Animal welfare, etológia és tartástechnológia

Animal welfare, ethology and housing systems

Volume 16 Issue 1

Gödöllő
2020

THE OCCURRENCE OF MASTITIS AND ITS IMPACT ON SELECTED MILK AND FERTILITY PARAMETERS OF DAIRY COWS

Zigo František[1], Vasiľ Milan[1], Ondrašovičová Silvia[2], Zigová Martina[3], Kudělková Lenka[4]

[1]Department of Animal Husbandry, University of Veterinary Medicine and Pharmacy, Komenskeho 73, 041 81 Kosice, Slovak Republic, e-mail: Frantisek.Zigo@uvlf.sk
[2]Department of Anatomy, Histology and Physiology, University of Veterinary Medicine and Pharmacy, Komenskeho 73, 041 81 Kosice, Slovak Republic
[3]Department of Pharmacology, University of Pavol Jozef Šafárik in Košice, Faculty of Medicine, Trieda SNP 1, 040 11 Košice, Slovakia
[4]Department of Animal Husbandry and Animal Hygiene, University of Veterinary and Pharmaceutical Sciences Brno, Palackého tř. 1946/1, 612 42 Brno, Czech Republic
frantisek.zigo@uvlf.sk

Received – Érkezett: .17. 11. 2019.
Accepted – Elfogadva: 21. 04. 2020.

Abstract

Besides reproduction management, one of the important roles of farmers is to control the incidence of diseases during the lactation in dairy herds, especially mastitis. The aim of the study was to evaluate the occurrence of mastitis and its impact on production and fertility indicators in dairy cows' herd. In herd of 180 dairy cows on the basis of the data provided from milk recording service, 127 cows of Slovak Spotted cattle breed and their crosses with red holstein were included in to the study between 1-2 months after calving. The examination of the health status of mammary gland was consisted from clinical exanimation of udder, assessment of California mastitis test supplemented by the collection of mixed milk samples from each cow and laboratory examination of bacterial pathogens causing mastitis. In addition to the mammary investigation, quantitative and qualitative milk indicators as milk yield, somatic cell count (SCC), percentage of milk fat and protein complemented with fertitlity parameters service period and calving interval were analyzed in the selected dairy cows. Latent (23.6%), subclinical (13.3%) and clinical (4.6%) forms of mastitis were most common in the monitored herd. The most frequently isolated pathogens were coagulase negative staphylococci (54.1%), *S. aureus* (16.9%), *Streptococcus* spp. (15.0%), *A. viridans* (7.5%) and other bacteria (6.4%) from infected milk samples. A reduced milk yield for standardized lactation in cows with clinical and subclinical mastitis was observed, and also was noted an increase SCC in the same groups compared to healthy cows. Among milk qualitative indicators, elevated protein levels in dairy cows with clinical and subclinical form of mastitis have been reported. Decreased milk fat was only observed in dairy cows with clinical mastitis. Comparing the results obtained from fertility indicators an increased and unsatisfactory service period and calving interval in the group of dairy cows with clinical mastitis were recorded. In healthy cows as well as in groups of cows with latent and subclinical mastitis, all reproductive indicators were at optimal levels.
Keywords: cows; lactation; mastitis; somatic cell count; milk yield; service period

10.17205/SZIE.AWETH.2020.1.087

Introduction

The economic value of dairy cows is commonly determined by their milk yield and longevity, because milk is the main source of income on dairy farms. The economic losses are mainly due to the prolongation of the service period (the number of days between the first and successful insemination) and the calving interval (the number of days between the consecutive calvings) whose nonstandard length affects of reduced milk yield during the subsequent lactation. (*Říha and Hanuš*, 2001).

In addition to reproduction management in dairy herds, one of the important roles of farmers is to control the incidence of diseases, especially mastitis. Inflammation of the mammary gland is usually the second main cause (after fertility disorders or heavy births) of culling of cows resulting in economic losses in production farms (*Crowe et al*., 2018).

Inflammation of the mammary gland and udder tissue is a major endemic disease of dairy cattle. It usually occurs as an immune response to bacterial invasion of the teat canal by variety of bacterial sources present on the farm, and can also occur as a result of chemical, mechanical, or thermal injury to the cow's udder (*Pecka-Kielb et al*., 2016).

Disorders of the mammary gland are accompanied by an increase in somatic cell counts (SCC), changes in protein composition, salt and lactose concentrations, which usually affects milk composition and its physico-chemical and processing properties. Increased vascular permeability during mammary gland infection results in increased passage of inflammatory markers, plasma proteins and blood enzymes into milk, which may lead to proteolysis of milk proteins and increased accumulation of harmful products (*Idriss et al*., 2013).

The main contributor to the economic losses caused by mastitis is the lower milk sales due to reduced milk yield and milk withdrawal within the withdrawal period. Often due to the lack of symptoms, identification of mastitis is an essential problem for dairy farmers and veterinarians to ensure not only the animal health but also the hygienic quality of produced milk. Based on the intensity and severity of clinical signs, mastitis is usually divided into subclinical and clinical disease. In clinical mastitis (CM), signs range from mild to severe and can be systemic, local, or milk related, whereas in subclinical mastitis (SM) no signs are observed. According to the literature, the mean annual incidence of clinical mastitis in dairy cows reaches 5-30 %. A significantly higher incidence is usually reported for subclinical mastitis, and can be up to 40 times more common than the clinical illness (*Zigo et al*., 2019).

Postpartum diseases, especially mastitis, can have a major impact on milk and reproductive performance of dairy cows. Due to the symptoms is insufficient or difficult to detect estrus cycle in mastitic cows resulting in prolongation of service period and calving interval. Therefore, the aim of the work was to evaluate the occurence of mastitis and their impact on selected milk and fertility indicators in a dairy cows' herd.

Materials and methods

Cows and milking

The study was conducted in the farm of west Slovakia with 180 dairy cows of Slovak Spotted cattle breed and their crosses with red Holstein with an average annual milk production of 7 228 kg. Cows were kept in free housing system with deep litter based on the repeated spreading of straw every second days. Cows were milked twice a day in fishbone milking parlor (DeLaval, UK) 2 ×10 stalls with standard exit and single return lane. The first milking starting at 4:30 a.m.

and the second at 4:30 p.m. The milking routine consisted from udder washing with water from hose to remove impurities. Subsequently, the udder was thoroughly wiped with disposable paper wipes. The forestripping from each quarter was hand-drawn into a dark-bottomed cup for visual assessment of milk consistency. Milking and pulsation vacuum were set at 42 kPa. Pulsation ratio was 60:40 at a rate of 52 c/min and termination was automatically signed when the milk flow dropped to 0.2 l/min. After the milking process, the teats were disinfected by teat-dipping. The milk was stored in refrigerated milk tanks at + 5 °C and removed daily around 11.30 a.m.

Animal selection

Altogether 127 animals from the 180-cow herd were involved in the study and their results were processed statistically. The monitored animals were selected based on the milk recording service and were investigated for 1-2 months after calving. Herd monitoring was carried out during one lactation period of each selected cow at the turn of 2017/18. Complex examination of each cow was performed a for mastitis detection with statistical analysis of milk indicators as milk yield, somatic cell count (SCC), percentage of milk fat and protein coplemented with analysis of reproductive indicators as the service period and the calving interval during this period.

Udder exanimation and bacteriological analyses

A thorough evaluation of udder health in 128 selected cows included veterinary history, clinical examination, sensory analysis of milk from fore stripping of each udder quarter followed by assessment of CMT with subsequent collecting of milk samples. A mixed milk sample collect from each selected cow was inoculated onto MacConkey agar (HiMedia, India) and blood agar base (Oxoid, England) enriched with 7% defibrinated sheep blood. The inoculated plates were identified based on growth characteristics according to methodological procedures Malinowski et al. (2006). Growth-confirmed colonies of *Staphylococcus* spp., *Streptococcus* spp. and *Enterobacteriacae* spp. were further identified biochemically using the STAPHYtest 24, STREPTOtest 24, resp. ENTEROtest 24 (Erba-Lachema, CZ) and the software TNW Pro 7.0 (Erba-Lachema, CZ).

Statistical analysis

The average values of reproductive and fertile parameters in selected cows were analyzed by Dunnett's multiple comparison test to compare mastitis groups of dairy cows with a healthy (control) group. The level of significance was set to $P<0.05$.

Results and discussion

Milk production is one of the basic economic indicators of cattle breeding. For this reason, the attention of dairy producers focuses on continuous increase of milk yield without adverse effects on the health of the mammary gland and reproductive indicators (Idriss et al. 2013).

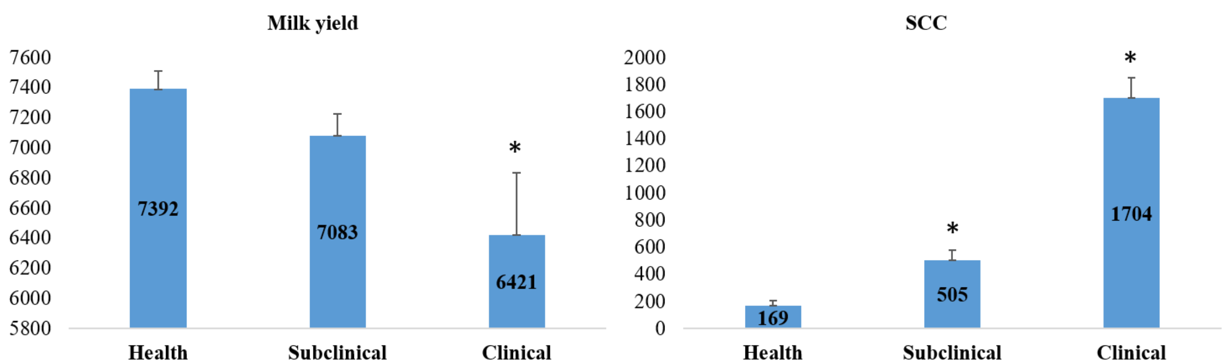
The occurrence of mastitis in the monitored group of dairy cows was 43.3%. Bacterial agents of mastitis were isolated from 55 of the 127 investigated animals. The most common bacterial isolates were coagulase negative staphylococci (CNS (40%), *S. aureus* (18%), *Streptococcus* spp. (16%), *Aerococcus viridans* (12%) and other bacterial agents (14%). After a comprehensive examination, the animals were classified in the following groups: 21.2% latent, 17.4% subclinical and 4.7% clinical mastitis. Of the CNS, the most common isolates were *S. chromogenes*, *S. warneri* and *S. xylosus*, which occurred mainly in latent and subclinical forms. *S. aureus*, and *Str. sanquin* were most commonly isolated from clinical forms of mastitis. A similar incidence of intramammary infections was reported by *Kivaria and Noordhuizen* (2007), who isolated *Staphylococcus* spp in the dairy herd followed by *Streptococcus* spp., *E. coli* and *Klebsiella* spp.

CNS have been increasingly isolated on dairy farms and are reported to be the leading cause of environmental mastitis. In addition to latent and subclinical forms, CNS are often isolated also from clinical and persistent mastitis. For most farms, the prevalence and number of infected cows is unknown, these cases do not show any clinical signs and are determined only by bacteriological milk examination or by measuring the milk abnormality. The most common method of assessing milk is to determine the SCC and assess the California mastitis test (CMT) score (*Taponen et al*., 2006).

High SCC present in milk is the main indicator of mammary gland infection, caused by specific and non-specific microorganisms, which cause contagious and environmental mastitis. The mammary gland immune response cells acting against microbial infections are macrophages, neutrophils and other cells that rapidly enter the bloodstream of the infected quarter and cause an increase in milk SCC in dairy cows (*Le Roux et al*,. 2003).

The results of our study showed that the mean SCC were the highest in dairy cows with clinical mastitis (1704×10^3) and the lowest in healthy cows (169×10^3) which was reflected in a positive effect on milk yield and overall milk performance (*Figure 1*).

***Figure 1*: Milk yield** (L) **and SCC** (x 10^3) **in selected groups of cows**



Note: SCC – somatic cell count, *P<0.05 – significant differences between selected groups

Malinowski et al. (2006) reported that milk samples with SCC lower than 200,000 cells/ml were mostly (59.6%) culture negative. Coagulase-negative staphylococci (CNS) and *Staph. aureus* were mostly noted in samples with 200,000 to 2,000,000 of SCC/ml. Samples having more than 2 million/ml of SCC were infected mainly with streptococci and gram-negative bacilli. Very high SCC (≥5 million/ml) related to infections caused by *Prototheca* spp. (64.5%), yeast-like fungi (60.2%) and *Streptococcus* spp. (55.1%).

Factors that determine the biological and technological properties of milk include proteins, fat, carbohydrate content, and protein fractions, including caseins. In dairy cows with mastitis, in addition to elevated SCC, there is a change in protein and fat composition and this affects the physical and chemical properties of milk. (*Pecka-Kielb et al*. 2016).

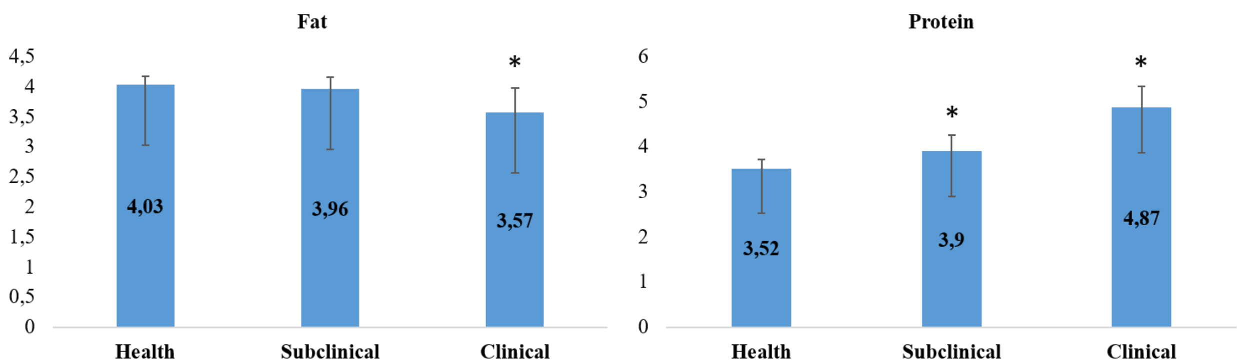
10.17205/SZIE.AWETH.2020.1.087

In our study, the average proportion of milk fat in the investigated dairy cows ranged from 3.57 to 4.07%. In dairy cows with a clinical form of mastitis, in addition to reduced milk yield, there was a reduced milk fat content, probably related to the high serum protein transfer and increased SCC, as reflected in an increase in milk proteins compared to healthy cows (*Figure 2*).

Milk fractions, such as proteins, in milk produced by dairy cows from which the *Streptococcus* spp. were isolated have a longer coagulation time and a higher proportion of whey proteins. Also, the proportion of fats and proteins is altered due to contamination of bacterial mammary gland by pathogens and immune cells entering the site of inflammation (*Seegers et al*. 2003).

The onset of mastitis also promotes a metabolic disorder due to which fat accumulates in the liver and its content in milk is reduced. Intramammary infection results in a decreased capacity of the immune system causing depletion and reduction of the antioxidant capacity of the enzymes involved in the deactivation of reactive oxygen species (*Zigo et al*. 2019).

***Figure 2*: Milk fat** (%) **and protein** (%) **in selected groups of cows**

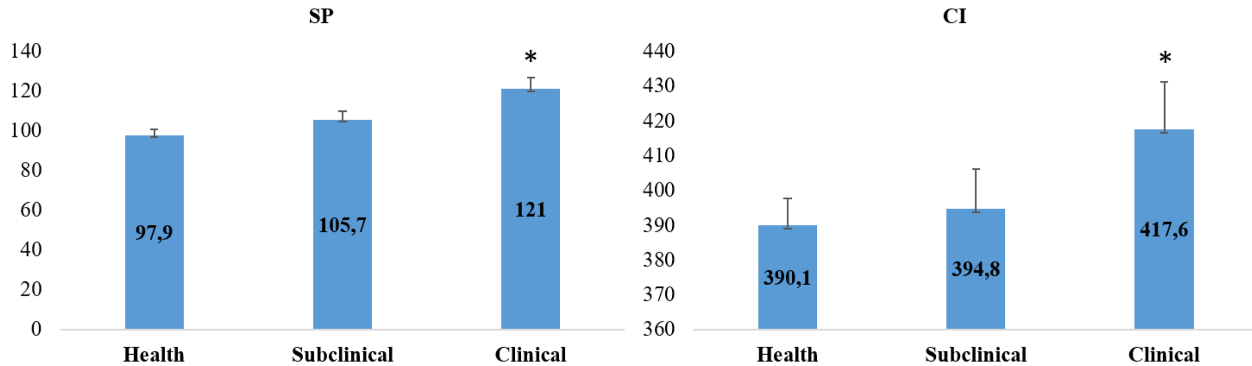


*P<0.05 – significant differences between selected groups

Olechnowicz and Jaskowski (2013) also reported that mastitis occurring during first phase of lactation has a negative effect on the fertility. Mastitis contributes to an almost three-fold increase in pregnancy loss during the 45 days after the successful insemination. According to *Kumar et al*., (2017) the ideal service period is 85 days but may be longer in high-performance animals. The causes of service period prolongation can be found in inadequate monitoring of oestrus, especially for non-fertilized cows, but also for physiological and health reasons. For high-yield dairy cows, service period from 110 to 125 days can be tolerated, but only when the interval calving does not exceed 400 days. The results of our study showed that in dairy cows with clinical mastitis was the length of service period at the defined value (121 days) but with a significantly increased calving interval (418 days) which is considered unsatisfactory in both cases (*Figure 3*).

10.17205/SZIE.AWETH.2020.1.087

***Figure 3*: Service period and calving interval in selected groups of cows**



Note: SP – service period, CI – calving interval, * P<0.05 – significant differences between selected groups

Conversely, the best milk yield (7 392 kg) was found in healthy dairy cows with a service period of up to 98 days. In dairy cows with clinical mastitis in addition to increased service period, we observed excessively long calving interval which resulted in reduced milk yield (6 421 kg).

Conclusion

Diagnosis and treatment of mastitis is very costly as it involves reduced milk yield and impaired reproductive parameters and has also a significant impact on the health of affected dairy cows. It is important to note that the effectiveness of generally established methods used to reduce environmental mastitis caused by major pathogens of the mammary gland is usually limited due to the polyethological and multifactorial origin of the disease. Given the several factors involved in the occurrence of mastitis, economic prosperity will depend largely on the expertise and ability of business managers or dairy herds owners to introduce quickly the proposed anti-mastitis programs into their livestock management programs.

Acknowledgements

This work was supported by Slovak projects APVV no. SK-PL-18-0088, VEGA no. 1-0529-19 and KEGA no. 006UVLF-4/2020.

References

Crowe, M. A., Hostens, M., Opsomer, G. (2018): Reproductive management in dairy cows – the future. Irish Veterinary Journal, 71. 1.

Idriss, S.H., Tančin, V., Foltýs, V., Kirchnerová, K., Tančinová, D., Vršková, M. (2013): Relationship between mastitis causative pathogens and somatic cell count in milk of dairy cows. Potravinárstvo (Food Industry), 7. 207–212.

Kivaria, F.M., Noordhuizen, J.P. (2007): A retrospective study of the aetiology and temporal distribution of bovine clinical mastitis in smallholder dairy herds in the Dar es Salaam region of Tanzania. The Veterinary Journal, 173. 617–622.

Kumar, N., Manimaran, A., Kumaresan, A., Sakthivel, J., Sreela, L., Mooventhan, P., Sivaram, M. (2017): Mastitis effects on reproductive performance in dairy cattle: a review. Tropical Animal Health and Production, 49. 4. 663–673.

Le Roux, Y., Laurent, F. Moussaoui, F. (2003): Polymorphonuclear proteolytic activity and milk composition change. Veterinary Research, 34. 629–645.

Malinowski, E., Lassa, H., Kłlossowska, A., Smulski, S., Markiewicz, H., Kaczmarowski, M. (2006): Etiological agents of dairy cows' mastitis in western part of Poland. Polish Journal of Veterinary Sciences, 9. 191–194.

Olechnowicz, J, Jaskowski, J.M. (2013): A connection between mastitis during early lactation and reproductive performance of dairy cows – a review. Annals of Animal Science, 13. 435–448.

Pecka-Kiełb, E., Vasiľ, M., Zachwieja, A., Zawadzki, W., Elečko, J., Zigo, F., Illek, J., Farkašová, Z. (2016): An effect of mammary gland infection caused by *Streptococcus uberis* on composition and physicochemical changes of cows' milk. Polish Journal of Veterinary Sciences, 19. 49–55.

Říha, J., Hanuš, O. (2001): Important aspects of detecting the reproduction of dairy cows, Výzkum v chovu skotu,(Research in cattle breeding), 3. 12–17 (In Czech).

Seegers, H., Fourichon, C., Beaudeau, F. (2003): Production effects related to mastitis and mastitis economics in dairy cattle herds. Veterinary Research, 34. 475–491.

Taponen, S., Simojoki, H., Haveri, M., Larsen, H.D., Pyőrälä, S. (2006): Clinical characteristics and persistence of bovine mastitis caused by different species of coagulase-negative staphylococci identified with API or AFLP. Veterinary Microbiology, 115. 199–207.

Zigo, F., Elečko, J., Vasiľ, M., Ondrašovičová, S., Farkašová, Z., Maľová, J., Takáč, L., Zigová, M., Bujok, J., Pecka-Kielb, E., Timkovičová-Lacková, P. (2019): The occurrence of mastitis and its effect on malondialdehyde level and activity of antioxidant enzymes in dairy cows. Veterinary Medicine Journal, 64. 10. 423–32.

10.17205/SZIE.AWETH.2020.1.087