UDC: 619:615:577.1:616-003.269:636

THE EFFECT OF TWO DIFFERENT DOSES OF SELENIUM YEAST AND SODIUM SELENITE ON SELENIUM LEVEL IN BLOOD, COLOSTRUM, MILK AND METABOLIC PROFILE IN DAIRY COWS

[1]**J. Illek,** *Associate Professor MVDr., DrSc., Dipl. ECBHM,*
Heat of Department of Large Animal Clinical Laboratory
President of Czech Association for Buiatrics
hhps://orcid. org/0000-0002-1374-7918
[1]*University of Veterinary Sciences Brno, Czech Republic*
E-mail:illekj@vfu.cz
[2]**D. Kumprechtová,** *Ph. Dr., Researcher*
hhps://orcid. org/0000-0002-2591-9377
[2]*Institute of Animals Science Prague, Czech Republic*
E-mail: dana.kumprechtova@gmail.com
[3]**V. A. Tomchuk,** *Doctor of Veterinary Sciences, Professor,*
Department of Animal Biochemistry and Physilogy named after Academician M. F. Gulyi
hhps://orcid. org/0000-0003-0622-6345
[3]*National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine*
E-mail: tomchuk_viktor@ukr.net
[3]**V. A. Gryshchenko**, *Doctor of Veterinary Sciences, Professor,*
Department of Animal Biochemistry and Physilogy named after Academician M. F. Gulyi
hhps://orcid. org/0000-0001-6601-1392
[3]*National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine*
E-mail: viktoriya_004@ukr.net
[3]**I. V. Kalinin,** *Doctor of Biological Sciences, Professor,*
Department of Animal Biochemistry and Physilogy named after Academician M. F. Gulyi
https://orcid.org/0000-0002-3740-7600
[3]*National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine*
E-mail: kalininihor@gmail.com

Abstract. *The aim of the study was to compare effects of two levels of selenium yeast (SY) and sodium selenite (SS) supplementation on blood, colostrum and milk Se levels, blood chemistry parameters in dairy cows under field conditions.*

The study included 36 Holstein cows from 5 weeks prepartum to 12 weeks postpartum. The cows were divided into 4 treatments (n = 9): 1. Negative Control (NC) – no Se supplement; 2. Positive Control (PC) – 0.3 ppm Se (from sodium selenite); 3. S1 – 0.3 ppm Se (from selenium yeast – SELSAF®, Lesaffre Feed Additives, France); 4. S2 – 5 ppm Se (SELSAF®, Lesaffre Feed Additives, France).

At 5 and 1 weeks prepartum, on the calving day, and 4, 8, 12 weeks postpartum, blood samples were taken. Colostrum and milk were collected on the calving day and 4, 8 and 12 weeks postpartum and analysed for Se content. Initial Se status in all the cows was marginal. Negative Control cows showed suboptimal blood Se levels for the whole period under study. S1 and S2 showed significantly ($P < 0.01$) higher values than NC and PC cows. Colostrum Se levels were significantly higher in S1 (128.17 ug/L) and S2 (155.58 ug/L) than in NC (94.68 ug/L) and PC (99.3 ug/L) cows.

Overall mean milk Se levels in S1 (20.4 ug/L) and S2 (50.0 ug/L) were higher than in NC (10.9 ug/L) and PC (16.6 ug/L). Biochemical indicators of blood did not significantly differ between the treatments and were within the physiological ranges.

Se levels in whole blood, colostrum and milk, and GSH-Px activity were significantly increased by selenium yeast supplementation. The response was dose dependent and consistent. Selenium from organic source was more bioavailable than selenium from sodium selenite. Dietary Se at a tolerance dose (5 ppm) had no detrimental effect on the blood chemistry parameters analysed.

Keywords**: **dairy cows, selenium, yeast, milk

Introduction

It is known that feeding organic Se to ruminants can increase the levels of Se in both colostrum and milk. This can have a two-fold benefit. Firstly, higher levels of Se are passed to suckling offspring, increasing their Se status and optimising health, immunity and growth rates. Secondly, the resulting milk can be marketed as a value added food for the human market, as selenium is also an essential nutrient for human health (Surai, 2008).

Selenium is recognized as an essential trace element and its deficiency has been associated with impaired growth, fertility, and health in farm livestock (Schwarz and Foltz, 1957; Weiss et al., 1990). Selenium is extremely important for the proper postnatal development of the calf. In the first weeks of life, milk is the only source of Se for the calf. However, Se content in milk is rather low (Ortman and Pehrson, 1999), therefore calves from mothers with insufficient Se supplementation often suffer from myodystrophic diseases and other disorders later in their lives. The level of absorption and retention of microelements is modulated by their actual levels in the body and their concentrations in the diet and is generally higher for intake of their organic forms, i.e. those bound to aminoacids (Knowles et al., 1999). The absosorption takes place in the small intestine. SeMet is efficiently absorbed via the methionine transporting system, whereas the absorption of sodium selenite is less efficient and occurs mainly by passive diffusion (Weiss, 2003).

Several studies have shown that Se from sodium selenite is poorly transferred to milk (Ortman and Pehrson, 1999) and that it is unable to maintain the Se status of nursing calves (Koller et al., 1984; Ortman and Pehrson, 1999). Dietary supplementaiton of selenium yeast to cows results in higher concentrations of Se in milk than inorganic Se supplementation (Aspila, 1991; Malbe et al., 1995; Ortman and Person, 1997; Ortman and Pehrson, 1999; Mahan, 2000; Givens et al., 2004).

Selenium is a natural antioxidant. As an integral part of the enzyme glutathione peroxidase (GSH-Px). Se functions to prevent oxidative damage to body tissues (Hoekstra, 1974; Gryshchenko et al., 2016). Many reserachers demonstrated a positive correlation between Se concentrations and GSH-Px activity in blood.

The aim of this study was to investigate the effect of Se source on Se levels in blood, colostrum and milk of dairy cows and whether a high level of supplementation with organic Se does not induce blod and milk Se levels exceeding the physiological range; and what is the dynamic of changes of Se levels in colostrum and milk. Furthermore, the effects of supplementation with different forms and levels of Se on some blood chemistry parameters were investigated.

Materials and methods of research

Management, animals and feeding

The study was performed on a dairy farm with 640 Holstein crossbred cows basic herd with average milk yield of 10.500 kg. The cows were housed loose in pens by 30–40 heads, with straw bedding. Each pen was milked and fed separately, migration of animals between pens was excluded. Cows in the initial lactation phase (ca. 3 weeks post partum) were milked three times a day, others twice a day. The cows were fed total mixed ration TMR. For the diet compostion and analytical values see Tables 1 and 2.

1. Diet composition

Feed (kg/day)	Dry cow diet	Close-up diet	Fresh cow diet	Lactation diet
Clover-grass silage	10	8	9	11
Peas silage	4	5	7	7
Maize silage	6	10	14	14
Maize silage (ears + leaves)	0	2	6	4
Sugar beet pulp	4	6	8	6
Yeast	0	3	3	3
Hey	3.5	1.5	1.5	2
Straw	3	1	0.3	1.0
Concentrate	1	3.5	7.5	4.5
Peas seed	0	0.3	0.5	0.5
Bearley meal	0	2	3	2
Mineral Feed Mikrop M5	0	0.16	0.16	0.16
Monophos	0.25	0	0	0
Sugar	0.3	0	0	0

2. Analysed diet nutrient contents

Nutrient	Unit	Dry cow diet	Close-up diet	Fresh cow diet	Lactation diet

		in fresh matter	in dry matter	in fresh matter	in dry matter	in fresh matter	in dry matter	in fresh matter	in dry matter
Dry matter	%	46.01	100	47.58	100	47.97	100	49.74	100
Crude protein	%	5.67	12.33	7.18	15.09	7.82	16.31	8.74	17.56
Fat	%	1.03	2.24	1.70	3.57	1.91	3:98	2.12	4.26
Crude Fibre	%	11.07	24.06	9.75	20.49	8.56	17.84	7.63	15.33
Ash	%	2.86	6.22	3.64	7.65	3.86	8.05	4.09	8.22
Nitrogen-free extract	%	25.37	55.15	25.32	53.21	25.82	53.82	27.17	54.62
ME cattle	%	4.27	9.27	4.95	10.41	5.63	11.73	5.95	11.96
Calcium	g/kg	3.10	6.73	3.44	7.24	4.40	9.17	4.85	9.75
Phosphorus	g/kg	1.55	3.36	1.7	3.57	2.15	4.49	2.45	4.92
Sodium	g/kg	0.23	0.51	0.58	1.22	1.96	4.08	2.22	4.47
Magnesium	g/kg	0.94	2.04	1.14	2.40	1.44	3.01	1.70	3.41
Selenium	mg/kg	0.045	0,098	0.077	0,162	0.096	0,201	0.108	0,218

Experimental design

In the trial, 36 cows were included. There were four experimental treatments, 9 cows each.

From 5 weeks before the expected calving date to 12 weeks after the calving, the cows received the respective experimental diets: 1) Negative Control diet with no Se supplement; 2) Positive Control diet with sodium selenite – 0.3 ppm Se; 3) S2 diet with selenium yeast – 0.3 ppm Se; 4) S2 diet with selenium yeast – 5 ppm Se.

Se supplements were administered as top dressing on TMR in the through. For PC, S1 and S2, the Se supplements were provided via a wheat flour-wheat bran premix. NC received a wheat flour – wheat bran premix with no Se source added.

A regular diet on the farm is supplemented with 0.3 ppm Se from an inorganic source (sodium selenite). The regular Se supplement was withdrawn from the diet one moth before the start of the trial to induce a marginal selenium status in the cows.

The detailed time schedule of the trial was as follows:

All Treatments
Day 0: Beginning of experimental diets, selection of cows for the experimental treatments according to calving date, parity, previous lactation performance; Blood collection from all the cows for biochemistry (Se, GSH-Px, urea, CK, TP, albumin, GMT, AST, ALT, Vitamin E)
1 wk prepartum: Blood collection – Se, biochemistry
Calving: Blood collection – Se, biochemistry Colostrum collection – Se concentration
4 wk pospartum: Blood collection – Se, biochemistry Milk collection – Se concentration
8 wk postpartum Blood collection – Se, biochemistry Milk collection – Se concentration
12 wk postpartum Blood collection – Se, biochemistry Milk collection – Se concentration

Samplings and laboratory analyses

Blood samples were taken from the tail vein of all the cows, using the HEMOS kit (1 lithium heparine, 1 K_3EDTA, and 1 serum tube). Milk and colostrum were collected in sterile tubes. The samples were frozen at – 18 °C and processed in the end of the study. The blood chemistry parameters measured included total protein (TP), albumine (Alb), creatin phosphokinase (CK), aspartate aminotransferase (AST), gamma-glutamyltrasferase (GMT), alanine aminotransferase (ALT), vitamin E, and glutathione peroxidase (GSH-Px). Standard analytical techniques were used for these analyses (Central Clinical Laboratories, University of Veterinary and Pharmaceutical Scinces, CZ). The concentrations of Se in whole blood, milk and feed were analysed with hydride generation atomic absorption spectrophotometry (HG-AAS) as described by Sturman (1958). At the start of the trial, feed analyses were performed.

The raw data were statistically processed with the software SPSS. The cow represented the unit for statistical analysis. Data except colostrum Se content, milk composition and production were analysed by a mixed repeated procedure. Colostrum Se content, milk composition and production data were analysed by a variance analysis (ANOVA). Results were declared as significant from $P < 0.1$.

Results of the research and their discussion

Blood chemistry parameters

The values of TP, urea, billirubin, AST, GMT, CK were within physiological ranges (Table 3). AST and GMT liver enzyme values were not apparently influenced by Se supplementation. CK activity decreased with increasing levels of organic Se, suggesting an improved muscle metabolism due to organic Se supplementation. These results are in accordance with those received by Juniper et al. (2006) who did not find any significant effect between with different levels of supplemental Se from Se yeast and the unslupplemented control, with the exception of blood urea and glucose values.

The values we found were generally within the expected normal range (Beers and Berkow, 1998).

3. Mean blood chemistry values from cows supplemented with selenite or two different levels of selenium yeast

Index	NC	PC	S1	S2	SE	P
Total protein, g/L	73.8	75.0	75.4	74.8	0.6	NS
Urea (mmol/L)	4.8	4.75	4.9	4.9	0.2	NS
Billirubin (μmol/L)	4.4	4.5	4.5	4.3	0.1	NS
Aspartate aminotransferase, ukat/L	1.5	1.5	1.5	1.5	0.0	NS
Gamma-glutamyltrasferase, ukat/L	0.4	0.4	0.4	0.4	0.0	NS
Creatin phosphokinase, ukat/L	3.3^{b}	4.7^{a}	2.8^{bc}	2.0^{c}	0.4	<0.01

Notes: ^{a,b,c} Means within a line with different superscripts differ significantly.

gGSH-Px activity

The activity of the selenoenzyme glutathione peroxidase is often considered to reflect the selenium concentration in whole blood. This was the case in this study, too. Levels of GSH-Px in the SY supplemented groups were significantly higher already in the fourth week of the study (1 wk prepartum) ($P < 0.01$) and the SS supplemented group the GSH-Px values were significantly lower than those in the NC only 9 weeks from the start of supplementation (Table 4).

This increase seems to be earlier than that reported by Ortman and Perhson (1999) who noted that in a 12-wk study comparing the effect of Se source, the GSH-Px activity in cows receiving either selenate, SS or SY remained relatively constant for the first 6 wk of the study, but then increased markedly in wk 6 to 12, with the highest values noted for cows receiving the diet containing SY.

On the contrary, Juniper et al. (2006) did not receive any significant treatment effect for either source or concentration of dietary selenium on GSH-Px, but in their study 5 wk periods were used in the Latin square design which might have not be long enough for differences to develop. Similarly, out of 11 studies reviewed by Weiss (2003), 9 reported no significant difference in GSH-Px activity when comparing SY with SS.

4. Glutathione peroxidase activity in erythrocytes (ukat/L) of cows when supplemented with selenite or two different levels of selenium yeast

Treatment	NC	PC (0.3ppm Se)	S1 (0.3ppm Se)	S2 (5 ppm Se)	*P*

	GSH-Px (ukat/L)		GSH-Px (ukat/L)		GSH-Px (ukat/L)		GSH-Px (ukat/L)		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	
5 wk a.p.	701.69	22.13	606,52	59,57	658.31	58.43	640.04	47.48	
1 wk a.p.	688.48a	41.05	770,27ab	117,0	808.35b	81.88	1000.45c	89.05	< 0.01
Calving	692,20a	89.27	782,29a	96,48	968.51b	65.92	1062.96c	96.07	< 0.01
4 wk p.p.	687.40a	91.12	819,42b	70,84	1051.91c	111.09	1160.97d	71.87	< 0.01
8 wk p.p	719,84a	4.28	826,15b	49,19	898.44c	322.79	1141.14d	94.61	< 0.01
12 wk p.p.	737.95a	108.62			1014.59b	44.84	1168.39c	94.58	< 0.01

Notes: ^{a,b,c,d} Means within a line with different superscripts differ significantly.

Selenium concentrations in blood

As shown in the Table 5, Se concentrations in blood in all the cows at the beginning of the trial, pre-supplementation, were suboptimal in all the experimental groups (NC – 69.06 ug/L, PC – 70.3 ug/L, S1 – 77.74 ug/L, S2 – 70.6 ug/L).

5. Mean whole blood selenium concentration for cows when supplemented with selenite or two different levels of selenium yeast

Treatment	NC		PC (0.3ppm Se)		S1 (0.3ppm Se)		S2 (5 ppm Se)		*P*
	Se (ug/L)		Se (ug/L)		Se (ug/L)		Se (ug/L)		
	mean	S.D.	mean	S.D.	mean	S.D.	mean	S.D.	
5 wk a.p.	69.16	5.0	70.3	5.7	77.7	7,3	70.6	6,7	
1 wk a.p.	68,2^{a}	6.2	90.8^{a}	7.0	97,7^{b}	7.7	155,0^{c}	22.1	< 0.01
Calving	67.0^{a}	5.6	93.6^{b}	7.9	109,1^{c}	7,9	152,2^{d}	16.5	< 0.01
4 wk p.p.	65.7^{a}	5.7	86.1^{b}	33.7	129,1^{c}	7.7	170,8^{d}	19.8	< 0.01
8 wk p.p	68.9^{a}	4.3	105.1^{b}	7.0	128.6^{c}	11.2	184.4^{d}	9.9	< 0.01
12 wk p.p.	73,52^{a}	5.03	110.0^{b}	15.9	129,22^{c}	9.58	193,49^{d}	15.32	< 0.01

Notes: ^{a,b,c,d} Means within a line with different superscripts differ significantly.

The unsupplemented Negative Control cows showed suboptimal Se concentrations in blood for the whole experimental period, with the highest values in the weeks 8 and 12 postpartum (68.94 ug/L and 73.52 ug/L, respectively), but not significantly different.

The S1 (0.3 ppm Se as selenium yeast) and PC cows (0.3 ppm Se as sodium selenite) showed a steady increase in blood Se concentrations which were significantly higher ($P < 0.05$) than those of the NC. Mean values for the whole experimental period were 118 and 99 ug/L, respectively. Selenium concentration in blood of S1 cows was significantly higher than the one in PC cows ($P<0.05$).

Se concentrations in blood of the S2 (5 ppm Se as Se yeast) cows was increasing quickly and already one week prepartum were more than twice as high as in the NC (68.18 vs. 155.09, $P < 0.01$). The blood Se concentrations were gradually increasing in S2 and reached 184.42 ug/L and 193.49 ug/L in the weeks 8 and 12 post partum, respectively. These values are relatively high and are considered as optimal by many scientists.

Similar benefits of SY over SS were reported by Fisher et al. (1995), Knowles et al. (1999), Pehrson et al., 1999, Juniper et al. (2006) and in the studies reviewed by Weiss (2003) who reported an overall mean 18% difference in blood Se concentrations between cows supplemented with equal amounts of Se yeast and sodium selenite in the studies reviewed.

The values received in this study were generally lower (even for the 5 ppm dose of Se from Se yeast) than those received by Juniper et al. (2006).

Selenium concentrations in colostrum and milk

As shown in Table 6, the differences in Se concentrations in colostrum between the experimental groups were considerable. As compared with the NC group (94.68 ug/L), Se colostrum concentrations were significantly ($P < 0.01$) higher with both the levels of SY (S1 – 128.17 ug/L; S2 – 155.58 ug/L), but not with SS as Se source.

6. Selenium concentrations in colostrum and milk for cows when supplemented with selenite or two different levels of selenium yeast

Treatment	NC		PC (0.3 ppm Se)		S1 (0.3 ppm Se)		S2 (5 ppm Se)		P
	Se (ug/L)		Se (ug/L)		Se (ug/L)		Se (ug/L)		
	mean	S.D.	mean	S.D.	mean	S.D.	mean	S.D.	
Calving	94.68[a]	9.14	99,31[a]	8,0	128.17[b]	18.90	155,58[c]	14.75	< 0.01
4 wk p.p.	10.10[a]	3.38	15,93[b]	2,22	21.24[b]	2.46	37.01[c]	14.84	< 0.01
8 wk p.p	9.50[a]	5.65	16,58[b]	2,78	19.64[b]	1.41	45.23[c]	9.93	< 0.01
12 wk p.p.	9.09[a]	5.21			20.06[b]	2.16	56.49[c]	24.53	< 0.01

Notes: [a,b,c,] Means within a line with different superscripts differ significantly.

Se concentrations in milk of the NC cows were low throughout the experimental period, there was not a great variation between the individual cows. The S1 cows showed significantly (P < 0.01) higher concentrations than the control ones. The S2 cows showed the highest values, significantly (P < 0.01) higher than the NC and S1. Cows receiving SS had significantly higher Se levels in milk, similar to those supplmented with the lower dose of SY.

An increase of Se in milk of animals supplemented with SY as compared with those supplemented with SS has been reported to range from 34% (Juniper et al., 2006) to 90% (Weiss, 2003).

It has been demonstrated that Se content in colostrum is higher than that in milk (Micetic-Turk et al., 2000; Pavlata et al., 2004).

Significantly higher concentration of Se in milk of dayir cows supplemented with selenium yeast were also reported by Givens et al. (2004), Juniper et al. (2006) and other researchers. As suggested by Pehrson (1993), the increased selenium concentration in milk derived from diets containign Se may be due to the preferential mammary gland uptake of SeMet, which is readily incorporated into milk protein (Juniper et al., 2006).

Conclusion

The study investigated the effect of dietary supplementation with two different levels of Se from selenium yeast (recommended and tolerance levels) and sodium selenite in selenium deficient dairy cows in the period from 5 weeks prepartum to 12 weeks postpartum on selenium levels in blood and milk and blood chemistry.

The results have shown that the Se levels in whole blood, colostrum and milk were significantly increased by SY supplementation. The GSH-Px activity was also significantly improved by SY supplementation. The response was dose dependent and consistent. Both the experimental doses eliminated selenium deficiency.

In this trial, Se from organic source – selenium yeast – was more bioavailable than selenium from inorganic source-sodium selenite.

References

Aspila, P. (1991). Metabolism of selenite, selenomethionine and feed incorporated selenium in lactating goats and dairy cows. Journal of agricultural science in finland, 63, 1-74. doi: 10.23986/afsci.72394

Beers, M. H., & Berkow, R. (1998). The merck veterinary manual. http://www.merck.com Accessed May 15, 2005.

Fisher, D. D., Saxton, S. W., Elliott, R. D. & Betty, J. M. (1995). Effects of selenium sources on selenium status of lactating cows. Veterinaiy clinical nutrition, 2, 68–74. doi: 10.3168/jds.S0022-0302(06)72394-3

Givens, D. I., Allison, R., Cottrill, B. & Blake, J. S. (2004). Enhancing the selenium content of bovine milk through alteration of the form and concentration of selenium in the diet of the dairy cow. Journal of the science of food and agriculture, 84, 811–817. doi: 10.1002/jsfa.1737

Gryshchenko, V. A., Chernyshenko, T. M., Gornitska, O. V., & Platonova, T. M. (2016). Evaluation of the functional state of liver and the efficiency of therapy for enteropathy of calves. Fiziolohichnyi Zhurnal, 62(6), 102-109. doi: 10.15407/fz62.06.102

Hoekstra, W. G. (1974). Biochemical role of selenium. Pages 61–77 in Trace element metabolism in animals, Vol. II. W. G. Hoekstra, J. W. Suttie, H. E. Ganther, and W. Mertz, ed. Univ. Park Press, Baltimore, MD.

Juniper, D. T., Phipps, R. H., Jones, A. K. & Bertin, G. (2006). Selenium supplementation of lactating dairy cows: effect on selenium concentration in blood, milk, urine and feces**.** Journal of dairy science, 89, 3544-3551. doi: 10.3168/jds.S0022-0302(06)72394-3

Surai, P. F. (2008). Increasing selenium levels in mil. Pages 325-327 in Current advances in selenium research and applications, Vol. I P.F. Surai, J.A. Taylor-Pickard, ed. Wageningen Academic Publishers

Koller, L. D., Whitbeck, G. A., & South, P. J. (1984). Transplacental transfer and colostral concentrations of selenium in beef cattle. American journal of veterinary research, 45, 2507-2510. PMID: 6524746

Knowles, S. O., Grace, N. D., Wurms, K. & Lee, J. (1999). Significance of amount and form of dietary selenium on blood, milk, and casein selenium concentrations in grazing cows. Journal of dairy science, 82, 429–437.

Mahan, D. C. (2000). Effect of organic and inorganis selenium sources and levels on sow colostrum and milk selenium content. Journal of animal science, 78, 100-105. doi: 10.3168/jds.S0022-0302(99)75249-5

Malbe, M., Klaassen, M., Fang, W., Myllis, V., Vikerpuur, M., Nyholm, K., Sankari, S., Suoranta, K. & Sandholm, M. (1995). Comparisons of selenite and selenium yeast feed supplements on Seincorporation, mastitis and leucocyte function in Se-deficient dairy cows. Journal of veterinary medicine, A 42, 111-121. doi: 10.1111/j.1439-0442.1995.tb00362.x.

Micetic-Turk, D., Rossipal, E., Kracher, M. & Li, F. (2000). Maternal selenium status in Slovenia and its impact on the selenium concentration of ublicical cord serum and colostrum. European journal of clinical nutrition, 54(6):522-524. doi: 10.1038/sj.ejcn.1601050

Ortman, K., & Pehrson, B. (1997). Selenite and selenium yeast as feed supplements for dairy cows. Journal of veterinary medicine, A 44, 373-380. doi: 10.1111/j.1439-0442.1997.tb01121.x

Ortman, K., & Pehrson, B. (1999). Effect of selenate as a feed supplement to dairy cows in comparison to selenite and selenium yeast. Journal of animal science, 77(12), 365-3370. doi: 10.2527/1999.77123365x

Pavlata, L., Pechova, A. & Dvorak, R. (2004). Microelements in colostrum and blood of cows and their calves during colostral nutrition. Acta veterinaria Brno, 73, 421-429. doi: 10.2754/avb200473040421

Pehrson, B. (1993). Selenium in nutrition with special reference to biopotency of organic and inorganic selenium compounds. Pages 71-89 in Proc. 9th Alltech Symp., Biotechnol. Feed Ind. T. P. Lyons, ed. Nottingham University Press, Nottingham, UK.

Pehrson, B., Ortman, K., Madjid, N. & Trafikowska, U. (1999). The influence of dietary selenium as selenium yeast or sodium selenite on the concentration of selenium in the milk of suckler cows and on the selenium status of their calves. Journal of animal science, 77, 3371-3376. doi: 10.2527/1999.77123371x

Schwarz, K., & Foltz, C. M. (1957). Selenium as an integral part of factor 3 against dietary necrotic liver degeneration. Journal of the American Chemical Society, 79, 3292-3293. PMID: 10408880

Suzuki, K. T., & Ogra, Y. (2002). Metabolic pathway for selenium in the body: Speciation by HPLC-ICP MS with enriched Se. Food additives and contaminants. 19(10), 974-983. doi: 10.1080/02652030210153578

Weiss, W. P. (2003). Selenium nutrition of dairy cows: Comparing responses to organic and inorganic selenium forms. Pages 333-343 in Proc. 19th Alltech Annual Symp. Nutr., Biotechnol. Feed Food Ind. P. T. Lyons and K. A. Jacques, ed. Nottingham University Press, Nottingham, UK.

Weiss, W. P. (2005). Selenium sources for dairy cattle. Pages 61-72 in Proc. Tri-State Dairy Nutr. Conf., Ft. Wayne, IN. The Ohio State Univ., Columbus.

Weiss, W. P., Todhunter, D. A., Hagan, J. S. & Smith, K. L. (1990). Effect of duration of supplementation of selenium and vitamin E in periparturient dairy cows. Journal of dairy science, 73, 3187-3194. doi: 10.3168/jds.S0022-0302(90)79009-1

Wright, P. L., & Bell, M. C. (1966). Comparative metabolism of selenium and tellurium in sheep and swine. The American journal of physiology, 211(1), 6-10. doi: 10.1152/ajplegacy.1966.211.1.6

Іллек Й., Кумпречтова Д., Томчук В.А., Грищенко В.А., Калінін І.В. Вплив двох різних доз селено-містких дріжджів та селеніту натрію на рівень селену в крові, молозиві і молоці та металопрофіль у молочних корів (2021). *Ukrainian Journal of Veterinary Sciences. Метою дослідження було порівняти вплив двох доз добавок селен-містких дріжджів (SY) та натрію* *селеніту (SS) на рівень Se в крові, молозиві та молоці, біохімічні показники крові в молочних корів у польових умовах.*

Дослідження включало 36 корів голштинської породи від 5 тижнів до отелення і 12 тижнів після них. Корів було поділено на 4 групи (n = 9): 1. Від'ємний контроль (NC) – без добавки Se; 2. Позитивний контроль (PC) – 0,3 проміле Se (з селеніту натрію); 3. Дослідна група S1 – 0,3 проміле Se (з селено-містких дріжджей – SELSAF®, кормові добавки Lesaffre, Франція); 4. Дослідна група S2 – 5 ppm Se (SELSAF®, кормові добавки Lesaffre, Франція).

Зразки крові від корів відбирали на 5 та 1 тижні до народження, у день отелення та на 4, 8 і 12 тиждень після отелення відбирали зразки крові. Молозиво і молоко вилучали в день отелення і на 4, 8 та 12 тиждень після нього і аналізували їх на вміст Se. Початковий рівень Se в крові корів усіх чотирьох груп був низьким. Впродовж усього досліджуваного періоду в крові корів групи NC спостерігався вихід рівня Se за оптимальні межі. У групах S1 і S2 встановлено вірогідно ($P < 0,01$) вищі його значення, ніж у корів NC і PC груп. Рівень Se у молозиві у корів груп S1 (128,17 мкг/л) і S2 (155,58 мкг/л) був значно вищим, ніж у корів груп NC (94,68 мкг/л) і ПК (99,3 мкг/л).

Загальний середній рівень Se в молоці корів дослідних груп S1 (20,4 мкг/л) та S2 (50,0 мкг/л) був вищим, ніж у контрольних групах NC (10,9 мкг/л) і ПК (16,6 мкг/л). Біохімічні показники крові тварин з різних груп істотно не відрізнялися і знаходилися в межах фізіологічних діапазонів.

Рівень Se в цільній крові, молозиві та молоці корів, а також активність глутатіонпероксидази значно підвищувалися за рахунок добавок селен-містких дріжджів. Відповідь організму була дозозалежною та опосередкованою. Селен з органічних джерел був біодоступнішим, ніж із селеніту натрію. Добавка Se з допустимою дозою (5 проміле) не мала негативного впливу на досліджувані біохімічні показники крові.

Ключові слова: молочні корови, селен, дріжджі, молоко