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REGULAR ARTICLE

BLOOD SELENIUM CONCENTRATION AFFECT MASTITIS AND MILK QUALITY IN DAIRY COWS

Davidov Ivana[1]*, *Erdeljan Mihajlo*[1], *Radinović Miodrag*[1], *Stančić Ivan*[1], *Kovačević Zorana*[1]

Address: Department of Veterinary Medicine, Faculty of Agriculture, University of Novi Sad, Trg D. Obradovića 8, 21000 Novi Sad, Serbia.

*Corresponding author: ivanadav@polj.uns.ac.rs

ABSTRACT

Milk quality is usually defined in terms of mastitis. Milk with somatic cell count low then 400.000/ml and visibly normal (no clots) is considered high quality. Thirty Holstein cows were used in the study to determine affect blood serum selenium concentration on mastitis and milk quality. Cows received *ad libitum* access to potable water and daily 0.3 mg/kg inorganic selenium supplementation in food. Blood and milk samples were taken at first and sixth lactating month. Mean selenium blood serum concentrations were found to be lower within first lactating month, and then increased in the sixth lactating month. Average somatic cell count at first lactating month was 450.000/ml of milk and at sixth lactating month was 355.000/ml. On the basis of these results it can be conclude that selenium have importance in proper functioning of the mammary glands of cows, and in reducing mastitis and in improving milk quality.

Key words: selenium, mastitis, milk, cow

INTRODUCTION

Selenium is an essential trace element for both animals and humans. In farm animals by **National Research Council (2001)** the recommended dietary selenium concentration is 0,3 mg/kg dry matter. Its deficiency is associated with impaired growth, fertility and health in

farm livestock **(Weiss *et al.*, 1990; Phipps *et al.*, 2008)**. In humans selenium deficiency can in extreme cases cause severe cardiomyopathy (Kashan disease) and joint abnormalities (Kaschin-Back disease) **(Phipps *et al.*, 2008)**.

Milk quality is usually defined in terms of mastitis. Milk with somatic cell count low then 400.000/ml and visibly normal (no clots) is considered high quality. Although these measures are clearly important, the definition of high quality milk must be expanded. To ensure a continued growing demand by consumers for dairy products, milk and dairy products must also taste good **(Weiss, 2002)**. Milk quality is primarily measured through somatic cell count. Somatic cell count measures the amount of leukocytes, that include macrophages, lymphocytes and polymorphonuclear neutrophilic leukocytes. 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 dietary selenium requirement is important for livestock health, and has been associated with a reduction in somatic cell count and the incidence of mastitis **(Weiss *et al.*, 1990; Weiss, 2002)**. Selenium supplementation of livestock diets may also enhance the nutritional quality of livestock products. Selenium supplements are in two principal forms, inorganic mineral salts and organic forms such as Se-yeast **(Juniper *et al.*, 2006)**.

Under normal dietary conditions, the majority of endogenous selenium is present in body tissues and fluids **(Suzuki and Ogra, 2002)**. Selenium absorption occurs in the small intestine **(Weiss, 2003)** and after that, selenium transport to the blood and whole body, including udder.

Concentrations of selenium in serum and whole blood have been used as an index of selenium status because increased concentrations of selenium in serum or whole blood have been related to reduced milk somatic cell count, reduced mastitis and improved neutrophil function **(Smith *et al.*, 1984; Erskine *et al.*, 1987; Cebra *et al.*, 2003; Weiss and Hogan, 2005)**. The positive effect of selenium supplementation on clinical mastitis is probably mediated via effects of selenium on neutrophils and other immune cells.

Davidov *et al.* (2011) in their research were conducted in two groups of 15 cows, where group I was a control group, and group II received via food 50 mg/day of selenium. According to the blood test and blood serum analysis, they noticed that in the group I, selenium levels were below the physiological limits, while in group II the level of selenium was within the margin of physiological values. Also, after conducting milk somatic cell count in groups I and II, they found that the majority of cows in the group I had a somatic cell count between 310.000 and 500.000/ ml and in the group II the majority of cows had somatic cell

count between 210.000 and 300.000/ ml. According to the analysis of the correlation test, they noticed that there was a negative correlation with the second group of cows, because the increasing levels of selenium in blood serum cause a decline in the number of milk somatic cells. On the basis of these results they conclude that selenium is of great importance in the preservation and proper functioning of the mammary glands of cows.

The aim of this study was to find out how blood concentration of selenium affect mastitis and milk quality.

MATERIAL AND METHODS

Animals

The study was performed on thirty Holstein cows approximate same body weight, ages 3 to 5 years and in first to third lactation, and they giving approximately the same amount of milk. All cows were stabling with dry straw for bedding and with *ad libitum* access to potable water, and feed by total mixed ration. The total mixed ration contained maize silage, grass silage, cracked wheat, soyabean meal, rapeseed meal, sugar beet and hay. Thirty days before conception and trough all lactating months all cows received 0.3 mg/kg inorganic selenium supplementation in food.

Sampling

The cows were sampled two times: at first and at sixth lactating months. The same sampling procedure was used each time. Blood samples were taken after the 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. The level of selenium in blood serum was determined by mineralizing 1g of sample in 4 ml of 16 M HNO_3 and 2 ml of 9.8 M H_2O_2 within a closed-vessel heating block system. The solution was further diluted with water and selenium was subsequently determined using inductively coupled plasma mass spectrometry (Perkin Elmer Elan 6100 ICPMS, Massachusetts, USA). 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.

Milk samples for somatic cell count were analyzed by the fluoro-optoelectronic method (Fossomatic; Foss Electric, Hillerod, Denmark).

Statistical analysis

The findings were evaluated using test of correlation between selenium blood concentration and milk somatic cell count at first and sixth lactating month. The evaluation was performed using Microsoft Excel 2007 software.

RESULTS AND DISCUSSION

Selenium blood serum concentration was measured on 60 samples. Also on the same number of samples, e.g. 60 samples of milk were count somatic cell. The results on selenium blood serum concentration at first lactating month are in table 1 and at the sixth lactating month are in table 2.

Table 1 Selenium blood serum concentration at first lactating month

No. cows	Se conc. µmol/l	No. cows	Se conc. µmol/l	No. cows	Se conc. µmol/l	No. cows	Se conc. µmol/l	No. cows	Se conc. µmol/l
1.	0.276	7.	0.202	13.	0.897	19.	0.900	25.	0.347
2.	0.350	8.	0.514	14.	0.776	20.	0.242	26.	0.364
3.	0.254	9.	0.312	15.	0.679	21.	0.302	27.	0.759
4.	0.303	10.	0.83	16.	0.688	22.	0.514	28.	0.495
5.	0.394	11.	0.801	17.	0.769	23.	0.586	29.	0.612
6.	0.736	12.	0.612	18.	0.815	24.	0.264	30.	0.628

The mean estimate of selenium blood serum concentration at first lactating month was 0.536µmol/l and standard deviation was 0.224789. At sixth lactating month of lactations mean estimate of selenium blood serum concentration was 0.601µmol/l, and standard deviation was 0.236800. Mean selenium concentrations were found to be lower within first lactating month, and then increased in the sixth lactating month.

In table 3 is value of milk somatic cell count at first lactating month, and in table 4 is value of milk somatic cell count at sixth lactating month.

Table 2 Selenium blood serum concentration at sixth lactating month

No. cows	Se conc. µmol/l	No. cows	Se conc. µmol/l	No. cows	Se conc. µmol/l	No. cows	Se conc. µmol/l	No. cows	Se conc. µmol/l
1.	0.296	7.	0.222	13.	0.998	19.	0.903	25.	0.379
2.	0.353	8.	0.714	14.	0.896	20.	0.242	26.	0.446
3.	0.354	9.	0.382	15.	0.772	21.	0.307	27.	0.799
4.	0.400	10.	0.783	16.	0.812	22.	0.541	28.	0.549
5.	0.494	11.	0.842	17.	0.869	23.	0.658	29.	0.643
6.	0.834	12.	0.741	18.	0.855	24.	0.284	30.	0.662

Table 3 Milk somatic cell count at first lactating month

No. cows	Somatic cell count/ml	No. cows	Somatic cell count/ml	No. cows	Somatic cell count/ml	No. cows	Somatic cell count/ml	No. cows	Somatic cell count/ml
1.	570.000	7.	540.000	13.	350.000	19.	360.000	25.	560.000
2.	510.000	8.	410.000	14.	400.000	20.	540.000	26.	530.000
3.	530.000	9.	520.000	15.	380.000	21.	450.000	27.	430.000
4.	490.000	10.	320.000	16.	390.000	22.	480.000	28.	480.000
5.	480.000	11.	330.000	17.	410.000	23.	430.000	29.	420.000
6.	390.000	12.	410.000	18.	420.000	24.	580.000	30.	420.000

Within first lactating month the somatic cell count of 43.33% (13/30) of the cows was over 450.000/ml and standard deviation were 73.68853. In the sixth month of lactating, 26.67% (8/30) of the cows had a somatic cell count over 450.000/ml and standard deviation were 102.7468. Average somatic cell count at first lactating month was 450.000/ml of milk and at sixth lactating month was 355.000/ml of milk.

According to table 5, it was noticed that there was 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.

Table 4 Milk somatic cell count at sixth lactating month

No. cows	Somatic cell count/ml	No. cows	Somatic cell count/ml	No. cows	Somatic cell count/ml	No. cows	Somatic cell count/ml	No. cows	Somatic cell count/ml
1.	490.000	7.	510.000	13.	170.000	19.	160.000	25.	450.000
2.	420.000	8.	330.000	14.	210.000	20.	490.000	26.	430.000
3.	470.000	9.	450.000	15.	280.000	21.	460.000	27.	280.000
4.	400.000	10.	220.000	16.	330.000	22.	410.000	28.	380.000
5.	390.000	11.	230.000	17.	270.000	23.	390.000	29.	370.000
6.	290.000	12.	310.000	18.	240.000	24.	490.000	30.	330.000

Table 5 Test correlation between selenium blood concentration and milk somatic cell count at first lactating month

First lactating month		
Somatic cell count/ml	Selenium conc. (µmol/l)	n=30
320.000-380.000	0-0.24	5
390.000-450.000	0.25-0.49	12
460.000-530.000	0.5-0.74	8
540.000-580.000	0.75-1	5
		-0.89935*

*Negative correlation

The analysis of the correlation test in table 6, it was noticed that there was 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.

A reduction in somatic cell count and the low incidence of mastitis are present with blood serum selenium concentration with estimate value 0.601µmol/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.

Table 6 Test correlation between selenium blood concentration and milk somatic cell count at sixth lactating month

Sixth lactating month		
Somatic cell count/ml	Selenium conc. (µmol/l)	n=30
150.000-240.000	0-0.24	6
250.000-340.000	0.25-0.49	8
350.000-440.000	0.5-0.74	8
450.000-540.000	0.75-1	8
		-0.956*

*Negative correlation

CONCLUSION

There is strong relationship between blood serum concentration of selenium and functioning of dairy cows mammary gland. There are many interrelations of the nutrients and effects of supplementing selenium in daily food of cows. The cow`s uptake and requirement of selenium vary due to the lactating months and health status. On the basis of these results it can be conclude that selenium has importance in proper functioning of the mammary glands of cows, and in improving milk quality.

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