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THE EFFECT OF EWE MINERAL STATUS ON THE LAMBS MINERAL SUPPLY

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ABSTRACT

The aim of our study is to examine the mineral status of Tsigai ewes and their lambs based on wool mineral content, and the relationship between ewes wool and milk mineral content and the lamb wool mineral concentration. Ten Tsigai sheep nursing single lamb was randomly selected on the 6–10th day of lactation. Sampling was carried out in March. Wool samples free of visible contamination were obtained from the withers of the ewes and the lambs using bended scissors. Approximately 10 ml of milk samples were collected by hand milking. Ca, Mg, Na, Cu, S, P, Se and Zn content were determined by ICP-OES (Perkin-Elmer, Optima 3300 DV). Statistical analyses were carried out by SAS (SAS Institute Inc., Cary, NC) GLM procedure. Wool mineral content did not show deficient supply in case of ewes. Young lamb's wool mineral composition is distinct from those measured in adult ewes. This fact and the lack of significant correlation between ewe and lamb mineral status indicates strictly regulated mineral passage through placenta.

Key words: sheep, ewes, lambs, mineral status, wool mineral content, milk mineral content

1 INTRODUCTION

Follicle development during the last third of the gestation period and early postnatal life determines the amount and quality of wool produced by adult sheep. The ewes' nutrient intake must be adequate for the maintenance and wool growth as well as for the foetus growth and development until weaning (Hatcher and Johnson, 2005). Insufficient nutrient supply is one of the factors of which can adversely affect follicle development. Studies with merino sheep (Corbett, 1979) demonstrated that the impaired initiation and maturation of secondary follicles during the third trimester of pregnancy permanently reduces adult wool production. All follicles initiated at birth, but undernutrition during early postnatal life can reduce the capacity of follicles to produce wool and delay the maturation of secondary follicles even 6–12 months (Khan *et al.*, 2012). The essentiality of sixteen minerals has been identified in sheep diets (Sahoo and Soren, 2011). Minerals has influence on wool growth by reducing feed intake (Na, K, S, P, Mg, Co and Zn), by altering rumen function and thus the supply of nutrients (S, Na, K and Co) or by disturbing metabolic processes (Zn, Cu, Se, I and Co). Maternal Se status has been demonstrated to have an effect on secondary to primary follicle ratio of lambs (Magolski *et al.*, 2011). The sulfur content of wool fibre has a strong correlation with fiber strength, work of rupture and initial modulus (Qi and Lupton, 1994). Copper deficiency can cause depigmentation, lack of crimps, low mechanical strength and lustrous appearance. Zinc deficiency results in reduced wool growth, lack of crimps, lustrous and brittle fibers (White *et al.*, 1994). Se deficiency also reducing wool growth, but has no effect on

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feed intake (Sahoo and Soren, 2011). Therefore, the aim of our study is to examine the mineral status of Tsigai ewes and their lambs based on wool mineral content, and the relationship between ewes wool and milk mineral content and the lamb wool mineral concentration.

2 MATERIALS AND METHODS

Ten Tsigai sheep nursing single lamb was randomly selected on the 6–10th day of lactation. Sampling was carried out in March. The animals received the same feeding regime, of which consisted of alfalfa hay and concentrate. Wool samples free of visible contamination were obtained from the withers of the ewes and the lambs using bended scissors. Approximately 10 ml of milk samples were collected by hand milking. After sampling, samples were directly transported to the laboratory, and calcium (Ca), magnesium (Mg), sodium (Na), copper (Cu), sulphur (S), phosphorus (P), selenium (Se) and zinc (Zn) content were analysed. Organic contamination of wool was removed by washing with ethyl-alcohol (96 %, Sigma-Aldrich). Dried samples were mineralized by 2 ml nitric acid (distilled, Sigma-Aldrich) in ultrasonic cleaning unit at 60 °C for 30 min. After cooling 2 ml of 30 % hydrogen peroxide (Sigma-Aldrich) were added and samples were mineralized for 90 min at 100 °C. After mineralization solutions were filled up to 10 ml with distilled water and filtered throughout MN 619 G ¼ (155 mm diameter) filter paper. Measurement of solutions was carried out with ICP-OES (Perkin-Elmer, Optima 3300 DV). Statistical analyses were carried out by SAS (SAS Institute Inc., Cary, NC) GLM and CORR procedure at $p = 0.05$ level. Group differences were tested with Tukey range test.

3 RESULTS AND DISCUSSION

Interestingly, the calcium, phosphorus, magnesium, selenium and zinc content of ewes' wool and milk was similar (Table 1). Ewe's milk had higher concentration of Na, Cu and S than wool. Quite surprisingly lamb's wool had significantly lower mineral concentrations, than ewes, except phosphorous. The Ca content of both wool samples were similar to those reported for other genotypes (Patkowska-Sokola *et al.*, 2009), but about tenfold higher than suggested by Sahoo and Soren (2011). The Ca transported in ionized form, and its value regulated in narrow intervals in blood plasma (Georgievskii *et al.*, 1982). Anke (1966) reported that the dietary Ca intake had negative correlation with P and Zn content of hair. As it is presented in Table 1 milk contains about four times more Ca than P, thus lambs consuming only milk had much higher Ca intake. Despite that, the P content of lambs' wool was more than two times higher than in case of ewes. Lambs have wool coverage at birth, and in the first week of life certainly a minimal growth occurs. Therefore, the mineral content of that base wool depend on the maternal nutrition during late gestation. The P content of ewe's wool was about 2–4 times higher reported for other genotypes (Patkowska-Sokola *et al.*, 2009), indicating that the supply was more than adequate. Mg and Na content of wool showed average supplementation based on other research results (Szigeti *et al.*, 2016; Patkowska-Sokola *et al.*, 2009). The Cu content of hair is close correlation with the liver Cu reservoir if it is less than 20 mg/kg (Kellaway *et al.*, 1978). According to Suttle and McMurray (1983) if fleece Cu content is above 2.5 mg/kg than deficiency could occur only for a very short period without any effect on production. The concentration of 5.36 mg/kg indicates sufficient dietary supply. As it is indicated earlier, S content of wool is in close correlation with several wool quality parameters. The S content of wool is usually between the ranges of 27–54 000 mg/kg (Qi and Lupton, 1994). Our results similarly to literature values (Patkowska-Sokola *et al.*, 2009) are below the normal range. This may reflect the fact that ruminal protein is deficient in S containing amino acids, and if the daily ration does not contain enough rumen undegradable protein or by-pass amino acids, there won't be optimum supply for wool production.

According to Olson (1969) the concentration of Se

Table 1: *Mineral content of ewe's wool and milk, and the offspring wool (mg/kg dry matter)*

Sample	Ca	P	Mg	Na	Cu	S	Se	Zn
Ewe, wool	2701	581^{b}	550^{a}	1743^{b}	5.36^{b}	20175^{b}	8.88^{a}	217.4^{a}
Ewe, milk	3183	880^{b}	797^{a}	2480^{a}	9.01^{a}	23515^{a}	11.1^{a}	299.6^{a}
Lamb, wool	1878	1445^{a}	133^{b}	349^{c}	0.80^{c}	485^{c}	1.95^{b}	5.5^{b}
P	0.0798	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
RMSE	1252	469	288	536	1.96	2038	4.03	96.3

RMSE : root mean square error; ^{a,b,c} Means in a column with common superscript do not differ significantly ($p > 0.05$)

Table 2: *Correlation between the mineral content of lambs' wool and the mineral content of ewes wool and milk*

Trait	Ca	P	Mg	Na	Cu	S	Se	Zn
Ewe, wool	0.37	0.20	0.54	–0.20	0.09	0.18	–0.36	–0.06
P	0.30	0.58	0.10	0.57	0.81	0.62	0.31	0.87
Ewe, milk	0.04	–0.38	–0.20	0.04	–0.09	–0.15	0.47	0.20
P	0.91	0.28	0.58	0.92	0.8	0.68	0.17	0.57

in the level of 5–10 mg/kg in the hair can indicate grazing induced Se poisoning, however, we did not noticed any signs of that. In our previous study we detected somewhat above 5 mg/kg Se in the wool and hair of sheep. It is known that the majority of soils in Hungary is Se deficient. Alfalfa hay originating from Se deficient unfertilized fields contains only about 0.1 mg Se/kg dry matter (Carter *et al.*, 1969, Hall *et al.*, 2013). However, with fertilization it was possible to increase the Se content up to 3.26 mg/kg dry matter (Hall *et al.*, 2013). We measured 9.13 and 7.50 mg/kg in the alfalfa hay and concentrate, respectively. We have no explanations to those very high values, but at least they explain the high concentration measured in ewes' wool. Zn level was also much higher compared to literature data (Patkowska-Sokola *et al.*, 2009). Zn status of ruminants depends on the forage type, geographical source, possible Zn emission and antagonistic factors in the metabolism (Regiusné Mőcsényi, 1990). Alfalfa hay contains 22–24 mg/kg Zn (NRC, 2007) on average, while we detected only 14.1 mg/kg in the feed of our test sheep. This value does not justify, why we detected that high concentration of Zn in the wool of ewes.

As the lamb nutrient supply is entirely depends on the ewe nutrient intake, we hypothesised that there should be some correlation between the ewe and lamb mineral status as approached by the mineral content of wool and milk. It is surprising that we could not detect even any moderate correlation (Table 2). This fact indicate that the mineral supply of foetuses through the placenta regulated by strict mechanisms ensuring the steady mineral flow.

4 CONCLUSIONS

Wool mineral content did not show deficient supply in case of ewes. Young lamb's wool mineral composition is distinct from those measured in adult ewes. This fact and the lack of significant correlation between ewe and lamb mineral status indicates strictly regulated mineral passage through placenta.

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