 (±0.28)	26.8 (±5.57)
Lame cows (36)	3.03 (±0.23)	18.78 (±8.29)
t-test	P <0.01	P <0.01

Table 2 2nd phase of the lactation

	Protein (%)	Urea (mg/100ml)
Healthy cows (35)	3.46 (±0.27)	28.93 (±6.36)
Lame cows (35)	3.22 (±0.28)	23.47 (±8.07)
t-test	P <0.01	P <0.01

Table 3 3rd phase of the lactation

	Protein (%)	Urea (mg/100ml)
Healthy cows (28)	3.69 (±0.31)	29.32 (±6.59)
Lame cows (28)	3.31 (±0.23)	24.04 (±8.29)
t-test	P <0.01	P <0.01

O'Callaghan et al. (2003) in their study on 345 lactating dairy cows found a reduced daily activity of lame dairy cows caused by hoof pain. Bach et al. (2007) observed a reduction in feed intake time with increasing degree of lameness. Lame animals, in the work of Grimm et al. (2019), fed less frequently and for a shorter time with reduced dry matter intake during one feeding. The shorter feeding time causes a reduced dry matter intake, which results in a reduced saturation of the milk protein precursors. Factors causing changes in milk composition, include the stage of lactation of the cows, breed, plane of nutrition, seasonal factors and pathological changes associated with mastitis (Auldist et al., 1995, 1998). In our study we can exclude all of these factors, because all animals in each of three groups were in the same stage of lactation, they were all same breed, they were fed same feed (according to their actual stage of lactation), all animals were examined in same season and suffered no diseases, except the claw lesions in lame cows. The content of milk protein during mastitis is usually increased, because of the influx of blood-borne protein (serum albumin, immunoglobulins, minor serum proteins) into the milk, associated with caseins decrease (Auldist et al., 1995, Holdaway 1990, Shuster et al., 1991). The amount of total protein in milk increases as the lactation stage advances (Auldist et al., 1998). The same pattern was observed in out work in both healthy and lame cows (with lower values in lame cows). Milk urea concentration is mostly determined by dietary protein and energy balance and its values significantly increase during late lactation stages (Dhali et al., 2006). In our study milk urea concentration was increasing during the advance of the lactation stages, with significantly lower values in lame cows.

4 Conclusions

In our work, we observed lower concentrations of milk protein and urea in lame dairy cows. Considering how milk protein and urea are dependent on the quality and quantity of the protein and energy acquired from the consumed feed, and the fact that the only difference between cows with higher and lower concentration of milk protein and urea (in each group) was a claw pathology, we can deduce, that claw diseases can affect feeding habits of dairy cattle, which leads to decline in the concentration of milk protein and urea.

References

Auldist, M. J. et al. (1995). Changes in the composition of milk from healthy and mastitic dairy cows during the lactation cycle. *Australian Journal of Experimental Agriculture*, 35, 427-436. https://doi.org/10.1071/EA9950427

Auldist, M. J. et al. (1998) Seasonal and lactational influences on bovine milk composition in New Zealand. *Journal of Dairy Research*, 65, 401–411. DOI: https://doi.org/10.1017/s0022029998002970

Auldist, M. J. and Hubble, I. B. (1998). Effects of mastitis on raw milk and dairy products. *The Australian Journal of Dairy Technology*, 1998, 53, 28–36. AGR: IND21984460.

Bach, A. et al. (2007). Associations between lameness and production, feeding and milking attendance of Holstein cows milked with an automatic milking system. *Journal of Dairy Research*, 74(1), 40–46. DOI: https://doi.org/10.1017/S0022029906002184

Bradley, A. et al. (2012). Control of mastitis and enhancement of milk quality. In Green M. et al. (eds). *Dairy Herd Health*. Croydon:CABI, 117–168. DOI: https://doi.org/10.1079/9781845939977.0117

Dhali, A et al. (2006). Monitoring feeding adequacy in dairy cows using milk urea and milk protein contents under farm condition. *Asian-Australasian Journal of Animal Science*s, 19, 1742–1748. DOI: https://doi.org/10.5713/ajas.2006.1742

Green, L. E. et al. (2010). Associations between lesion-specific lameness and the milk yield of 1635 dairy cows from seven herds in the Xth region of Chile and implications for the management of dairy cows worldwide. *Animal Welfare*, 19, 419–427. ISSN 0962-7286.

Grimm, K. et al. (2019). New insights into the association between lameness, behavior, and performance in Simmental cows. *Journal of Dairy Science*, 102(3), 2453–2468. DOI: https://doi.org/10.3168/jds.2018-15035

Haug, A. et al. (2007). Bovine milk in human nutrition – a review. *Lipids in Health and Disease*, 6(1), 25. DOI: 10.1186/1476-511X-6-25

Holdaway, R. J. (1990). *A comparison of methods for the diagnosis of bovine subclinical mastitis within New Zealand dairy herds.* Thesis (Ph. D.) Massey University. http://hdl.handle.net/10179/3162

Jonker, J. S. et al. (1998). Using milk urea nitrogen to predict nitrogen excretion and utilization efficiency in lactating dairy cows. *Journal of Dairy Science*, 81, 2681–2692. https://doi.org/10.3168/jds.S0022-0302(98)75825-4

Kohn, R. A. et al. (2002). Evaluation of models to estimate urinary nitrogen and expected milk urea nitrogen. *Journal fo Dairy Science*, 85, 227–233. DOI: https://doi.org/10.3168/jds.S0022-0302(02)74071-X

Mudroň, P. (2015). Claw diseases and dairy production. *Slovak Veterinary Journal*, 40(1–2), 77–80.

O´Callaghan, K.A. et al. (2003). Subjective and objective assessment of pain and discomfort due to lameness in dairy cattle. *Animal Welfare*, 12(4), 605–610.

Shuster, D. E. et al. (1991). Suppression of Milk Production During Endotoxin-Induced Mastitis. *Journal of Dairy Science*, 74 (11), 3763–3774. DOI: https://doi.org/10.3168/jds.S0022-0302(91)78568-8

Tyasi, T. L. et al. (2015). Assessing the effect of nutrition on milk composition of dairy cows: A review. *International Journal of Current Science*, 17, 2250–1770. ISSN 2250-1770.

Vajda, V. and Maskaľová, I. (2016). *Evaluation of feed quality and creation of productive animal health*. Košice: UVLF. ISBN 978-80-8077-526-1.

