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SELENIUM IN GOAT NUTRITION

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Abstract

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The aim of the experiment was to assess the effect of selenium on the qualitative and quantitative parameters of goat milk. The experiment was conducted on an organic farm in June and July of 2016. The experiment lasted for 30 days. The breeds were chosen shorthaired. Twelve goats were categorized into the experimental group (n = 6) and the control group (n = 6). At the beginning and at the end of the experiment, milk samples were taken from each goat for the analysis. The results showed that the addition of selenium proved an effect on selenium concentration in goat milk. However, the effect of the milk components (fat, protein, lactose, urea, number of SB) and milk yield were not observed. These results confirmed that a functional food can be produced by adding selenium to the goat diet.

Keywords: selenium, goat, milk

INTRODUCTION

Selenium is an indispensable trace element in animal and human nutrition. One of the most famous trace element with antioxidant activity. Selenium is an integral part of glutathione peroxidase which together with superoxide dimethase prove anti-inflammatory effects. The boundary between toxicity and the essential effect can be very close (Horky *et al.*, 2012; Kominkova *et al.*, 2015). The concentration of selenium in soil in the Czech Republic is inadequate which is also reflected in the concentration of this element in plants and consequently in products of plants or animal origin. Selenium plays an important role in the proper functioning of the immune system and thyroid activity and also participates in spermiogenesis, and affects fertility (Horky *et al.*, 2014; Horky 2014; Skalickova *et al.*, 2017). It is involved in the prevention of inflammatory diseases, anti-tumor protection and anti-infective functions. Selenium is also an integral part of the antioxidant capacity of the organism (Horky *et al.*, 2016; Horky *et al.*, 2013; Klusonova *et al.*, 2015). One way to add selenium to the diet of the population is to enrich the animal products (milk, meat) with selenium using inorganic and organic sources. The addition of micronutrients to the diet of animals ensures their high reproduction and subsequent production (Horky *et al.*, 2015; Nevrkla *et al.*, 2014). Selenium in the diet of animals can also eliminate certain types of stress such as heat stress or postpartum stress (Herbut, 2013; Herbut *et al.*, 2015). The aim of the experiment was to verify the effect of dietary selenium on the qualitative and quantitative parameters of milk and to evaluate the selenium content in goat milk that could serve as a functional food for the final consumer.

MATERIALS AND METHODS

The goats included in the experiment came from the breeds of White Shorthaired Goat. The experiment included up to 12 goats of the same weight, lactation and milk yield. The goats were divided into two balanced groups.

The goats in the control group weighted on the average of 55 ± 5 kg. The weight of goats in the experimental group ranged from 57 ± 6 kg. The goats of the control group were on average at 3.8 lactation with an average milk yield of 517 liters. The goats of the experimental group were on average at 4.7 lactation with an average milk yield of 533 liters. Both experimental and control animals received the same feed dose (Tab. I).

The goats received up to 3.33 kg of dry matter/pc/day and had free access to the water.

I: *Composition of feed dose for goats (in the original mass)*

Feed	Quantity in kg
Grazing (clover)	10
Barley	0.75
Hey	Ad libitum

The basic feed dose of the control group contained only native selenium (0.04 mg/kg diet). The goats were divided into two balanced groups. The first group of goats (n = 6) was control group without the addition of selenium. The second group of goats (n = 6) was tested with selenium addition of 0.30 mg/kg per diet. Selenium was given during milking. Milk samples were collected at milking carried out once a day. The samples were taken at the beginning of the experiment at day of 0 and at the end of the experiment on the 30th day. Milk was put in native samplers during milking. From each goat, 3 different samples were obtained. One sample was pure for the analysis of the physicochemical properties of milk (fat, protein, lactose, somatic cells, urea), the other, containing a stabilizing agar, was prepared to determine the total number of microorganisms. The third sample was used for the analysis of selenium. The samples were cooled to 4–6 °C until the analysis was proved. The analysis was carried out after 18 hours from the collection. The milk components (fat, protein, lactose) and urea were analyzed by infrared spectrometry according to ČSN 57 0536/1999. The number of somatic cells was determined by fluoro-optoelectronic according to ČSN EN ISO 13 366-2/2007. Selenium was determined on a 290Z Agilent (Santa Clara, CA, USA) using an atomic absorption spectrophotometry method with electrochemical atomization.

Ultrasonic discharge lamp with hollow cathode was used to determine the selenium content, and a 10 mA lamp was used as the source of radiation. The spectrometer operated at 196 nm with a spectral bandwidth of 1.0 nm. The volume of sample injected into the graphite tube reached up to 20 µl. The argon flow (inert gas) was up to 300 ml/min. The correction was used with a field strength of 0.8 Tesla. Selenium was determined in the presence of palladium (chemical modifier). The samples were always measured in two repetitions.

Statistics

The data were statistically analyzed using STATISTIKA.CZ version 10.0 (the Czech Republic). Results were expressed as mean ± standard variance. Statistical significance was observed between sampling using ANOVA and Scheffe's test – one-factor analysis (animal group) for all parameters. The difference ($P < 0.05$) was considered as significant.

RESULTS

The selenium, fat, protein, lactose, somatic cells and urea content of milk were selected as markers of goat milk quality in relation to selenium feed. The animal performance was also observed during the experiment.

When the content of selenium in the milk was evaluated, the level of selenium reached below the limit of detection in both experimental and control groups. At the end of the experiment (30th day), a detectable amount of selenium was measured in the experimental group. In the goats of the experimental group, selenium was measured at an average of 0.08 µl/ml of milk. No selenium was detected in goats of the control group (see Tab. II).

The fat in the experimental group was decreased by 1.2% and in the control group by 1% with no statistical difference as seen in the 1A Figure. The decrease in the amount of fat in both groups could be due to the period in which the experiment was performed. The protein was detected at the same level between 3.0 – 3.2% in the control and experimental groups at the beginning and at the end of the experiment as shown in Fig. 1B. The measured values were not proved statistically significant. Selenium did not affect the amount of protein in the experimental group.

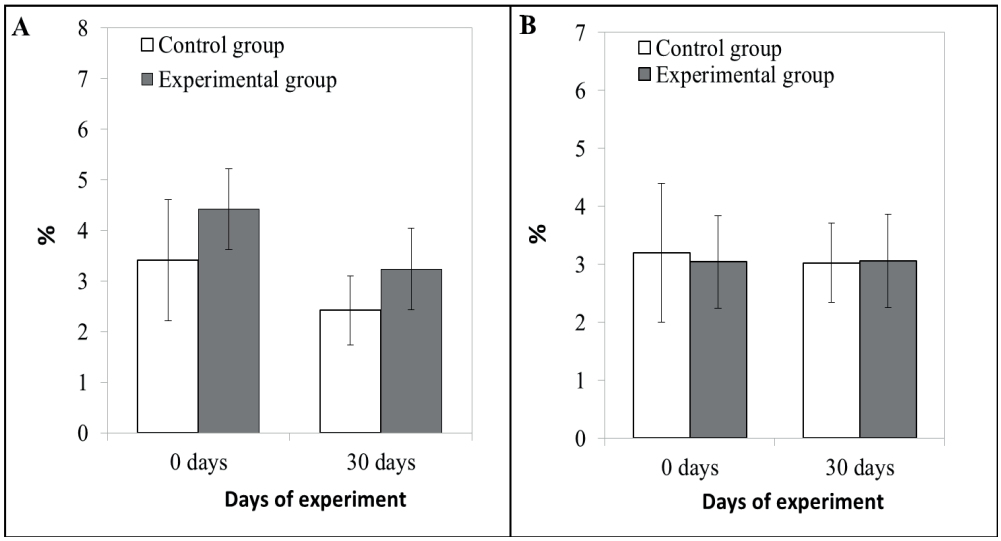
The lactose value was not changed significantly during the experiment and the addition of selenium had no significant effect on the value. Lactose was in the physiological range from 4.3 to 4.8% as seen in Fig. 2A. Urea was decreased during the experiment in the control and experimental groups. It can be concluded that the addition did not affect the urea level as seen in Fig. 2B. The urea level indicated the suitable content of nitrogenous substances in the feed.

The addition of selenium did not affect the amount of somatic cells in milk. The decrease occurred in the control group in the range from 764.2 to 506.0 mg/ml ($P < 0.05$). In the experimental group, the increase was detected from 457.40 to 596.00 mg/mL SB as seen from Fig. 3A. No significant difference was observed in the daily performance of goat milk between the groups (Fig. 3B).

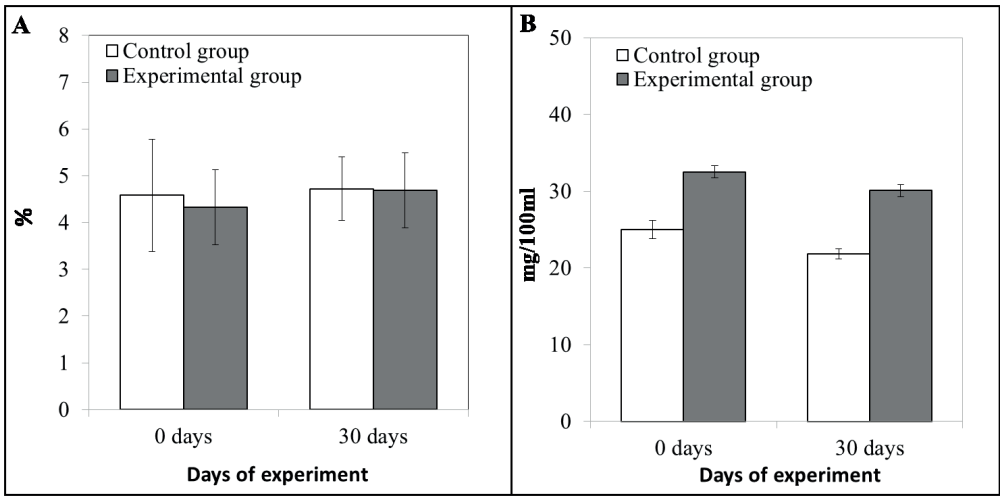
II: *Selenium content in milk (µl/ml)*

	0.day	30th.day
Control group	BDL	BDL
Experimental group	BDL	0.08 ± 0.02

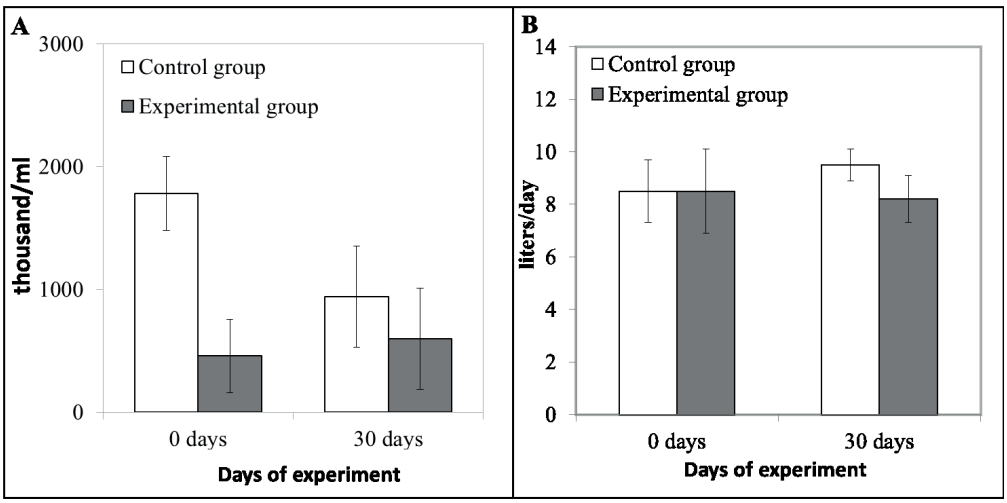
BDL – below the detection limit



1: *Effect of selenium on fat (A) and protein (B) in goat milk*



2: *Effect of selenium on the content of lactate (A) and urea (B) in goat milk*



3: *Effect of selenium on the content of somatic cells (A) and milk yield (B)*

DISCUSSION

In our experiment, the effect of selenium in organic form was studied on qualitative and quantitative parameters of goat milk. The results obtained by Pechova *et al.* (2008) showed that the selenium concentration in goat milk was increased to 0.018 µg/ml by the addition of organic selenium in the form of yeasts containing most of the selenium in the form of selenium-mytidine. This form was more absorbable proved higher efficacy, and is incorporated into milk proteins unless it is immediately metabolized to selenide. The selenium concentration in milk in our experiment was similar to the level of 0.02 µg/ml. On the other hand, other researchers, following the addition of selenium up to 0.3 mg/kg of diet, observed an increase in the content of 0.73 µg/ml. Further research compared organic and inorganic forms of selenium. According to Pechove *et al.* (2008), no difference was observed in these two forms of selenium.

Only few studies described the effects of selenium on goat milk production. Wang *et al.* (2009) reported that selenium supplemented with selenium yeasts to the feed of dairy cows can positively affect milk production. A positive effect was achieved due to the positive effect of selenium yeast on fermentation in rumen resulting in increased digestibility of the nutrients contained in the feed. In our experiment, the effect of selenium on increasing daily milk production has not been confirmed. This fact could have been due to the experimental period – during the summer due to warm weather. Horky *et al.* (2015) observed the increase in milk fat of cows in organic farming after the addition of selenium (0.3 mg/kg diet). Pechova *et al.* (2008) explained this fact due to the favorable influence of selenium on rumen fermentation. In our experiment, the amount of fat in goat milk decreased by 1.18% in the experimental group and by 0.99% in the control group. Lužova *et al.* (2012) reported that the lactose content of goat milk was decreased due to the summer season.

In our experiment, the lactose content was increased from 4.32 to 4.68% and from 4.58% to 4.72% the control group although the experiment was performed during the summer. Sellen did not prove a significant effect on the change of lactose content. According to our hypothesis, selenium can have anti-inflammatory effect which may result in a decrease in the number of somatic cells in the experimental group of animals. The official limit for the number of SB in goat milk is not legally regulated. As stated by Horky (2014), the average SB number in milk, taken from healthy animals, was in the range of 270–2,000 mg/ml, in cows with mastitis, the SB was in the range of 659–4,213 mg/ml. From our experiment, it can be deduced that the selenium did not effect the number of SB. In the control group, the number of SBs decreased from 764 to 506 mg/ml during the experiment. In the experimental group, the total SB was detected significantly lower. However, during the experiment, we observed a slight increase from 457 to 596 mg/ml in SB. Horky (2015), however, observed a significant decrease in somatic cells of cow milk, to which selenium was put in the amount of 0.3 mg/kg (organic form) into a diet.

CONCLUSION

In the experiment, the effect of selenium on the qualitative and quantitative parameters of goat milk and the selenium content were detected in organic farming. Selenium at a dose of 0.3 mg/kg per diet was fed in the form of selenomethionine. The results of our research showed that the addition of selenium in the form of selenomethionine had an effect on selenium concentration in goat milk. The selenium concentration increased from the value below the threshold of measurability to average value of 0.08 µl/ml. The addition of selenium did not affect the amount of fat, protein, lactose, urea or SB number, and the measured values were statistically insignificant. Selenium also did not affect the milking of goats.

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