

EFFECT OF SUBCLINICAL MASTITIS ON METABOLIC PROFILE IN DAIRY COWS

UTICAJ SUBKLINIČKOG MASTITISA NA METABOLIČKI PROFIL KRAVA

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APSTRACT

Mastitis is one of the most important disease in dairy cows, leading to significant economic losses. Subclinical mastitis is defined as inflammation of udder without any visible changes in the udder and milk. The aim of this study was investigate the influence of subclinical mastitis on the metabolic parameters in dairy cows. The study included 40 holstein Friesian cows with the same body score condition and in the same lactation phase. Divided into two groups of 20 each; subclinical mastitis and a control group of healthy cows. Cows with subclinical mastitis were detected by CMT (California mastitis test). Blood was sampled from the jugular vein, after morning milking and the concentration of glucose, NEFA, BHB, triglycerides, total protein, albumin, globulin, AST, ALT, ALP, LDH, calcium, magnesium and phosphorus were determined. This study showed significant increase in concentration of NEFA, total protein, globulin and LDH in cows affected by subclinical mastitis compared to control group. On the other hand concentration of triglycerides and ALT was significant lower in cows affected by subclinical mastitis compared to healthy ones. Increase of the NEFA concentration and decrease in concentration of triglycerides can indicate on the increase of lipid mobilization with consequently possible development fatty liver or ketosis in cows, while increase in concentration of total protein and globulin indicate on inflammation. Beside, increase concentration of LDH in blood serum with increase of somatic cell count in the milk may be useful indicator for detect subclinical mastitis in dairy cows.

Key words: cows, subclinical mastitis, metabolic profile

SAŽETAK

Mastitis je jedna od najvažnijih bolesti kod muznih krava, koja dovodi do značajnih ekonomskih gubitaka. Subklinički mastitis se definiše kao zapaljenje vimena bez vidljivih promena u vimenu i mleku. Cilj ovog rada bio je da se ispita uticaj subkliničkog mastitisa na metaboličke parametre kod mlečnih krava. Studija je obuhvatila 40 holštajn frizijskih krava sa istim stanjem tela i u istoj fazi laktacije. Podeljeni u dve grupe od po 20; subklinički mastitis i kontrolna grupa zdravih krava. Krave sa subkliničkim mastitisom su otkrivene CMT (kalifornijski mastitis test). Uzeta je krv iz jugularne vene, nakon jutarnje muže i utvrđena koncentracija glukoze, NEFA, BHB, triglicerida, ukupnih proteina, albumina, globulina, AST, ALT, ALP, LDH, kalcijuma, magnezijuma i fosfora. Ova studija je pokazala značajno povećanje koncentracije NEFA, ukupnog proteina, globulina i LDH kod krava obolelih od subkliničnog mastitisa u poređenju sa kontrolnom grupom. Sa druge strane, koncentracija triglicerida i ALT je bila značajno niža kod krava obolelih od subkliničnog mastitisa u odnosu na zdrave. Povećanje koncentracije NEFA i smanjenje koncentracije triglicerida može ukazivati na povećanje mobilizacije lipida sa posledično mogućim razvojem masne jetre ili ketoze kod krava, dok povećanje koncentracije ukupnog proteina i globulina ukazuje na upalu. Osim toga, povećanje koncentracije LDH u krvnom serumu sa povećanjem broja somatskih ćelija u mleku može biti koristan indikator za otkrivanje subkliničkog mastitisa kod mlečnih krava.

Ključne reči: krave, subklinički mastitis, metabolički profil

INTRODUCTION

Mastitis is one of the most important diseases in the dairy cows, leading to significant economic losses associated with the decreased milk production and quality, increased rate of culling and higher cost of veterinary treatment (1-3). Mastitis represents inflammatory reaction of the mammary gland as response to the injury or infection, caused by different causative agents (4). On the basis of visible signs of udder inflammation, mastitis could be divided in subclinical and clinical mastitis (5). Subclinical mastitis is harder for diagnostic, due to absence of visible signs and mostly remains unnoticed by the farmer. Additionally, subclinical mastitis can represent constant source of infection for other animals in the herd. For this reason, subclinical mastitis should be detected by specific tests are performed in milk samples. More advanced techniques are required for subclinical mastitis detection, including somatic cell evaluation, plate-culture methods, pH, electrical conductivity, enzymatic activity, molecular diagnostic tools, and biosensors (6). Subclinical mastitis leads to damage to the parenchyma of the mammary gland, which results in changes in the chemical composition of milk. Beside, subclinical mastitis leads to changes in metabolic parameters in the blood serum (7). It appears as a consequence cytokines released from immune cells. These cytokines cause difference changes in the metabolism of the cows. Furthermore, these metabolic changes can lead to various metabolic diseases in the cows. On the other hand, metabolic diseases such as ketosis could be cause the subclinical or clinical mastitis, because the ketone bodies impair the activity of immune cells and mammary gland defense (8). For this reason, the aim of this study was determining influence of subclinical mastitis on metabolic adaptation in dairy cows.

MATERIAL AND METHOD

This study was performed on the dairy farm in the republic of Serbia. The study included 40 holstein

Friesian cows with the same body score condition and in the same lactation phase. Divided into two groups of 20 each; subclinical mastitis and a control group of healthy cows. Blood serum metabolic profiles were measured using a Rayto spectrophotometer (Rayto, Shenzhen, China). Metabolic profile was included concentration of glucose, non-esterified fatty acids (NEFA), beta-hydroxybutyrate (BHB), triglyceride, total protein, albumin, globulin, aspartate aminotransferase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), gamma-glutamyl transferase (GGT), lactate dehydrogenase (LDH), calcium (Ca), magnesium (Mg) and phosphorus (P). All analyses were performed at the Laboratory of Pathophysiology, Department of Veterinary Medicine, University of Novi Sad. All the obtained results were summarized by Microsoft Office Excel (v2019) and processed by the application of Statsoft Statistica (v12.5) (Tulsa, Oklahoma).

RESULTS AND DISCUSSION

Table 1 shows metabolic parameters in cows affected by subclinical mastitis and healthy cows, and statistically significance difference in metabolic parameters between these groups of cows. This study showed significant increase in concentration of NEFA, total protein, globulin and LDH in cows affected by subclinical mastitis compared to control group. On the other hand concentration of triglycerides and ALT was significant lower in cows affected by subclinical mastitis compared to healthy ones. Increase of the NEFA concentration and decrease in concentration of triglycerides can indicate on the increase of lipid mobilization with consequently possible development fatty liver or ketosis in cows, while increase in concentration of total protein and globulin indicate on inflammation. Beside, increase concentration of LDH in blood serum with increase of somatic cell count in the milk may be useful indicator for detect subclinical mastitis in dairy cows.

Table 1. Metabolic characteristics of healthy cows and cows with subclinical mastitis

	Subclinical mastitis	Healthy cows	Statistical significance
Glucose(mmol/L)	1.92 ± 0.34	2.03 ± 0.48	NS
NEFA(mmol/L)	0.44 ± 0.18	0.34 ± 0.08	P < 0.05
BHB(mmol/L)	0.35 ± 0.16	0.31 ± 0.09	NS
Triglycerides (mmol/L)	0.51 ± 0.34	0.70 ± 0.29	P < 0.05
Total protein (g/L)	66.1 ± 10.23	59.46 ± 6.64	P < 0.01
Albumin (g/L)	27.35 ± 3.54	29.51 ± 3.03	NS
Globulin (g/L)	38.74 ± 8.93	29.69 ± 4.74	P < 0.01
AST (U/L)	76.76 ± 40.27	66.53 ± 14.17	NS
ALT (U/L)	27.04 ± 6.85	36.79 ± 8.94	P < 0.01
ALP (U/L)	39.56 ± 14.21	35.33 ± 9.07	NS
LDH (U/L)	1366.05 +/- 203.69	984.68 ± 152.14	P < 0.01
Ca (mmol/L)	2.13 +/- 0.33	2.02 ± 0.36	NS
P (mmol/L)	2.53 +/- 0.71	2.38 ± 0.47	NS
Mg (mmol/L)	0.77 +/- 0.33	0.66 ± 0.35	NS

*NS – non-statistically significant difference; p<0.01, P<0.05 statistically significant differences

Bovine mastitis remains a significant global concern, causing economic losses in the dairy industry due to reduced milk production, increased treatment expenses, lower fertility, and elevated culling of affected animals (9, 10). Subclinical mastitis has negative effect on the economy of dairy farmers due to directly affect on the milk quality and quantity (11). Inflammatory response of the mammary gland can lead to damage to the parenchyma of mammary gland and different changes in metabolic profile. This response includes increase level of cytokines, which have key role in hemotaxis, activation of immune cells and increase of phagocytic activity of macrophages and neutrophils (12). Beside, these cytokines can causing lipomobilisation of the NEFA from peryperipheral adipose tissue (13). This fact could be explain significance increase of NEFA concentration in cows affected by subclinical mastitis in compare to healthy one. Furthermore, high level of NEFA in serum may be significant predisposition for develop fat liver and ketosis in cows. For these reasons, early detection of subclinical mastitis in dairy herd is very important for animal health.

In current study, significance difference in concentration of NEFA, triglycerides, total protein, globulin, ALT and LDH were recorded between cows affected by subclinical mastitis and healthy cows. Significant higher concentration of NEFA, total protein, globulin and LDH was recorded in cows affected by subclinical mastitis in compare to

healthy ones. On the other hand, concentration of triglycerides and ALT was significant lower in cows affected by subclinical mastitis in compare to healthy animals. The increase of NEFA concentration could be explained by greater of mobilization from adipose tissue, which is caused by release of different cytokines in inflammatory response (13). Schwegler et al. (2013) suggested that cows with low glucose and higher NEFA in the prepartum were more susceptible for mastitis in the early postpartum, probably due to low immune function associated to a more negative energy balance (14). Beside, cytokines released from activated immune cells primarily macrophages stimulate the production of positive acute-phase proteins (e.g., haptoglobin) and reduce the synthesis of negative acute-phase proteins (e.g., albumin) in the liver (13). This fact could be explains obtained results, which show the decrease of albumin and increase of total protein and globulin in cows affected by subclinical mastitis. Beside, activated bovine plasma cells release the immunoglobulines (15), which belong at globulins. Matei et al. (16) recorded significant increase of total serum protein and globulin in cows with subclinical form of mastitis in compare to healthy cows. They suggest the increase proteins and globulin in the blood of cows indicate an activation of immune response following infection of the mammary gland (16). Beside, Ali et al. (17) found the higher concentration of total protein and lower concentration of globulin

in cows with subclinical mastitis compared to healthy cows. Furthermore, these mentioned authors didn't find the significance difference in albumin concentration between sick and healthy cows and that's in accordance with this study (17).

In this study was observed significant lower concentration of triglycerides in cows affected by subclinical mastitis compared to healthy ones. This could be as a consequence increase of lipid mobilization and decrease of functional activity of the liver. In contrary to these results, Ali et al. (17) didn't find significant difference in triglyceride concentration between cows with subclinical mastitis and healthy ones.

Lactate dehydrogenase (LDH) is widely distributed enzyme in cells of various living systems where it is involved in carbohydrate metabolism catalyzing interconversion of lactate and pyruvate with NAD⁺/NADH coenzyme system (18). Changes in plasma or serum enzymes are useful indicators of tissue damage in many diseases (18). The LDH in milk originates from the damaged udder epithelial cells or from the leukocytes in milk (18). Increase concentration of LDH in milk lead to increase the concentration of this enzyme in blood. These could

be explain the results obtained in present study, where significantly higher levels of LDH are determined in the blood serum from cows affected by subclinical mastitis compared to healthy ones. These results are in accordance with other authors (19).

CONCLUSION

The healthy cows and mammary glands are the most important conditions for the successful of milk production. Subclinical mastitis leads to significant changes in metabolic profile of dairy cows. These changes arise as a consequent inflammatory response of the mammary gland. Increase of the NEFA concentration and decrease in concentration of triglycerides can indicate on the increase of lipid mobilization with consequently possible development fatty liver or ketosis in cows, while increase in concentration of total protein and globulin indicate on inflammation. Beside, increase concentration of LDH in blood serum with increase of somatic cell count in the milk may be useful indicator for detect subclinical mastitis in dairy cows.

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