

LOW CONCENTRATION OF HEAVY METAL SELENIUM EFFECT ON MILK SOMATIC CELL COUNT IN DAIRY COWS

Ivana Davidov¹, Miodrag Radinović¹, Zorana Kovačević¹, Mira Pucarević²,
Nataša Stojić², Dragica Stojanović¹

¹Department of Veterinary Medicine, Faculty of Agriculture, University of Novi Sad,
21000 Novi Sad, Serbia

²Faculty of Environmental Protection, Educons University,
21208 Sremska Kamenica, Serbia
ivana.davidov@polj.edu.rs

The aim of this study was to determine the influence of low concentration on heavy metal selenium on milk somatic cell count in dairy cows. Selenium acts as a cellular antioxidant in the cell cytoplasm by preventing cell damage. Milk quality is primarily measured through somatic cell count. The experiment included thirty high-yielding Holstein cows. After measuring blood serum selenium concentration of dairy cows, the average selenium concentration in the blood serum was 0.53 ± 0.11 mmol/l and the average somatic cell count was 457 ± 84 (000/ml). The low levels of selenium in blood serum caused increasing number of milk somatic cell count that gives negative correlation according to correlation test. Changes caused by low concentration of heavy metal selenium occur due to marked inflammation process in the cow udder. Results showed that heavy metal selenium has a significant impact on udder health.

Key words: heavy metal selenium; somatic cell count; dairy cows

ВЛИЈАНИЕ НА НИСКОТО НИВО НА КОНЦЕНТРАЦИЈА НА ТЕШКИОТ МЕТАЛ СЕЛЕН ВРЗ БРОЈОТ НА СОМАТСКИТЕ КЛЕТКИ ВО МЛЕКОТО НА МОЛЗНИТЕ КРАВИ

Целта на оваа студија беше да го утврди влијанието на ниската концентрација на тешкиот метал селен врз бројот на соматските клетки во млекото на молзните крави. Селенот дејствува како антиоксиданс врз клетките на цитоплазмата при спречување оштетување на клетките. Квалитетот на млекото првенствено се мери преку бројот на соматските клетки. Експериментот вклучи 30 високопродуктивни крави од расата холштајн. Според мерењето концентрацијата на селен во крвниот серум на молзните крави беше 0.53 ± 0.11 mmol/l, а просечниот број на соматските клетки беше 457 ± 84 (000/ml). Според тестот за корелација, негативната корелација на концентрацијата на селен во крвта и бројот на соматските клетки во млекото настана поради ниско ниво на селен во крвта што предизвика зголемен број на соматските клетки во млекото. Промените предизвикани од ниската концентрација на тешкиот метал селен се појавуваат при воспалителен процес на вимето на кравата. Резултатите покажаа дека тешкиот метал селен има значително влијание врз здравјето на вимето.

Клучни зборови: тежок метал селен; број на соматски клетки; молзни крави

INTRODUCTION

Selenium as trace element and heavy metal as well, has essential importance in maintaining udder health of dairy cows (Andrieu, 2008), acting as a cellular antioxidant in the cell cytoplasm by preventing cell damage due to peroxidase, and plays major role in the function of the immune response (Miller et al., 1993). Uncontrolled peroxidase is highly damaging to healthy cells and healthy tissue of the

cow udder (Kommisrud et al., 2005). Selenium is essential in helping leukocytes to reduce the formation of peroxidase, to translate them into safe substance and to destroy phagocytized pathogens (Larsen, 1993; Finch and Turner, 1996; Smith et al., 1997; McKenzie et al., 1998). Selenium, also provide a solid udder first line against environmental microorganisms (Sordillo et al., 1997).

The dietary selenium requirement is important for dairy cows health, and has been associated with

a reduction in somatic cell count (Weiss et al., 1990; Weiss, 2002). Selenium supplementation of dairy cows diets may also enhance the nutritional quality of dairy products (Juniper et al., 2006). Milk quality is primarily measured through somatic cell count. Somatic cells are mainly milk-secreting epithelial cells that have been shed from the lining of the gland and white blood cells (leukocytes) that have entered the mammary gland in response to injury or infection. The milk somatic cells include 75% leukocytes, i.e. neutrophils, macrophages, lymphocytes, erythrocytes, and 25% epithelial cells (Sharma et al., 2011). Milk that is from uninfected quarters generally has a somatic cell count of 200,000/ml or less. A somatic cell count of 500,000/ml or more indicates an inflammation of the udder (Boboš et al., 1997).

The aim of this study was to determine the influence of low concentration on heavy metal selenium on milk somatic cell count in dairy cows.

MATERIALS AND METHODS

Animals

The study was performed on thirty Holstein cows approximate same body weight, ages 3 to 5 years and they giving approximately the same amount of milk. All thirty cows raised under farm conditions with dry straw for bedding and with ad libitum access to potable water.

Blood analysis

Blood samples were taken after morning milking from the caudal vein by applying the principles of asepsis and antisepsis. Tubes with appropriate needle were used for taking blood. The blood in tubes was left at room temperature for 24 hours to separate the serum. Blood sera were further analyzed by atomic absorption spectrometry (AAS).

Milk analysis

Milk samples taken at time of blood sampling. Milk from all four quarters was taken during morning milking and whole milk samples were taken with milk meter for somatic cell count. When quarter milk samples were taken the teat ends were disinfected. Somatic cell count (SCC) was determined using MILKOSCAN appliances.

Statistical analysis

The findings were evaluated using test of correlation between heavy metal selenium blood concentration and milk somatic cell count. The evaluation was performed using Microsoft Excel 2007 Software.

RESULTS AND DISCUSSION

After measuring blood serum selenium concentration of dairy cows, the average selenium concentration in the blood serum was 0.53 ± 0.11 mmol/l and the average somatic cell count was 457 ± 84 (000/ml). Number of cows with low concentration on heavy metal selenium and number of somatic cell count (SCC) are shown in Table 1.

Table 1

Blood serum selenium concentration and somatic cell count in dairy cows

	No. of cows	SCC (000/ml)
Blood selenium conc. 0.2–0.5 mmol/l	17	570–410
Blood selenium conc. 0.6–0.9 mmol/l	13	400–310
Total	30	

According to Table 2, it was noticed that there was a negative correlation within blood serum selenium concentration and milk somatic cell count because the low levels of selenium in blood serum caused increasing number of milk somatic cell count.

Table 2

Test correlation between selenium blood concentration and milk somatic cell count

SCC (000/ml)	Blood selenium conc.	n = 30
320–380	0–0.24	5
390–450	0.25–0.49	12
460–530	0.5–0.74	8
540–580	0.75–1	5
		–0.89935*

*Negative correlation

The mean estimate of selenium blood serum concentration was 0.536 $\mu\text{mol/l}$ and standard deviation was 0.224789. Average somatic cell was 450.000/ml of milk and 56.67% of the cows was over 450.000/ml with standard deviation 73.68853.

The range of physiological values for blood selenium in dairy cows is 0.6 to 0.9 mmol/l (Eredljan et al., 2011; Juniper et al., 2006; Gunter et al., 2003). Pechová et al. (2008) reported that is no significant correlation between blood selenium concentration and milk selenium concentration. However, Davidov et al. (2013) found a negative correlation within blood serum selenium concentration and milk somatic cell count because the increasing levels of selenium in blood serum cause a decline in the number of milk somatic cell count. This occurs because selenium deficiency provokes an inflammatory process due to reduced antioxidant activity in tissues when there is an accumulation of immune cells in response to prolonged inflammation.

The concentration of selenium negatively correlated with the degree of cellular infiltration in the parenchyma of the mammary gland. Selenium supplementation leads to reduction in subclinical mastitis and somatic cell count in dairy cows (Barbano et al., 2006; Rabiee et al., 2010; Wiess, 2002; Davidov et al., 2012). A reduction in somatic cell count and the low incidence of mastitis are present with blood serum selenium concentration with estimate value 0.601 $\mu\text{mol/l}$. This results are matched with group of authors Weiss et al. (1990); Weiss (2002); Juniper et al. (2006); Phipps et al. (2008); Davidov et al. (2011), who claim that selenium have an important influence on reducing somatic cell count.

CONCLUSION

Heavy metal selenium as trace element plays important role of proper functioning of cow udder. Low selenium blood serum concentration is negatively correlated with somatic cell count. That low concentration increase milk somatic cell count which can be lead to inflammation in parenchyma of cow udder.

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