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Zinc Effect on Milk Somatic Cell Count in Dairy Cows

Ivana Davidov[1], Miodrag Radinović[1], Mihajlo Erdeljan[1], Željka Jurakić[2] & Zorana Kovačević[1]

ABSTRACT

***Background*:** The cow's requirement of zinc must be provided in the diet. The contents vary between different feedstuffs, and can be negatively influenced by factors like soil type, harvest, storage conditions. Also vary due to stage of lactation and health status of cow. Therefore, extra supplementation of zinc is sometimes warranted. Adequate zinc intake is particularly important during the late dry period and the early stages of lactation in order to prevent diseases around parturition. The aim of this study was to measure the concentrations of zinc in blood samples taken from dairy cows in different state of lactation and comparing with somatic cell count in cows milk.

***Materials, Methods & Results*:** A total of 45 Holstain cows were divided on days of milking into 3 groups of 15 cows (group A, B and C). All cows were stabling with dry straw for bedding and with ad libitum access to potable water, and feed by total mixed ration. Blood samples were taken after the morning milking from the caudal vein by applying the principles of asepsis and antisepsis. Blood samples were taken in vacutainer tubes with added anticoagulant K3E in quantities of 0.072 mL. Milk samples were taken during morning milking. The whole milk samples were taken with milk meter for somatic cell count. When quarter milk samples were taken the teat ends were disinfected. After analyzing the results, blood mean zinc concentration was found to be lower in group B of cows. Group C had highest level of blood zinc concentration. The mean estimate blood zinc concentration in group A was 16.66 μmol/L, in group B was 8.26 μmol/L and in group C was 17.82 μmol/L. Mean value of milk somatic cell count in group A was 298.67/mL, in group B was 451.33/mL and in group C 492.67/mL.

***Discussion*:** Analyzing the results in this examination, it has been noticed that zinc concentration varied through all three groups of cow. Cows in group B have mean value of blood zinc concentration 8.26 μmol/L, and that results are match with several authors. Other authors, found that dairy cows around parturition have decrease in blood concentrations of vitamins A and E, and Zn. Physiological blood level of zinc in dairy cows is 7-13 μmol/L, and cows from group A and C have mean value 16.66 μmol/L and 17.82 μmol/L. The blood zinc level was adequate for dairy cows in these groups of cows in this study. Adequate zinc intake is particularly important during the late dry period and the early stages of lactation in order to prevent diseases around parturition. During involution and again towards the end of the dry period, risk for intramammary infection is at the highest level. Somatic cell count in milk is one of the best indicators of udder health status both in pathogenic and non-pathogenic cases. In this research, mean value of somatic cell count in group A was 298.67x103/mL, in group B was 451.33x103/mL and in group C 492.67x103/mL. It is known that cows in first 30 days of milking have high somatic cell count. According to that, cows in group C and A have adequate somatic cell count, and adequate value of blood zinc concentration. All this can indicate a good immune system and absence of intamammary infection and clinical mastitis. Analyzing statistical correlation test, it has been noticed negative correlation within blood zinc concentration and milk somatic cell count in all three groups of cows. That means increasing levels of zinc cause a decline number of milk somatic cell count.

Keywords: zinc, somatic cell count, dairy cow.

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[1]Department of Veterinary Medicine. [2]Department for Animal Science, University of Novi Sad, Faculty of Agriculture Novi Sad, Serbia. CORRESPONDENCE: Ivana Davidov [ivana.davidov@polj.edu.rs - Tel.: +381 (21) 453-900]. Department of Veterinary Medicine, University of Novi Sad, Faculty of Agriculture, 21000 Novi Sad, Serbia.

INTRODUCTION

The trace element such as zinc (Zn) is an essential for the health and performance of dairy cows [4,10]. That micronutrient is cellular antioxidant, preventing peroxidative damage in the cytoplasm and it is essential for a well functioning of immune system [9, 14,15].

The immune system of dairy cows is suppressed around parturition resulting in an increased susceptibility to infectious diseases [5,7]. This may partly be due to a decrease in blood concentrations of vitamins A and E, and Zn observed at this time [2,8,9].

During involution and again towards the end of the dry period, risk for mastitis is at the highest [13]. After drying off, milk is no longer removed from the udder, and intramammary pressure may cause leakage of milk from the teats. Leukocytes start entering the gland within 1 week after dry off period, but do not immediately protect the gland. The keratin plug, which also contains inhibitory substances against bacteria, is formed within 1-2 weeks after dry off and should naturally seal the teat. Quarters that form a keratin plug, which completely closes the teat soon after dry off period, have significantly less risk to develop an intramammary infection [1].

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 [6,11,12]. Somatic cell count in milk is one of the best indicators of udder health status both in pathogenic and non-pathogenic cases. It results in a significant reduction in milk yield, due to damage of milk producing tissues in the udder [3].

Therefore, the aim of this study was to measure the concentrations of Zn in blood samples taken from dairy cows in different stage of lactation and comparing with somatic cell count in milk.

MATERIALS AND METHODS

Animals

The study was performed on Holstein cows approximate same body weight, ages 3 to 5 years, with equally milk production. 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. A total of 45 Holstein cows from farm in region of Serbia- Vojvodina in stall feeding system, were divided on days of milking into 3 groups of 15 cows: group A (lactating days 60-180), group B (lactating days 180-305) and group C (lactating days 10-60).

Blood samples

Blood samples were taken after the morning milking from the caudal vein by applying the principles of asepsis and antisepsis. Blood samples were taken in vacutainer tubes[1] with added anticoagulant K3E in quantities of 0.072 mL. After sampling each vacutainer tube is marked with ID number of cow and left at room temperature. The solution was further diluted with water and zinc was subsequently determined using inductively coupled plasma mass spectrometry (Perkin Elmer Elan 6100 ICPMS)[2].

Milk samples

Milk from all four quarters of each cow from all three groups, was taken during morning milking. The 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 (Fluoro-optoelectronic- Fossomatic)[3]. Daily milk production of tested cows was measured using Waikato devices attached to milking machine.

Statistical analysis

The results were subjected to the correlation test and all results were analyzed by Microsoft Excel package 2007.

RESULTS

Zinc concentration was measured on 45 samples of cow blood. Also on the same number of samples, e.g. 45 samples of milk were count somatic cell. The results of blood zinc concentration and somatic cell count (SCC) of all 3 groups (A, B, C) are in Table 1. In Table 1, is also value of milk somatic cell count at group A, B and C.

In group A, only one cow of fifteen has somatic cell count over 400.000/mL. In group B, only one cow of fifteen has somatic cell count lower 400.000/mL. And in group C, 46.67% or 7/15 cows have somatic cell count lower 500.000/mL.

Mean blood zinc concentration was found to be lower in group B. Group C had highest level of blood zinc

concentration. The mean estimate of blood zinc concentration in group A was 16.66 µmol/L, in group B was 8.26 µmol/L and in group C was 17.82 µmol/L. Mean value of somatic cell count in group A was 298.67x 10^3/mL, in group B was 451.33 x 10^3/mL and in group C 492.67 x 10^3/mL. These results are show in Table 2.

According to the analysis of the correlation test, it has been noticed that there was a negative correlation within zinc concentration and milk somatic cell count in all of three group, because the increasing levels of zinc cause a decline in the number of milk somatic cell count (Table 3).

Table 1. Zinc concentration and somatic cell count in dairy cows.

A group		B group		C group	
Zn µmol/L	SCC x10^3/L	Zn µmol/L	SCC x10^3/L	Zn µmol/L	SCC x10^3/L
13,93	330	8,73	490	16,73	470***
19	270	11,17	420	19,90	510
20,4	240	10,92	470	18,20	530
20,5	160	10,95	400	18,95	490***
24,85	290	11,51	390**	21,51	480***
10,58	220	5,86	490	15,86	540
14,85	410*	6,98	510	16,98	540
16,73	390	9,58	430	19,58	410***
11,57	230	4,64	450	14,64	520
14,99	310	4,55	460	14,55	450***
12,14	270	4,64	490	14,64	580
22,63	280	10,23	450	19,62	560
10,54	380	4,61	430	19,61	530
19,65	370	10,76	410	18,73	400***
17,58	330	8,82	480	17,84	380***

*milk somatic cell count over 400.000/mL; **milk somatic cell count lower 400.000/mL; ***milk somatic cell count lower 500.000/mL.

Table 2. Descriptive statistics of group A, B and C.

Group	Variable	No.	Mean	Minimum	Maximum	Std. Dev.
A	Zn	15	16.6627	10.5400	24.8500	4.48007
	SCC x 10^3/L	15	298.6667	160.0000	410.0000	70.79817
B	Zn	15	8.2633	4.5500	11.5100	2.75738
	SCC x 10^3/L	15	451.3333	390.0000	510.0000	37.00708
C	Zn	15	17.8227	14.5500	21.5100	2.17760
	SCC x 10^3/L	15	492.6667	380.0000	580.0000	60.41129

Table 3. Correlation test of group A, B, C.

Group A		Group B		Group C	
Zn µmol/L	SCC x10^3/L	Zn µmol/L	SCC x10^3/L	Zn µmol/L	SCC x10^3/L
13,93	330	8,73	490	16,73	470
19	270	11,17	420	19,90	510
20,4	240	10,92	470	18,20	530
20,5	160	10,95	400	18,95	490
24,85	290	11,51	390	21,51	480
10,58	220	5,86	490	15,86	540
14,85	410	6,98	510	16,98	540
16,73	390	9,58	430	19,58	410
11,57	230	4,64	450	14,64	520
14,99	310	4,55	460	14,55	450
12,14	270	4,64	490	14,64	580
22,63	280	10,23	450	19,62	560
10,54	380	4,61	430	19,61	530
19,65	370	10,76	410	18,73	400
17,58	330	8,82	480	17,84	380
-0.13495		-0.51531		-0.20443	

DISCUSSION

Adequate zinc intake is particularly important during the late dry period and the early stages of lactation in order to prevent intramammary infection around parturition. According to analyzing the results in this examination, it has been noticed that blood zinc concentration varied through all three groups of cow, which is show in Table 1. Cows in group B have mean value of blood zinc concentration 8.26 µmol/L, and that results are match with several authors [2,8,9]. Meglia *et al.* [8] found that dairy cows around parturition have decrease in blood concentrations of vitamins A and E, and Zn. Physiological blood level of zinc in dairy cows is 7-13 µmol/l, and cows from group A have mean value 16.66 µmol/L and from group C have mean value of 17.82 µmol/L.

During involution and again towards the end of the dry period, risk for intramammary infection is at the highest level [13]. Somatic cell count in milk is one of the best indicators of udder health status both in pathogenic and non-pathogenic cases [6,11,12]. In the research, mean value of somatic cell count in group A was 298.67 x 10^3/mL, in group B was 451.33 x 10^3/mL and in group C 492.67 x 10^3/mL. It is known that cows in first 30 days of milking have high somatic cell count. According to that, cows in group C have adequate somatic cell count, and adequate value of zinc concentration. All this can indicate a good immune system and absence of clinical mastitis. Cows from group A also have adequate somatic cell count, and adequate value of zinc concentration.

Statistical correlation test gave a negative correlation within blood zinc concentration and milk somatic cell count in all three groups of cows. That negative correlation means increasing levels of blood zinc cause a decline number of milk somatic cell count in dairy cows.

CONCLUSION

Analyzing results of blood zinc concentration and somatic cell count in dairy cows with different stage of lactation, the present study indicated that with increasing level of zinc in blood of dairy cow, cause decline somatic cell count and reduction of intramammary infections. Therefore, it could be concluded that zinc has effect on milk somatic cell count in dairy cows.

MANUFACTURERS

[1]Preanalytical Solutions. Norfolk, UK.

[2]Perkin Elmer Elan 6100 ICPMS. Massachusetts, USA.

[3]Foss Electric. Hillerod, Denmark.

***Declaration of interest*.** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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