Journal of Animal and Feed Sciences, 14, Suppl. 1, 2005,255–258

Effects of pre- and postpartum injections of Se, Zn and vitamin E on their concentration in ewes milk*

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ABSTRACT

The study was conducted on 40 Polish Merino ewes divided into two groups: experimental (E) and control (C), each of 20 animals. Four weeks before lambing, 1 day, 3 weeks and 6 weeks after lambing, the ewes from group E were i. m. injected with 5 ml 0.1% Na_2SeO_4, 10 ml 10% $ZnSO_4$ and 250 mg vitamin E (α- tocopherol). The concentrations of Se, Zn and vitamin E were determined in ewe milk 1 day after lambing (colostrum), 1 week, 3, 4, 6 and 7 weeks after lambing. The colostrum concentrations of Se (130.7 ng/ml), Zn (28.4 μg/ml) and vitamin E (2.66 μg/ml) were higher ($P<0.01$) than in milk. Simultaneous injections of Se, Zn and vitamin E at 4 weeks before lambing did not increase the level of these nutrients in colostrum. The Se, Zn and vitamin E injections after lambing were effective in increasing the contents of these nutrients in milk.

KEY WORDS: selenium, zinc, vitamin E, milk, ewes

INTRODUCTION

Interest in the role of selenium (Se), zinc (Zn) and vitamin E in human nutrition is increasing as more and more investigators realize the essential role of

* Supported by the State Committee for Scientific Research, Grant No. 6 P06Z 01921
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these nutrients in human health. The milk of all animal species is notoriously low in trace elements. The Se concentration in milk is lower than that of other essential trace elements (Cu or Zn).

Transfer of nutrients from dam to offspring occurs *via* two pathways, placental transfer and colostrum/milk digestion. Prepartum injections of Se and vitamin E to sheep will result in higher colostrum concentrations of these elements, with a 1 month carry-over of Se in milk produced later (Cuesta et al., 1995). Some researchers have reported higher milk levels of Se but not vitamin E by subsequent injection of Se or vitamin E, respectively (Meneses et al., 1994). Enhancement of food with trace elements based on their introduction into the food chain is a safe and inexpensive method. This study was, therefore, initiated to evaluate opportunities to enhance the Se, Zn and vitamin E content in the milk of sheep. The objectives of this study were to evaluate the effects of intramuscular injection of Se, Zn and vitamin E to ewes on Se, Zn and vitamin E concentrations in colostrum and milk.

MATERIAL AND METHODS

The experiment was carried out on 40 Polish Merino ewes divided into two groups: control (C) and experimental (E), each of 20 animals. Four weeks before lambing, 1 day, 3 weeks and 6 weeks after lambing, 20 ewes from group E received intramuscular injections of 5 ml 0.1% Na_2SeO_4, 10 ml 10% $ZnSO_4$ and 250 mg vitamin E (α- tocopherol). The ewes from all groups were kept in the same shed. Nutrition was based on local feeds: maize silage, meadow hay, feed supplement (oats, wheat bran, rapeseed oilmeal), mineral premix and pasture in the summer. The content of Se and Zn in the feeds would be considered standard, i.e. 0.12-0.18 mg/kg DM Se and 25.1-53.1 mg/kg DM Zn.

Milk from ewes was sampled 1 day after lambing (colostrum) and 1 week, 3, 4, 6 and 7 weeks after lambing. Except at parturition, milk was sampled shortly after a 1 ml oxytocin injection to stimulate milk let-down. The Zn content in milk was determined by atomic absorption spectrometry. The α-tocopherol contents were determinaned by HPLC. Milk samples were mineralized in a mixture of 5 ml HNO_3 and 1 ml H_2O_2 in hermetic high-pressure vessels by heating in a microwave oven. Total selenium content was estimated by flame (air-acetylene) atomic absorption spectrophotometry using a hydrogen generation system. Selenium hydride was generated with $NaBH_4$. Basic statistical parameters of results (means, standard errors of means) and a comparison between results of groups using the t-test were computed using Microsoft Excel and Statistica for Windows.

RESULTS AND DISCUSSION

Means and standard errors of Se, Zn and vitamin E concentrations in colostrum and milk during the first 7 weeks of lactation are shown in Table 1. The levels of Se, Zn and vitamin E in colostrum in experimental and control groups were similar. This suggests that Se, Zn and vitamin E injected 4 weeks before lambing do not increase the levels of these nutrients. Probably the time before lambing (4 weeks) was too long. It was observed that colostrum contained higher concentrations of Se, Zn and vitamin E than whole milk. The second injection on 1 day after lambing slightly increased Se and Zn levels one week after lambing. The level of vitamin E also increased, but not significantly. The next injections at 3 and 6 weeks after lambing significantly increased Se levels at 4, 6 and 7 weeks after parturition, vitamin E levels at 4 and 7 weeks, and Zn levels 7 weeks after lambing. Meneses et al. (1994) showed that ewes injected with vitamin E and Se at lambing had significantly higher vitamin E and Se contents in milk than the control group up to day 14 of lactation. Ewes receiving two prepartum injections of the highest Se dose had higher milk Se concentrations than controls at both parturition and 1 month later (Cuesta et al., 1995).

Table 1. Means and standard errors (SE) of selenium, zinc and vitamin E in the milk of ewes

Weeks after lambing	Se ng/ml		Vitamin E µg/ml		Zn µg/ml	
	group E	group C	group E	group C	group E	group C
Colostrum	119.7	130.7	2.82	2.66	26.8	28.4
SE	34.7	42.8	0.55	0.49	11.0	11.4
Milk						
1	55.2^{a}	36.7^{b}	1.10	0.62	6.97^{a}	5.64^{b}
SE	24.5	9.8	0.56	0.31	1.79	0.59
3	42.2	35.9	1.05	0.56	6.18^{a}	5.56^{b}
SE	12.6	7.2	0.52	0.30	0.74	0.75
4	44.5^{a}	28.6^{b}	1.10^{a}	0.51^{b}	6.09	4.88
SE	10.4	10.1	0.50	0.23	1.64	0.80
6	30.8^{a}	22.1^{b}	0.89	0.51	5.38	4.52
SE	8.9	7.4	0.48	0.29	1.31	1.09
7	30.8^{A}	20.6^{B}	0.99^{a}	0.49^{b}	5.91^{A}	4.06^{B}
SE	5.3	5.1	0.49	0.21	0.85	0.70

$^{a,b;\ A,B}$ - means within the group E and C with different letters are significantly different:
^{a,b} - $P<0.05$, ^{A,B} - $P<0.01$

Selenium or vitamin E injection increased only Se in the colostrum but not vitamin E (Cuesta et al., 1995). Oral supplementation of Holstein-Friesian cows with mineral complex and vitamins (10-14 days before and 120 days after calving) resulted in an increase in the vitamin E concentration in milk (Strusińska et al., 2004). Some researchers have reported that cows fed a diet with higher levels of

Zn efficiently absorb this element, increasing its concentration in blood plasma but not in milk (Brzóska and Kowalczyk, 2002). Data obtained in this study indicate that injection of Se, Zn and vitamin E significantly affects Zn levels in milk at 1 week, 3 and 7 weeks after lambing. Introduction of Se, Zn and vitamin E through injection enables increasing their content in milk. In such studies sheep can be used as a model for other ruminant species.

CONCLUSIONS

Injection of Se, Zn and vitamin E together at 4 weeks before lambing does not increase concentrations of these nutrients in colostrum. The Se, Zn and vitamin E injections after lambing were effective in increasing these nutrients' contents in milk.

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STRESZCZENIE

Wpływ iniekcji Se, Zn i witaminy E przed i po wykocie owiec na ich zawartość w mleku

Badania przeprowadzono na 40 maciorkach merynosa polskiego, podzielonych na 2 grupy po 20: doświadczalną (E) i kontrolną (K). Maciorkom doświadczalnym podano w iniekcji domięśniowej 4 tygodnie przed planowanymi wykotami, 1 dzień po wykocie, oraz w 3 i 6 tygodni po wykocie następujące związki: 5 ml 0,1% Na_2SO_4, 10 ml 10% $ZnSO_4$ i 250 mg witaminy E (α-tocopherol). Oznaczono zawartość Se, Zn i witaminy E w mleku owiec w 1 dniu po wykocie (siara), oraz w 1, 3, 4, 6 i 7 tygodniu po wykocie. Stwierdzono, że siara owiec zawiera kilka razy więcej Se (130,7 ng/ml), Zn (28,4 μg/ml) i witaminy E (2,66 μg/ml) niż mleko ($P<0,01$). Domięśniowe iniekcje Se, Zn i witaminy E na 4 tygodnie przed wykotami owiec nie wpłynęły na wzrost ich zawartości w siarze. Kolejne iniekcje po wykocie wpłynęły natomiast istotnie na wzrost zawartości Se, Zn i witaminy E w mleku.