

Journal of the Hellenic Veterinary Medical Society

Vol 74, No 2 (2023)



Association between white line disease and sole ulcers with certain milk components in Simmental cows

M Ninković, J Žutić, S Arsić, N Zdravković, Z Zurovac Sapundžić, D Glišić, J Bojkovski, ND Giadinis, N Panousis

doi: [10.12681/jhvms.30424](https://doi.org/10.12681/jhvms.30424)

Copyright © 2023, M Ninković, J Žutić, S Arsić, N Zdravković, Z Zurovac Sapundžić, D Glišić, J Bojkovski, ND Giadinis, N Panousis



This work is licensed under a [Creative Commons Attribution-NonCommercial 4.0](https://creativecommons.org/licenses/by-nc/4.0/).

To cite this article:

Ninković, M., Žutić, J., Arsić, S., Zdravković, N., Zurovac Sapundžić, Z., Glišić, D., Bojkovski, J., Giadinis, N., & Panousis, N. (2023). Association between white line disease and sole ulcers with certain milk components in Simmental cows. *Journal of the Hellenic Veterinary Medical Society*, 74(2), 5843–5848. <https://doi.org/10.12681/jhvms.30424> (Original work published July 6, 2023)

Association between white line disease and sole ulcers with certain milk components in Simmental cows

M. Ninković¹, J. Žutić¹, S. Arsić², N. Zdravković¹, Z. Zurovac Sapundžić¹, D. Glišić¹,
J. Bojkovski², N.D. Giadinis³, N. Panousis³

¹Department for Healthcare, Serbian Institute of Veterinary Science, Belgrade, Serbia

²Department of Ruminants and Swine diseases, University of Belgrade, Faculty of Veterinary Medicine, University of Belgrade, Belgrade, Serbia

³Clinic for Large Animals, Faculty of Veterinary Medicine, Aristotelis, University of Thessaloniki, Thessaloniki, Greece

ABSTRACT: Lameness is one of the high influence production illnesses in intensive dairy production farming, it reduces milk yield and can also negatively affect the quality of milk. Many factors can affect the production of milk components. Subsequently, breed, nutrition, milk yield, various metabolic disorders, and lameness can have an effect on the synthesis of milk components. White line disease and sole ulcers are widespread hoof diseases of cows in tied-holding systems. Albeit the main cause of lameness, associations between claw disorders of cows and variation of milk components haven't been widely studied in Simmental cows. The objective of our study was to investigate the effect of white line disease and sole ulcers on the percentage of milk components of Simmental dairy cows kept in the small households in Mačva locality, Serbia. For milk analysis were enrolled 36 cows in the study: affected by white line disease (n=12), sole ulcers (n=12), and healthy cows (n=12) in the early stage of lactation. Milk components (milk protein, fat, and non-fat dry matter) were analyzed using Lactoscan S. Significance of differences in milk component characteristics between white line disease, sole ulcers, and healthy groups were tested using a Kruskal-Wallis multiple comparisons test. The percentage of milk fat of cows affected by white line disease and cows affected by sole ulcers were significantly lower than those of non-lame cows: 3.80%, 3.69%, and 4.18%, respectively (both $p < 0.05$). However, differences in the contents of milk protein and the contents of non-fat dry matter of cows affected by white line disease, sole ulcers, and in healthy cows were not significantly different ($p > 0.05$). Our results indicate that hoof diseases of cows namely white line disease and sole ulcers, are associated with reduced significantly milk fat production in lame Simmental cows.

Keywords: claw disease; lameness; milk fat; non-fat dry matter; Simmental cows.

Corresponding Author:
Milan Ninković, Department for Healthcare, Serbian Institute of Veterinary Science, Belgrade, Serbia.
E-mail address: milan.ninkovic1992@gmail.com

Date of initial submission: 23-05-2022
Date of acceptance: 17-07-2022

INTRODUCTION

Lameness causes reduced milk production, and reproductive disorders and has consequent economic losses (Warnick et al., 2001). Therefore it draws great attention to the in the dairy industry (Barker et al., 2010). Milk yield is correlated with lameness (Amory et al., 2008; Olechnowicz et al., 2010); it is decreased from 0.78 kg up to 5.5 kg per day, depending on the level of lameness and the stage of lactation (Onyiro et al., 2008). In Serbia, the frequency of white line disease and sole ulcers of Simmental cows are 18.5% and 15.7%, respectively (Ninković et al., 2021). The greatest reduction in milk yield of lame cows is caused by sole ulcers, white line disease, and interdigital phlegmon (Warnick et al., 2001). Metabolic changes in the digestive tract are key factors, that further trigger the occurrence of laminitis as the main inducer of white line disease and sole ulcers (Mulling, 2002; Holzhauser et al., 2008). Potential factors for the development of white line disease and sole ulcers include among others: stage of lactation, high milk yield, age, body condition, parity, and diet (Bicalho et al., 2009; Pavlenko et al., 2011). Nutritional diversities from optimal diet lead to ruminal disorders. The suboptimal ratio between roughage and concentrates increases the risk of developing subacute ruminal acidosis and rumen acidosis, resulting in an increased risk of lameness (Burger et al., 2017; Kitkas et al., 2019) and reduced milk fat content (Danscher et al., 2015). A linear relationship was found between the decrease in milk yield and the degree of lameness in cows in the early lactation phase (Hernandez et al., 2005).

Components of milk may be potential biomarkers for predicting lameness before the appearance of clinical signs of lameness (Antanaitis et al., 2021). Locomotion score is a useful tool for the determination of early lameness in cows (Sprecher et al., 1996). Literature on the effect of hoof diseases in cows and the impact on the components of milk is limited. This study aims to evaluate the association of sole ulcers and white line disease with the concentrations of certain milk components, during the first 100 days of lactation, in Simmental dairy cows.

MATERIAL AND METHODS

Study population

The study was performed during the winter and spring of 2021. A total of 36 Simmental dairy cows were enrolled, from two farms located in the municipality of Vladimirci, Mačva district, Western Serbia.

Both were tie-stall farms, having a concrete stall base with deep litter straw beds. Cows' selection was based on a known history of lameness, to represent those affected by either white line disease ($n=12$) or sole ulcers ($n=12$). The remaining 12 cows were clinically healthy and served as a control group. All cows in the study were between second and fifth lactation, in the early stage of lactation (<100 days in milk), and had an average milk yield from 5800 to 6400 kg. The average daily milk yield was 24 L. To be enrolled, all 36 cows were tested and found negative for the California mastitis test on the day of milk sampling. They were fed corn silage, alfalfa hay, and a concentrated mixture containing 16% protein and a vitamin-mineral supplement of 2%. The milk samples were collected on the days of the scheduled claw trimming, before trimming, and during the morning milking.

Locomotion score

The level of lameness of the enrolled cows was measured by performing a locomotion score. The cows were observed standing as they walk, using a five-point scale (1-non lame, 2-mildly lame, 3-moderately lame, 4-lame, and 5-severely lame) (Sprecher et al., 1997). Locomotion scores were collected before claw trimming.

Milk sample analysis

Milk samples were collected after proper disinfection of the teat surface with 70% ethanol, aseptically, in separate sterile containers. Immediately after collection, they were placed in the icebox and carried to the laboratory where they were kept at 4 °C until analysis. Concentrations of milk fat, protein and non-fat dry matter content were measured using a Lactoscan S Advanced (Milkotronic Ltd, Bulgaria).

Statistical analysis

Descriptive statistics and significance of differences in milk component characteristics between white line disease, sole ulcers, and healthy groups were tested. The collected data are ordinal values obtained by ranking the illness degree, also the Shapiro-Wilk test results revealed normal distribution scores in WLD scores, not on SU scores, therefore a nonparametric test set for inferential data analysis was chosen a Kruskal-Wallis multiple comparisons test, followed by Dunn's post hoc individual analysis in GraphPad® Prism®6 software. Probabilities of $p \leq 0.05$ were considered significant.

RESULTS

Contents of milk fat, protein, and non-fat dry matter during the first 100 dayspostpartum in healthy, white line disease and sole ulcersgroups ofSimmental cows are presented in Table 1.

The mean milk fatcontent in the group of cows with white line disease was3.80%, while in cows with sole ulcers was3.69%. Both groups had significantly lower contentsof milk fat compared with the healthy cows (Fig. 1), the difference among milk fat percentages was higher between groups of healthy cows and sole ulcers (p<0.0001) than between of healthy cows and white line disease group (p=0.001). There was not any significant difference among groups of lame cows (p=0.0665). The mean (±SD)lameness score of cows affected by white line disease was2.17±0.72(median 2) and by sole ulcers 2.83±0.94 (median 3). The distribution of lameness score in cows ofwhite line disease and sole ulcers groups is shown in Table 2.

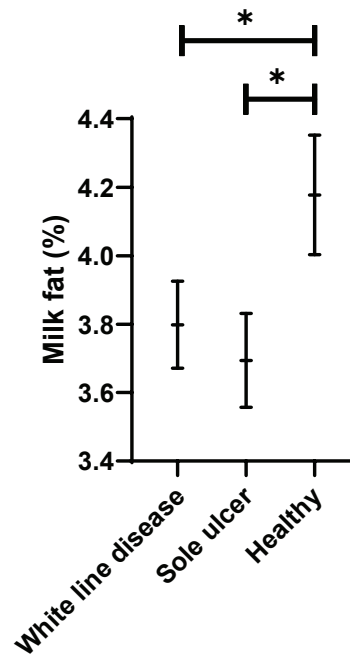


Figure 1: Statistical differences in milk fat (%) between groups of cows affected bywhite line disease, sole ulcer and healthy cows. Significance levels p≤0.05 (*)

Table 1: Descriptive statistics of milk components (%) of the cows of the 3 groups of the study

Parameter	Protein content			Non-fat dry matter		
	WLD	SU	Healthy	WLD	SU	Healthy
Group size	12	12	12	12	12	12
Min	3.32	3.30	3.34	9.03	9.09	9.12
Median	3.46	3.45	3.45	9.16	9.19	9.21
Max	3.57	3.55	3.56	9.26	9.25	9.29
Range	0.25	0.25	0.22	0.23	0.16	0.17
Mean	3.46	3.44	3.46	9.15	9.18	9.21
SD	0.073	0.068	0.069	0.068	0.048	0.049
Variation coef.	2.12%	1.99%	1.99%	0.741%	0.524%	0.536%
SE	0.021	0.020	0.020	0.020	0.014	0.014

Abbreviations: WLD - White line disease, SU-Sole ulcer SD-Standard deviation SE- Standard error
a, b - statistically significant difference between groups marked with the same letter

Table 2. Distribution of locomotion score in cows with lameness in sole ulcer (SU) and white line disease (WLD) groups

	Score distribution					Central tendency and variability						
	1	2	3	4	5	N	Min	Max	Range	Mean	Std. Deviation	Coefficient of variation (%)
SU	8%	25%	42%	25%	0%	12	1	4	3	2.833	0.937	33.09
WLD	17%	50%	33%	0%	0%	12	1	3	2	2.167	0.718	33.13

Abbreviations: WLD - White line disease, SU-Sole ulcer, Std.- Standard,N-observations per group

DISCUSSION

It's a widely recognized that lameness is associated with an overall decrease in milk yield (Hernandez et al., 2005; Archer et al., 2010); particularly cows affected with sole ulcers showed a significant reduction in milk yield in comparison with healthy cows (Charfeddine et al., 2017). Five main factors could influence the content of milk components: breed, nutrition, stage of lactation, milk yield, and subclinical ruminal acidosis (Alsaftli, 2020). Higher ratios of silage in the meal lead to decreased rumen pH, consequently leading, again, to subacute rumen acidosis (Amory et al., 2008) and consequently to reduced milk fat percentage in milk dairy cows (Malekhhahi et al., 2016). Negative energy balance during the first 50 days of lactation contributes to the development of lameness (Alawneh et al., 2014). The milk composition analysis in the present study showed a significant difference in milk fat percentage between cows having either white line disease or sole ulcers compared with non-lame cows. Our notice is supported in the study by Antanaitis et al., (2021) contents of milk fat of lame cows decrease 3rd day before a diagnosis of lameness. In agreement with our result, in one study Zhang et al., (2019) found that cows with lameness had lower content of milk fat than non-lame cows, while no significant differences in milk fat between lame and non-lame cows were detected in another one (Olechnowicz and Jaskowski, 2012). The presence of subacute ruminal acidosis in cows leads to a significant decrease in milk fat contents (Kitkas et al., 2019). However, Singh et al., (2018) reported non-significant variation in the contents of milk components between lame and non-lame Indian cross-bred cows. Our findings further agree with the results of studies by (Pavlenko et al., 2011) who found no significant differences between cows with white line disease and/or sole ulcers in comparison with healthy cows in the protein content of milk, but there are data finding milk protein to be significantly lower in lame cows (Olechnowicz and Jaskowski, 2012). Our results showed no significant differences in contents of non-fat dry matter in milk

between cows affected with white line disease and/or sole ulcers and non-lame cows. However, a study by Petrović et al., (2006) reported an average content of non-fat dry matter in raw cows' milk of only 8.56%, though the difference from non-fat dry matters obtained in our study may be influenced by breed. The authors consider that diet of silage increased contents may start the chain of events resulting in sole diseases. In our study, lameness scores were associated with lower milk quality and decreased contents of milk fat in lame cows compared non-lame cows, therefore a locomotion score is a useful tool for early identification of lameness and minimizing losses in milk production and milk components.

CONCLUSIONS

There were significantly lower milk fat contents in cows affected by white line disease and sole ulcer than in healthy cows. Contents of protein and non-fat dry matter in cows affected by white line disease or by sole ulcers were non-significantly different from those of healthy cows. Determining the lameness score is crucial for preventing losses in milk production and thus production milk of components. The results of this case warrant further investigation on a larger group of cows including research that should be done on a larger number of cows to take into account the interaction between cows that are clinically lame and the influence of diet on the content of milk components.

ACKNOWLEDGMENT

The study was funded by the Serbian Ministry of Education, Science and Technological Development (Contract No 451- 03- 68/2022- 14/200030). The authors thank the owners of the farms for their practical support. They also thank dvm Duško Stojićević for performing milk analyses.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

REFERENCES

1. Alawneh JI, Stevenson MA, Williamson NB, Lopez-Villalobos N, Otley T (2014) The effects of liveweight loss and milk production on the risk of lameness in a seasonally calving, pasture fed dairy herd in New Zealand. *Preventive of Veterinary Medicine*. 113(1), 72-79
- Amory J.R., Barker Z.E., Wright J.L., Mason S.A., Blowey R.W., Green, LW (2008) Associations between sole ulcer, white line disease and digital dermatitis and the milk yield of 1824 dairy cows on 30 dairy cow farms in England and Wales from February 2003-November 2004. *Preventive of Veterinary Medicine*. 83 (3-4): 381-391
- Antanaitis R, Juozaitienė V, Urbonavičius G, Malašauskienė D, Televičius M, Urbutis M, Džermeikaitė K, Baumgartner W (2021) Identification of Risk Factors for Lameness Detection with Help of Biosensors. *Agriculture*. 11(7):610.
- Alsaftli Z (2020) The Obstacles to Using Milk Composition as Management Tool in Dairy Cattle Farms. *Journal of Advance Dairy Research*. 8:233.
- Archer SC, Green MJ, Huxley JN (2010) Association between milk yield and serial locomotion score assessments in UK dairy cows. *Journal of Dairy Science*. 93(9):4045-53.
- Barker ZĚ, Leach KA, Whay HR, Bell NJ, Main DC (2010) Assessment of lameness prevalence and associated risk factors in dairy herds in England and Wales. *Journal of Dairy Science*. 93(3):932-41.
7. Bicalho RC, Machado VS, Caixeta LS (2009) Lameness in dairy cattle: A debilitating disease or a disease of debilitated cattle? A cross-sectional study of lameness prevalence and thickness of the digital cushion. *Journal of Dairy Science*. 92 (7): 3175-3184
- Burger M (2017) Nutritional factors affecting the occurrence of laminitis in dairy cows: A review: *Elsenburg journal. Agriprobe*. 14, 58-64
- Charfeddine N, Pérez-Cabal MA (2017) Effect of claw disorders on milk production, fertility, and longevity, and their economic impact in Spanish Holstein cows. *Journal of Dairy Science*. 100(1):653-665.
- Danschler AM, Li S, Andersen PH, Khafipour E, Kristensen N, Plaizier J (2015) Indicators of induced subacute ruminal acidosis (SARA) in Danish Holstein cows. *Acta Veterinaria Scandinavica*. 57, 39
- Hernandez JA, Garbarino EJ, Shearer JK, Risco CA, Thatcher WW (2005) Comparison of milk yield in dairy cows with different degrees of lameness. *Journal of the American Veterinary Medicine Association*. 227(8):1292-6.
- Holzhauser M., Hardenberg C., Bartels C.J. (2008). Herd and cow-level prevalence of sole ulcers in The Netherlands and associated-risk factors. *Preventive Veterinary Medicine*. 85(1-2): 125-135
- Kitkas C, Valergakis G E, Kritsepi-konstantinou M, Gelasakis A I, Arsenos G, Kalaitzakis E, & Panousis N (2019) Effects of ruminal pH and subacute ruminal acidosis on milk yield and composition of Holstein cows in different stages of lactation. *Journal of the Hellenic Veterinary Medical Society*, 70(2), 1551-1560.
- Malekhhahi M, Tahmasbi AM, Naserian AA, Danesh-Mesgaran M, Kleen JL, Al Zahal O, Ghaffari MH (2016) Effects of supplementation of active dried yeast and malate during sub-acute ruminal acidosis on rumen fermentation, microbial population, selected blood metabolites, and milk production in dairy cows. *Animal Feed Science Technology*. 213, 29-43.
- Mulling C (2002) Theories on the pathogenesis of white line disease: an anatomical perspective. In: *Proceedings of the 12th International Symposium on Lameness in Ruminants*, Orlando, FL, USA. pp. 90-98
- Ninković M, Arsić S, Žutić J, Zdravković N, Glišić D, Zurovac Sapundžić Z, Bojkovski J (2021) Frequency of White line disease and Sole ulcers and impact of hoof trimming in the examined herds of Simmental cows. *Large Animal Review*. 27 (6), 329-332.
- Olechnowicz J, Jaśkowski JM (2010) Risk factors influencing lameness and key areas in reduction of lameness in dairy cows. *Medicine Veterinaria*. 66. 507-511
- Olechnowicz J, Jaskowski MJ (2012) Relationship between clinical lameness and somatic cell counts, and fat and protein contents in the milk of dairy cows. *Medicine Veterinaria*. 2012, 68,12.
- Onyiro OM, Offer J, Brotherton S (2008) Risk factors and milk yield losses associated with lameness in Holstein-Friesian dairy cattle. *Animal*. 2 (8):1230-1237.
20. Pavlenko A, Bergsten C, Ekesho I, Kaart T, Aland A, Lidfors L (2011) Influence of digital dermatitis and sole ulcer on dairy cow behaviour

- and milk production. *Animal*, 5, 1259-1269.
- Petrović MD, Petrović MM, Nenadović G, Kurčubić V, Marinkov G (2006) Chemical-microbiological quality parameters of raw cow milk. *Biotechnology in Animal Husbandry*. 22, (5-6), 109-119
- Singh A, Singh S, Gupta D K, Bansal B K 2018: Relationship of lameness to body condition score, udder health and milk quality in crossbred dairy cattle. *Veterinarski Arhiv* 88: 179-190.
- Sprecher DJ, Hostetler DE, Kaneene JB (1997) A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. *Theriogenology*. 15;47(6):1179-87.
- Warnick L.D., Janssen D., Guard C.L., Gröhn Y.T. (2001). The effects of lameness on milk production in dairy cows. *Journal of Dairy Science*. 84:1988-1997.
- Zhang G, Hailemariam D, Dervishi E, Deng Q, Goldansaz SA, Dunn SM, Ametaj BN (2015) Alterations of Innate Immunity Reactants in Transition Dairy Cows before Clinical Signs of Lameness. *Animals*. 5(3):717-747