

THE INFLUENCE OF BLOOD AND MILK SERUM ZINC CONCENTRATION ON MILK SOMATIC CELL COUNT IN DAIRY COWS

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Original scientific paper

Abstract: The objective of this study was to evaluate the influence of blood and milk zinc concentration on somatic cell count, milk production and occurrence of subclinical mastitis cases. The study was performed on thirty Holstein cows approximate same body weight, ages 3 to 5 years, with equally milk production. Blood samples were taken after the morning milking from the caudal vein and milk from all four quarters was taken during morning milking. All samples of blood and milk were taken to determined zinc, using inductively coupled plasma mass spectrometry. 37.67% (11/30) cows have blood serum zinc concentration below $7\mu\text{mol/l}$, and 63.33% or 19/30 cows have blood serum zinc concentration higher then $13\mu\text{mol/l}$. Also 30% (9/30) cows have somatic cell count lower then 400.000/ml which indicate absence of subclinical mastitis, but 70% (21/30) cows have somatic cell count higher then 400.000/ml which indicate subclinical mastitis. According to all results in this research, zinc has very important influence on reducing subclinical mastitis and somatic cell count in milk of dairy cows.

Key words: zinc, somatic cell count, dairy cows

Introduction

Adequate mineral nutrition may be used as a strategy to optimize immune system function by the reduction of metabolic and oxidative stress and therefore it may have a positive effect on defense mechanisms on mammary gland against mastitis (*Weiss and Wyatt, 2002; Cortinhas et al., 2010*). Zinc is involved in the keratinization of epithelial tissue. These tissues include the lining of the streak canal of teats which is the port of entry to the udder of mastitis- causing microorganisms. Zinc is also involved in the maintenance of immune status. Zinc deficiency might be a factor in predisposing cows to mastitis and high milk somatic

cell count (*Whitaker et al., 1997; Meglia et al., 2004; Cortinhas et al., 2010*). High somatic cell count reflects subclinical mastitis, which is reputed to cause a greater loss of milk to the dairy industry than clinical cases. With high somatic cell count in milk attracting financial penalties it is important for farmers and their advisers that such claims are soundly based and correct (*Whitaker et al., 1997*).

Siciliano-Jones et al. (2008) supplemented dairy cows with organic source of Zn, Mn, Cu and Co, and reported no changes in milk composition and somatic cell count. *Griffiths et al. (2007)* studied Zn, Mn and Cu supplementation as an amino acid complex for grazing dairy cows reported increased milk production, but no differences on somatic cell count and milk composition was observed. In contrast, *Kinal et al. (2007)* observed a reduction in somatic cell count with organic sources of Zn, Mn and Cu supplementation for dairy cows during 305 days of lactation.

The objective of this study was to evaluate the influence of blood and milk zinc concentration on somatic cell count, milk production and occurrence of subclinical mastitis cases.

Materials and Methods

The study was performed on thirty Holstein cows approximate same body weight, ages 3 to 5 years, in the same phase of lactation (120-180 days of lactation), 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.

Blood samples were taken after the morning milking from the caudal vein by applying the principles of asepsis and antiseptis and minimum distress of animal. Blood samples were taken in vacutainers manufacturers BD Vacutainer Systems, Preanalytical Solutions UK with added anticoagulant K3E in quantities of 0.072 ml. After taking the samples should be gently shaken several times in order to anticoagulant mixes with the sample. After sampling each vacutainer 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, Massachusetts, USA).

Milk from all four quarters was taken during morning milking using testers. After sampling each battle with milk sample is marked with ID number of cow and left at incubation on 37°C for 24 hours in order to segregate milk serum. The solution was further diluted with water and zinc was subsequently determined using inductively coupled plasma mass spectrometry (Perkin Elmer Elan 6100 ICPMS, Massachusetts, USA). 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 Fluor-optoelectronic method (Fossomatic; Foss Electric, Hillerod, Denmark). Daily milk production of tested cows was measured using Waikato devices attached to milking machine.

Results and Discussion

After analyzing samples of blood and milk serums of 30 Holstein cows, shows that concentration of zinc varied and somatic cell count as well. Also analyzing milk production, it is noticed that cows with low blood zinc concentration have high somatic cell count and lower milk production. All this results are showed in table 1.

Table 1. Blood and milk serum concentration of zinc, somatic cell count (SCC) and milk production

No. of cows	Blood Zn conc. $\mu\text{mol/l}$	Milk Zn conc. $\mu\text{mol/l}$	SCC $\times 10^3$	Milk prod. kg	No. of cows	Blood Zn conc. $\mu\text{mol/l}$	Milk Zn conc. $\mu\text{mol/l}$	SCC $\times 10^3$	Milk prod. kg
1.	15.07	27.48	410	22	16.	13.23	5.65	470	21
2.	16.41	37.98	390	23.5	17.	18.12	6.84	380	24
3.	2.04	70.46	550	18	18.	18.22	5.08	350	24.5
4.	22.69	49.37	310	28	19.	17.59	3.06	370	23
5.	15.76	31.49	410	23	20.	21.15	7.76	330	26
6.	15.05	25.33	450	24	21.	5.58	5.08	560	19
7.	1.79	24.74	540	20	22.	13.98	4.56	430	22
8.	2.84	76.32	560	19	23.	15.86	7.88	400	22
9.	1.78	57.38	560	17.5	24.	6.64	3.12	470	19,5
10.	16.76	45.66	430	19	25.	4.95	6.84	500	18
11.	16.08	27.08	440	18	26.	5.64	1.02	560	17
12.	1.66	56.31	540	18	27.	18.62	1.75	420	20
13.	20.35	76.78	290	27	28.	6.61	3.62	550	18
14.	17.51	69.58	310	25	29.	16.61	6.04	460	21
15.	1.89	77.38	550	20	30.	13.28	1.78	490	21

Siciliano-Jones et al. (2008) reported that there is no changes in milk composition and somatic cell count after supplemented dairy cows with organic source of Zn, Mn, Cu and Co. *Griffiths et al. (2007)* studied Zn, Mn and Cu supplementation as an amino acid complex for grazing dairy cows, and reported increased milk production, but no differences on somatic cell count. In contrast, *Kinal et al. (2007)* observed a reduction in somatic cell count with organic sources of Zn, Mn and Cu supplementation for dairy cows during 305 days of lactation. Analyzing results in this research shows reduction in somatic cell count and absence of subclinical mastitis in cows with blood serum zinc concentration higher

then 13 $\mu\text{mol/l}$. It is known that physiology level of zinc blood serum concentration are between 7-13 $\mu\text{mol/l}$. 37.67% (11/30) cows have blood serum zinc concentration below 7 $\mu\text{mol/l}$, and 63.33% or 19/30 cows have blood serum zinc concentration higher then 13 $\mu\text{mol/l}$. Average value of blood zinc concentration was 12.12 $\mu\text{mol/l}$. Also 30% (9/30) cows have somatic cell count lower then 400.000/ml which indicate absence of subclinical mastitis, but 70% (21/30) cows have somatic cell count higher then 400.000/ml which indicate subclinical mastitis.

According to table 1, all cows with subclinical mastitis have milk serum zinc concentration between 1.02-77.38 $\mu\text{mol/l}$ and average value was 26.62 $\mu\text{mol/l}$. In cows without subclinical mastitis milk serum zinc concentration was between 3.06-76.78 $\mu\text{mol/l}$ and average value was 29.37 $\mu\text{mol/l}$. There is no data of influence of milk serum zinc concentration on milk somatic cell count and milk production.

In table 2, statistical test correlation show a negative correlation between blood serum zinc concentration and somatic cell count, which indicate that zinc from blood have influence on health and secretion of mammary gland. Blood serum zinc concentration and milk production are in positive correlation, which indicate no influence on secretion of mammary gland. Also milk zinc serum concentration, somatic cell count and milk production are in positive correlation which indicate that zinc from milk have not influence on health and secretion of mammary gland.

Table 2. Test correlation between blood and milk serum zinc concentration, somatic cell count (SCC) and milk production

Blood Zn conc.-SCC	Blood Zn conc.-Milk prod.	Milk Zn conc.-SCC	Milk Zn conc.-Milk prod.
-0.91429	0.78091	0.02311	0.05041

According to results in the table 2, there is no significant influence of zinc milk serum concentration to somatic cell count and milk production, but zinc blood serum concentration had significant influence on somatic cell count and reducing subclinical mastitis.

Conclusion

The results indicate that cows with level of zinc in blood serum higher then 13 $\mu\text{mol/l}$ have lower somatic cell count and better milk production. Cows with lower zinc blood serum concentration then 7 $\mu\text{mol/l}$ have high somatic cell count and high incidence of subclinical mastitis. According to all results in this research, zinc has very important influence on reducing subclinical mastitis and somatic cell count in milk of dairy cows.

Uticaj koncentracije cinka krvnog i mlečnog seruma na broj somatskih ćelija mleka visoko mlečnih krava

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Rezime

Cilj ovog istraživanja je da se utvrdi uticaj cinka iz krvnog i mlečnog seruma na broj somatskih ćelija u mleku krava, kao i njegov uticaj na produkciju mleka i pojavu subkliničkih mastitisa. Istraživanje je sprovedeno na trideset visoko mlečnih krava Holštajn rase. Sve krave su bile približne težine, starosti između 3 i 5 godina i davale su približno istu količinu mleka. Uzorci mleka su uzimani posle jutarnje muže iz kaudalne vene, dok su uzorci mleka uzimani iz sve četiri četvrti pre jutarnje muže. Svi uzorci seruma mleka i krvi su korišćeni za utvrđivanje koncentracije cinka primenom spektrometrije. 37,67% (11/30) krava je bilo sa koncentracijom cinka ispod $7\mu\text{mol/l}$, a 63,33% odnosno 19/30 krava je bilo sa koncentracijom cinka iznad $13\mu\text{mol/l}$. Takođe, 30% (9/30) krava je bilo sa brojem somatskih ćelija u mleku ispod 400.000/ml što ukazuje na odsustvo subkliničkog mastitisa, dok je 70% (21/30) bilo sa većim brojem somatskih ćelija u mleku od 400.000/ml što je pokazatelj subkliničkog mastitisa. Na osnovu dobijenih rezultata može se zaključiti da cink ima bitnu ulogu u smanjenju broja pojavljivanja subkliničkih mastitisa kao i na smanjenje broja somatskih ćelija u mleku visoko mlečnih krava.

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Received 20 February 2013; accepted for publication 30 October 2013