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INFLUENCE OF DIFFERENT SELENIUM AND IODINE OFFER DURING THE GRAZING PERIOD OF SHEEP ON THE MILK YIELD, MILK PERFORMANCE AND DAILY PROTEIN, FAT AND LACTOSE SECRETION

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Abstract

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The large population size of different sheep breeds and their wide adaptability to forage quality, make sheep widely accepted and genetically of great potential for production of ewes milk and different milk products. However, the established imbalances of basic essential elements in the flora (Se, I)) in the investigated area (Rhodope Mountain - Village Borino) affected negatively the milk production during the pasture period. Through the milking periods (April-June) the control ewes were additionally supplemented "per os" with 0.25mg selenium in the form of $NaHSe0_3$ and 0.15 mg iodine in the form of KI daily. The experiments were carried out with 16 ewes of Rhodope Tsygai breed, divided into two groups. The animals were fed according to ARC norms with different amounts of selenium and iodine during the experimental period. The milk samples were taken on the 30th and the 60th day after supplementation. Selenium and iodine deficiency in the ration reduced the milk yield during the whole period (60th days) by 44%. The Se-I-unsupplemented ewes produced daily 35% less fat and 41% less milk protein in comparison to the supplemented one.

Key words: selenium and iodine supplementation, ewe's milk, properties
Abbreviations: Se – selenium; I – iodine; KI – potassium iodide

Introduction

There has been increasing interest in the ewe's milk products in the last several years. Their quality highly depends on the milk performance of the raw milk. The effect of trace element supplementation in the feed ration of different sheep breeds on the milk yield and milk quality during the lactation period has not yet been thoroughly investigated. The species-specific trace element supply to different sheep breeds and its reaction during the supplementation showed that the results obtained in one genotype can not be transferred to another, without experimental testing (Angelow et al., 1998; Groppel, 1987; Odjakova et al., 1998; Petrova et al., 1999; Todorova et al., 1993; 1996; 1997). In mountainous areas the established deficiency of basic essential trace elements (sele-

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nium, iodine, zinc, cobalt, iron) in the feed ration reflects on the productivity and biological status of sheep (Angelow and Todorova, 1998). Se deficiency influenced negatively the Se transfer in goat and sheep milk (Angelow et al., 1993; Anke et al., 1989; Todorova et al., 1993, 1997). On the other hand high levels of some macro- and trace elements (Ca, S, Cu) might influence the Se accumulation and led to secondary Se-deficiency in the organism of ruminants (Angelow, 1995; Dragnev et al., 1991). Synergistic effect between Se and I was investigated in rats and sheep (Angelow, 1997; Arthur et al., 1991; Burk, 1994; Delange et al., 1993). Se deficiency impairs thyroid hormone metabolism by inhibiting the activity of the deiodinases, which convert thyroxine (T_4) to the more metabolically active 3, 3'-5 triiodthironine (T_3). Se deficiency led to a decrease of the I-contents (27-50%) in the milk and blood serum (Angelow, 2008).

The objective of present study was to establish the effect of Se and I supplementation to the feed of lactating sheep (Rhodope Tsigai) on the milk yield, fat and protein production during the lactation period (60 days).

Material and Methods

The experiments were carried out with 16 ewes of Rhodope Tsigai breed, divided into two groups. During the grazing period, in depends on vegetation stage of the flora, the animals were grazed on pasture with different amounts of selenium and iodine. From the first of May to the first of July the pasture grass contained on the average 0.085 mg Se/kg DM and 0.093 mg I /kg DM. During investigated period (60 days) the control group received additionally 0.25 mg Se/day as $NaHSeO_3$ and 0.20 mg I/day as KI.

The milk samples were taken on the 30th and 60th day after supplementation. Milk protein was determined using Milkotester of Foss Electric (Denmark) and milk fat by Gerber's method.

Through the milking periods (on pasture) the control ewes were additionally supplemented "per os" with 0.25mg Se in the form of $NaHSe0_3$ and 0.15 mg I in form of KI daily. The animals were fed according to ARC norms with different amounts of selenium and iodine during the experimental period. The milk samples were taken on the 30th and the 60th day after supplementation.

Statistical analyses were performed using "General Statistic Pack" of Hewlett Packard.

Results and Discussion

The effect of selenium and iodine supplementation on the milk production was investigated during the first 60 days after the weaning period. Milk yield was tested through individual milk samples,

Table 1

Effect of Se-I supplementation on the daily milk yield of Rhodope Tsigai ewes during the milking period (n= 8; 8)

Daily milk yield, ml	30th day after supplementation	60th day after supplementation	p**	%
Supplemented group	743 ± 212	363 ± 78	< 0.001	49
Deficient group	499 ± 229	309 ± 110	< 0.05	62
%	149	117	-	-
p*	< 0.05	> 0.05	-	-

* Deficient group=100%; Supplemented group=X%

** 30th day =100%; 60th day =Y%

collected during the active pasture period. Data on the milk yield dynamics at the 30th and 60th day after supplementation are presented on Table 1.

The amount of milk produced by control and deficient ewe's differed significantly. The control group produced at any time more milk (245 - 54 ml/d) with natural fat content in comparison to the deficient one (49% and 17%). With advance of lactation the milk yield of both groups has been reduced by 51% (363 ± 78 ml/day) and by 38% (309 ± 110 ml/day).

These results confirmed the tendency that Se-I unsupplemented animals produced less milk, because both elements take an important place in the intermediary processes and are responsible for the normalization of milk gland function. In this case a specific reaction of the organism depending from the initial biological status of different species is obvious. Selenium and iodine deficiency during the grazing period hadn't any effect on the protein content of sheep milk (Table 2).

During the different sub-periods, the protein contents varied from 5.90% to 6.62% in supplemented group, and from 6.09% to 6.50% in the deficient one. In the course of lactation changes in the milk protein composition and differences between the groups have not been established.

Regarding the fat content of raw milk the characteristic increase in the fat content with advance of lactation reached 24% in the supplemented group ($p < 0.01$) and 19% in the Se-I deficient ($p < 0.01$), and was related to the reduction of milk

Table 2

Effect of Se-I supplementation on the protein content of Rhodope Tsigai ewes during the milking period (n= 8; 8)

Milk protein, %	30th day after supplementation	60th day after supplementation	p**	%
Supplemented group	5.90 ± 0.17	6.62 ± 0.64	> 0.05	112
Deficient group	6.09 ± 0.24	6.50 ± 0.44	> 0.05	107
%	97	102	-	-
p*	> 0.05	> 0.05	-	-

* Deficient group=100%; Supplemented group=X%

** 30th day =100%; 60th day =Y%

Table 3

Effect of Se-I supplementation on the milk fat content of Rhodope Tsigai ewes during the milking period (n= 8; 8)

Milk fat, %	30th day after supplementation	60th day after supplementation	p**	%
Supplemented group	7.02 ± 0.53	8.69 ± 1.05	< 0.01	124
Deficient group	7.46 ± 0.46	8.85 ± 1.32	< 0.01	119
%	94	98	-	-
p*	> 0.05	> 0.05	-	-

* Deficient group=100%; Supplemented group=X%

** 30th day =100%; 60th day =Y%

Table 4

Effect of Se-I supplementation on the lactose content of Rhodope Tsigai ewes during the milking period (n= 8; 8)

Lactose, %	30th day after supplementation	60th day after supplementation	p**	%
Supplemented group	4.62 ± 0.20	4.51 ± 0.13	> 0.05	98
Deficient group	4.76 ± 0.23	4.42 ± 0.23	> 0.05	93
%	97	102		
p*	> 0.05	> 0.05		

* Deficient group=100%; Supplemented group=X%

** 30th day =100%; 60th day =Y%

Table 5

Effect of Se-I supplementation on the daily protein secretion of Rhodope Tsigai ewes during the milking period (n= 8; 8)

Milk protein, g/day	30th day after supplementation	60th day after supplementation	p**	%
Supplemented group	43.9 ± 13.0	23.8 ± 4.6	< 0.01	54
Deficient group	30.3 ± 14.0	20.1 ± 7.4	> 0.05	66
%*	149	118	-	-
p*	> 0.05	> 0.05	-	-

* Deficient group=100%; Supplemented group=X%

** 30th day =100%; 60th day =Y%

Table 6

Effect of Se-I supplementation on the daily fat secretion of Rhodope Tsigai ewes during the milking period (n = 8; 8)

Milk fat, g/day	30th day after supplementation	60th day after supplementation	p**	%
Supplemented group	52.3 ± 16.4	31.2 ± 6.2	< 0.01	60
Deficient group	36.7 ± 16.1	27.5 ± 10.8	> 0.05	75
%*	143	113	-	-
p*	> 0.05	> 0.05	-	-

* Deficient group=100%; Supplemented group=X%

** 30th day =100%; 60th day =Y%

secreted volume (Table 3).

At corresponding sub-periods the ewe milk of the deficient group had higher fat contents (from 7.46% to 8.85%) in comparison to the supplemented group (from 7.02% to 8.69%). The established differences varied from 2% to 6%, but not

significantly (Table 4).

This phenomenon has been reported by other studies (Angelow et al., 2000; Petrova et al., 1998) under conditions of muli-trace element deficiency. In cases of the deficient trace element status of organism the observed higher milk fat contents has been explained due to the mobilization of fat depots and partial reduction of fat content in the tissues.

Dynamics in the lactose contents, presented on Table 4 did not show differences between the two groups. The average lactose contents during the sub-periods in supplemented deficient ewes varied from 4.42% to 4.76%. The differences between both groups were not significant (2-3%). Based on the milk yield and properties of sheep milk at the 30th and 60th day of experiment, it could be calculate the daily secretion of protein, fat and lactose of both groups (Tables 5, 6, 7).

During the different periods the supplemented and non-supplemented ewes secreted on the average 43.9/ 30.3 g and 23.8 / 20.1 g protein daily. In both groups the average daily secretion decreased with the advance of lactation, what reflected on the reduction of milk yield and the alterations in the milk composition?

Regardless to the lower milk yield and due to the higher milk fat percentage of the Se-I deficient

Table 7

Effect of Se-I supplementation on the daily lactose secretion of Rhodope Tsigai ewes during the milking period (n= 8; 8)

Lactose, g/day	30th day after supplementation	60th day after supplementation	p**	%
Supplemented group	34.3 ± 10.2	16.3 ± 3.3	< 0.001	48
Deficient group	23.9 ± 11.4	13.7 ± 5.2	< 0.05	57
%	144	119	-	-
p*	> 0.05	> 0.05	-	-

* Deficient group=100%; Supplemented group=X%

** 30th day =100%; 60th day =Y%

Table 8

Influence of supplementation on milk properties during the whole period

Parameter	Deficient group		Supplemented group		%	p
	x	sd	x	sd		
Milk yield, ml/day	392	192	565	252	144	< 0.05
Fat content, %	8.24	1.23	7.80	1.17	95	> 0.05
Protein content, %	6.32	0.41	6.24	0.57	99	> 0.05
Lactose content, %	4.57	0.28	4.57	0.17	100	> 0.05
Fat secretion, g/day	31.5	13.7	42.4	16.4	135	< 0.05
Protein secretion, g/day	24.6	11.6	34.5	14.2	141	< 0.05
Lactose secretion, g/day	18.2	9.7	25.9	11.9	143	< 0.05
Total solids, %	20.1	1.4	19.5	1.6	97	> 0.05
Solids-non-fats, %	12	0.4	11.9	0.5	99	> 0.05

* Deficient group=100%; Supplemented group=X%

group, differences in fat secretion between the groups were not established on 30th and 60th day. The supplemented ewes secreted daily from 13 to 43% more fat into milk.

The secretion of lactose were higher between two groups during the first period, average by 44% , wireless differences in sub-periods varied from 48% to 57% ($P < 0.001$; $P < 0.05$).

The estimated reduction of the daily milk production in the experiment with the Rhodope Tsygai breed was 44% (Table 8).

Conclusions

The supplementation of lactating sheep during the period with 0.25 mg Se/day as $NaHSeO_3$ and 0.15 mg I/day as KI had a positive effect on the milk yield and the milk composition.

After weaning (April-June) the Se-I-deficient ewes produced 44% less milk with natural fat contents, 35% less fat, 41% and less milk protein daily in comparison to the supplemented group.

During the grazing period the daily lactose production in the deficient group was decreased by 43%. The results obtained showed that a correction of Se and I offer to the rations of lactating sheep was needed.

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