CONTEMPORARY AGRICULTURE / *SAVREMENA POLJOPRIVREDA* 63 (1-2) 55-61, 2014.
UDC: 63(497.1)(051)-"540.2" ISSN 0350-1205

UDC 632.2:546.47(043.3)

ZINC CONCENTRATION IN THE MILK SERUM OF COWS IN THE EARLY AND MID LACTATION*

ZORANA KOVAČEVIĆ, DRAGICA STOJANOVIĆ, IVANA DAVIDOV, GORDANA ŽUGIĆ, MIODRAG RADINOVIĆ, MIHAJLO ERDELJAN[1]

SUMMARY: The cows in early lactation take less food than they need to produce milk, which is reflected in the change in the metabolic status of cows and can affect to the health of the cows significantly. *There are* lower zinc concentration in the blood in early lactation, which is related to increased number of somatic cells in milk and occurrence of inflammatory processes. *The primary function of zinc is as an antioxidant. It is the micronutrient which has been established as an essential component of the dairy cow diet for maintaining health.* Also, zinc plays an important role in the immune response. The total content of zinc in the body is affected by strong homeostatic regulation. *For human consumption the best source of zinc are foods of animal origin. The value of zinc concentration in the milk serum of cows in early lactation was 24.78± 13.4 µmol/l, while in mid lactation it was 27.62± 12.8 µmol/l.* The results of our study shows that zinc concentration in the milk serum of cows at different periods of lactation, in first and in sixth month of lactation is approximate and stable during lactation.

Key wards: *zinc, milk serum, lactation, cow.*

INTRODUCTION

The cows in early lactation take less food than they need to produce milk, which is reflected in the change in the metabolic status of cows and can affect to the health of

---

Original scientific paper / *Originalni naučni rad*

[1] Zorana Kovačević, Mr Pharm, Teaching Assistant, Dragica Stojanović, DVM, PhD, Associate professor, Ivana Davidov, DVM, PhD, Assistant professor, Miodrag Radinović, DVM, PhD, Assistant professor, and Mihajlo Erdeljan, DVM, Teaching Assistant. University of Novi Sad, Faculty of Agriculture, Department of Veterinary Medicine, Novi Sad, Serbia. Gordana Zugić, PhD, Agencija za lekove i medicinska sredstva Srbije, Vojvode Stepe 458, 11000 Belgrade, Serbia. Corresponding author: Zorana Kovačević, e-mail: zoranakovacevic@yahoo.co.uk, phone.: +381/21-485-3524.

*This paper is the part of project TR31062, supported by Ministry of Science and Education, Serbia.

the cows significantly (Cincović et al., 2011; Cincović et al., 2012). There are lower zinc concentration in the blood in early lactation, which is related to increased number of somatic cells in milk and occurrence of inflammatory processes (Davidov et al., 2013).

The primary function of zinc is as an antioxidant. It is the micronutrient which has been established as an essential component of the dairy cow diet for maintaining health (Andrieu, 2008). Zinc is an essential component of many enzymes involved in the synthesis of DNA and RNA. He enters in the composition of the enzyme that prevents free radical activity (Prasad et al., 2004; Gressley, 2009). Also, zinc plays an important role in the immune response (Weiss and Spears, 2006).

The total content of zinc in the body is affected by strong homeostatic regulation. The amount of zinc excreted in the feces is proportional to food intake and the amount of zinc in the body. Homeostatic control mechanisms are complex and the main ways of the changes are in the extent of absorption of the meal, excretion in urine, feces and milk, as well as the deposit of non-harmful forms of trace element which can be mobilized in the case of a defect. (Baker and Hammerman, 1995). Approximately 20-30% of the food ingested zinc is absorbed, mainly in the duodenum and proximal jejunum. Absorption of zinc in both processes: passive diffusion and active transport (Lee et al., 1989, Cope et al., 2009). The absorption of zinc is affected by numerous factors such as the solubility of zinc in the intestinal tract, species and categories of animals, the composition of food and the most important content of zinc in the diet (Wiking et al., 2008; Cope et al., 2009; Rabbiee et al., 2010). After intestinal apsorption, zinc enteres the portal circulation and distributes by blood to tissues and organs bounded to albumin (Gordon et al., 1981). Contetn of zinc in blood is 0,5 % of the total amount of zinc in the body. There is 75-88% zinc in erythrocytes, 12-22% in plasma and in leukocytes and platelets around 3% (Kolarski, 1995). For human consumption the best source of zinc are foods of animal origin. Most zinc is in seafood and in red meat. Poultry, eggs, cheeses, milk, yogurt, nuts and whole grain cereals are good sources of zinc. Amont of zinc in cow milk is 0.3-0.4mg/100g (Wiking et al., 2008).

Adequate concentrations of zinc in the food, and consequently in the blood, have positive impact on proper immune response while zinc deficiency leads to improper functioning of the immune system and irregular keratinisation (Hutcheson, 1989; Reddy and Frey, 1990).

The content of zinc in the milk of dairy cows did not show high variability, and its average value was within the recommended limit for zinc content in consumer milk (Hosnedlova et al., 2005).

The aim of this study was to determinate the zinc concentration in milk serum in dairy cows in the early and mid period of lactation.

MATERIAL AND METHODS

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 libidum* access to potable water, and feed by total mixed ration. The total mixed ration contained maize silage, grass silage, cracked wheat, soybean meal, rapeseed meal, sugar beet and hay.

The milk samples were taken in two productive periods, in the postpartum period

(in the first lactating month) and in the mid lactation (in the sixth lactating month). The same sampling procedure was used each time.

Milk from all four quarters was taken before morning milking. When quarter milk samples were taken the teat ends were disinfected and milk samples were then stored at room temperature for 48 hours due to allocation of milk serum. Featured milk serum of cows in the first and sixth month of lactation were centrifuged at 1200 rpm for 15 minutes to completely set aside serum, and then freezed at -20 ° C for further analysis. When we have collected all the samples of milk, milk serum was further analyzed by atomic absorption spectrometry (AAS) on a Perkin Elmer Elan 6100 ICPMS, Massachusetts, USA.

For statistical analysis we used test of correlation by Statgraphic Centurion (USA). The first step was to determinate a descriptive statistical parameters. The difference in the concentration of zinc in the milk serum in the first and sixth months of lactation was investigated by Vilcoxon test, while the correlation between the concentration of zinc in the first and sixth month is determined by the Spearman correlation test with post-hock analysis of variance.

RESULTS AND DISCUSSION

The value of zinc concentration in the milk serum of cows in early lactation was 24.78± 13.4 μmol/l, while in mid lactation it was 27.62± 12.8 μmol/l. These results are shown in figure 1. and in table 1.

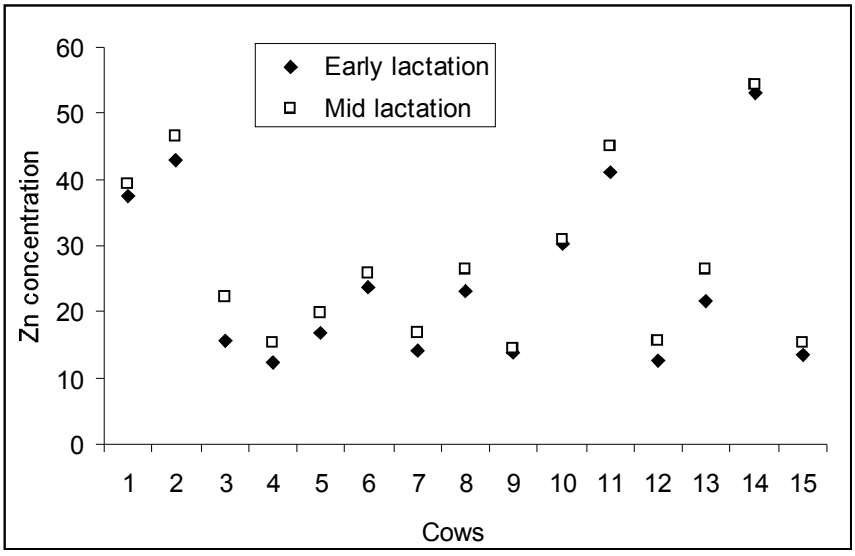

Figure 1. Presentation of the concentration of zinc in cows during two periods of lactation

Table 1. Descriptive statistics for the value of zinc in the milk serum of cows

	Early lactation	Mid lactation
Count	15	15
Average	24,78[a]	27,62[a]
Standard deviation	13,1458	12,9856
Coeff. of variation	53,05%	47,015%
Minimum	12,4	14,3
Maximum	53,1	54,4
Range	40,7	40,1
Stnd. Skewness	1,49566	1,3767
Stnd. Kurtosis	-0,216956	-0,328336

[a] Values with the same superscripts are not significantly different (p> 0.05).

The difference in the concentration of zinc in the milk serum in the first and in the sixth month of lactation did not show statistically significant (p>0,05). These results are shown in figure 2. and in figure 3.

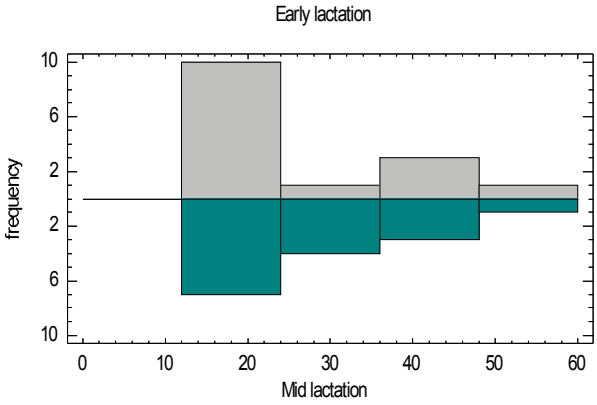

Figure 2. Frequency distribution of zinc concentration in the milk serum in early and mid lactation

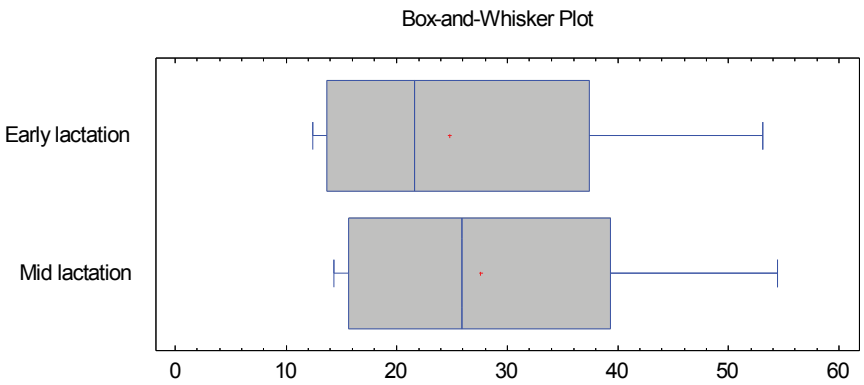

Figure 3. The average concentration (line) median (dot) and standard deviation of zinc concentration in the early and mid lactation

There is significiant positive correlation between the value of zinc in the first and in the sixth month of lactation (r = 0.99; r^2 = 98,54%; standard error of estimation = 1.62). Using regression analysis there was a formula that describes the relationship between concentration of zinc in the milk serum in the first and in the sixth month of lactation and it is:

Zn mid lactacion = 3.32086 + 0.989595 x Zn early lactation. Analysis of variance indicates a high statistical significance this regressim model (p<0,01) and it can be seen in figure 4. and in table 2.

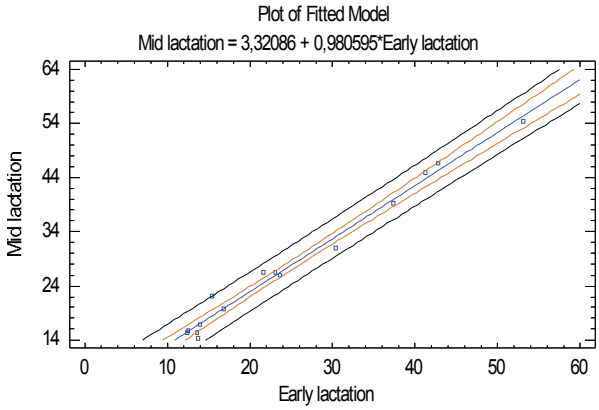

Figure 4. Linear regression and correlation of zinc values in the milk serum between the two groups

Table 2. Analysis of variance of the linear model to investigate the relationship between the concentration of zinc in the early and mid lactation

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	2326,38	1	2326,38	880,05	0,00001
Residual	34,365	13	2,64346		
Total (Corr.)	2360,74	14			

Since there is a significant positive correlation between the value of zinc in the two periods of lactation and that the difference in the concentration of zinc in milk serum is not statistically significant it could be concluded that the value of the zinc in milk serum is stable during time which is shown in the results of the other authors like Hosnedlova et al. (2005.) where the content of zinc in the milk of dairy cows did not show high variability, and its average value was within the recommended limit for zinc content in consumer milk. Since there is a lack of available results in literature about zinc concentration during the lactation period it could be concluded that concentration of zinc is stable during the lactation.

CONCLUSION

Zinc concentration in the milk serum of cows in early lactation was 24.78±13.4 µmol/l, while in mid lactation it was 27.62± 12.8 µmol/l and this value of zinc concentration in the milk serum of cows at different periods of lactation, in first and in sixth month, is approximate and stable during lactation.

REFERENCES

ANDIEU, S.: Is the role for organic trace element supplements in transition cow health? Vet. J., 176:77-83, 2008.

BAKER, D.H., HAMMERMAN, C.B.: Zinc availability. In Bioavailability for nutrients for animals. C.B. Hammerman, D.H. Baker, A.J. Lewis Eds. Academic Press, San Diego, USA, 367-398, 1995.

CINCOVIĆ, M.R., BELIĆ, B., VIDOVIĆ, B., KRČMAR, LJ.: Reference values and frequency distribution of metabolic parameters in cows during lactation and in pregnancy. Contemporary agriculture, 60(1-2)175-182, 2011.

CINCOVIĆ, M.R., BELIĆ, B., RADOJIČIĆ, B., TOHOLJ, B., STANČIĆ, I., STEVANČEVIĆ, M.: Periparturient metabolic profile, blood picture and body condition score in healthy cows and cows with associated periparturient disease. Contemporary agriculture, 61(3-4)205-220, 2012.

COPE, C.M., MACKENZIE, A.M., WILDE, D. AND SINCLAIR, L.A.: Effects of level and form of dietary zinc on dairy cow performance and health. J. Dairy Sci., 92:2128-2135, 2009.

DAVIDOV, I., RADINOVIĆ, M., ERDELJAN, M., CINCOVIĆ, M.R., STANČIĆ, I., BELIĆ, B.: Relations between blood Zinc concentrations and udder health in dairy cows. Rev. Vet. Med., 164(4)183-190, 2013.

GRESSLY, T.F.: Zinc, copper, manganese and selenium in dairy cattle rations. Proceedings of the 7th Annual Mid-Atlantic Nutrition Conference, pp.65-71, 2009.

GORDON, F.E., GORDON, C.R., PASSAL, B.D.: Zinc metabolism-Basic, clinical and behavioral aspects. J. Pediatr., 99:341-349, 1981.

HOSNEDLOVA, B., TRAVNICEK, J., CHRASTNY, V.: Zinc and copper concretation in milk of dairy cows in the south Bohemia region. XIIth International Congress, ISAH 2005, Warsaw, Poland, Vol I, pp 256.

HUTCHESON, D.P.: Nutritional factors affect immune response in cattle. Feedstuffs, 61:16-24, 1989.

KOLARSKI, D.: Osnovi ishrane domaćih životinja. Naučna knjiga. Beograd,1995.

LEE, H.H., PRASAD, S.A., BREWER, J.G., OWZANG, C.: Zinc absorption in human small intestine. Am. J. Physiol., 256:687-691, 1989.

PRASAD, A.S., BAO, B., BECK, Jr. F.W., KUCUK, O. SARKAR, F.H.: Antioxidant effects of zinc in humans. Free Radic. Biolo. and Med., 37:1182-1190, 2004.

RABIEE, A.R., LEAN, I.J., STEVENSON, M.A. AND SOCHA, M.T.: Effects of feeding organic trace minerals on milk production and reproductive performance in lactating dairy cows: A meta-analysis. J. Dairy Sci., 93:4239-4251, 2010.

REDDY, P.G., FREY, R.A.: Nutritional modulation of immunity in domastic food animals. Adv. Vet. Sci. Comp. Med., 35:255
281,1990.

WEISS, W.P., SPEARS J.W.: Vitamin and trace mineral effect on immune function of ruminants. In: Sejrsen K., Hvelplund T.,
Nielsen M.O. (Eds.), Ruminanat Physiology. Wageningen Academic Publishers, Utrecht, The Netherlands, pp. 473-496, 2006.

WIKING, L., LARSEN, T. AND SEHESTED, J.: Transfer of dietary zinc and fat to milk-evluation of milk fat quality,
milk fat precursors and mastitis indicators. J. Dairy Sci., 91:1544-1551, 2008.

KONCENTRACIJA CINKA U MLEČNOM SERUMU KRAVA U RANOJ I SREDNJOJ LAKTACIJI

ZORANA KOVAČEVIĆ, DRAGICA STOJANOVIĆ, IVANA DAVIDOV, GORDANA ŽUGIĆ, MIODRAG RADINOVIĆ, MIHAJLO ERDELJAN

Izvod

Kod krava u ranoj laktaciji uzimaju manje hrane nego što im je potrebno za proizvodnju mleka, što se ogleda u nastanku promena u metaboličkom statusu krava i može značajno uticati na zdravlje krava. U ranoj laktaciji postoje snižene koncentracije cinka u krvi, što je u vezi sa povećanim brojem somatskih ćelija u mleku i nastankom upalnih procesa. Primarna funkcija cinka je antioksidantna. To je mikronutritient za koji je utvrđeno da je bitan sastojak u ishrani mlrčnih krava za održavanje zdravlja. Takođe, cink ima značajnu ulogu i u imunološkom odgovoru organizma.Ukupan sadržaj cinka u organizmu je pod uticajem jake homeostatske regulacije. Za ishranu ljudi, najbolji izvor cinka su namirnice animalnog porekla. Koncentrancija cinka u mlečnom serumu krava u ranoj laktaciji je iznosila 24.78 ± 13.4 μmol/l, dok je u srednjoj laktaciji iznosila 27.62 ± 12.8 μmol/l. Rezultati našeg istraživanja ukazuju da je koncentracija cinka u mlečnom serumu krava u različitim periodima laktacije ima približne vrednosti i tokom perioda laktacije je stabilna.

Ključne reči: cink, mlečni serum, laktacija, krava.

Received / *Primljen*: 22.11.2013.
Accepted / *Prihvaćen*: 21.0 2.2014.