Original paper

THE INVESTIGATION OF SOME MOHAIR MINERAL LEVELS (Mg, Fe, Cu, Zn) OF ANGORA GOATS IN ORIGINAL ZONE OF ANKARA PROVINCE

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Abstract

In this study, determination of some mineral levels of mohair samples obtained from Angora goats *(Capra hircus ancyrensis)* bred in villages of Basayas (1st farm, n=28 goats) and Yagmurdede (2nd farm, n=30 goats) in Ankara province of Turkey was aimed. Totally 58 goats (2-4 years old) in two farms kept under similar managemental conditions and based on pasture were chosen as research materials. Mohair samples from mid-side of the goats were collected to determine the levels of magnesium (Mg), iron (Fe), copper (Cu) and zinc (Zn) by atomic absorption spectrophotometer (AAS) (M series V1, 23). The mohair mineral levels in the 1st and the 2nd farm of Angoras were found as 22.234 ± 1.030 µg/g and 20.952 ± 1.462 µg/g for Mg; 37.716 ± 1.573 µg/g and 32.271 ± 1.397 µg/g for Fe ($P<0.05$); 4.248 ± 0.293 µg/g and 7.169 ± 0.285 µg/g for Cu ($P<0.001$); 60.673 ± 2.395 µg/g and 62.802 ± 3.172 µg/g for Zn, respectively. In the 1st and the 2nd farm, non-significant positive and negative correlations between minerals were discovered. The estimated correlation coefficient between Fe and Cu was negative (r = □ 0.291) significant in total population ($P<0.05$).

Key words: *Angora goat, atomic absorption spectroscopy, mineral level, mohair*

Introduction

Turkey has about 8.2 million heads Hair goat (*Turkish:* Kıl keçisi) and 0.16 million heads Angora goat (*Turkish:* Ankara keçisi). 39.495 head of goats and 118.607 head of young-adults offspring were recorded of them in Angora goats (Anonymous, 2013). Goats are kept for their milk, meat, skin, hair, cashmere (down fibers) and mohair for several centuries in Anatolia (Koyuncu et al., 2005). Angora goats were raised in Ankara province of Turkey, at 39° 52′ 30″ N, 2° 49′ 59.88″ E, at an altitude of 938 m (3.077 ft).

There are some minerals that are necessary for feeding of goats. While macro minerals are needed to increase purchase, micro minerals are required in very small quantities. On the other hand mineral intakes in goats as well as sheep are very important for health. For instance, high Mg deficiency causes grass tetany in both. Similar to Fe level in blood it is important for interfering with the uptake of some other minerals that are in very small quantities, such as Zn. Zn and Cu minerals are required by goat for mohair growth and health for keratinisation. Investigations by Reis et al. (1989) proved that both Zn and Cu are indispensable micro nutrients for quite fast growing tissues such as follicles of fiber-producing. Additionally, balanced mineral intake of goats is effective on not only health

but also on productivity. Especially goat mohair quality is directly related to the mineral levels in the body.

Mineral deficiencies are common in small ruminants grazing poor quality pastures and reared under traditional system (Kawas et al., 2010, Xin et al., 2011). Fleece-eating is an important health problem for some animals such as sheep and goats. This event can be observed from lower concentrations of S and Mo. Yet, in this case, Ca, P, Fe, Mn, Zn, Cu, Co and Se are present in lower concentrations (Patkowska-Sokola et al., 2009).

Mohair is a soft, luxurious fiber with a rich luster used in fine clothing, carpets, blankets and upholstery and the main source of income for Angora goat producers. On the other hand mohair is a beautiful, lustrous, strong fiber with unique characteristics, making it as popular today. It is extremely durable with a soft luxurious texture and unique appearance (Anderson, 2014). The natural colours of mohair fiber are usually white and different shades of white. However, the colored (brownish, grey and silver) goats are frequently encountered in Turkey's east.

Typical Angora goats are fairly smaller than average sheep that are reared for wool but they produce twice as much fiber compared with sheep produce (Gallagher and Shelton, 1972). Besides, mohair is pure protein that is homologous to wool protein content (Parris and Swart, 1975) and a kind of admirable natural animal fiber.

The quality of mohair is classified based on following properties. It is also important to consider issues such as fine and long mohair fiber. It deepens on the quality drops. More numbers of crimps of the mohair are expected. Additionally bright fiber and more elegnation are desirable. However stiff bristles called □dog hairs□ are not inconvenient. In this manner, mohair quality is determined by considering these conditions.

Angora goats have received less research attention than meat or dairy goats, particularly in the last 10 to 20 years since animal numbers have declined in response to change in production profitability (Sahlu et al., 2009). Structural characteristics (Salehi, 2009; Syed Momen et al., 2009; McGregor and Butler, 2010) and mineral compositions (Eryavuz et al., 2002; Shamsaddini-Bafti et al., 2012) of goat natural fibers are highly investigated in the literature. Sufficient number of studies on wool mineral analyses of sheep (Aydin, 2008; Patkowska-Sokola et al., 2009) was presented, however, mohair mineral studies (Ehsani et al., 2005; Shamsaddini-Bafti et al., 2012) were relatively few.

The aim of the present study is the assessment of chemical mineral composition in 1st and 2nd quality mohair samples from Angora goats (Fig. 1 and Fig. 2) of similar performance types in capital of Turkey. In this way, the difference of the mineral content can be introduced between different quality (the 1st and the 2nd) and colour mohair.

Materials and methods

Before starting the research, we obtained some information concerning mohair quality on farms. This study was held in the 2 different villages (Basayas and Yagmurdede) of Ankara. The mohair from the 1st farm has 1st and the 2nd farm has 2nd quality mohair based on "Tiftik Birlik" that number of SS 459 in Ayas, Ankara. In February before shearing, in total 58 Angora goats (n1=28; n2=30) that appeared clinically healthy two private farms belonging to Angora goat were used. 2-4 year old goats were randomly selected from each farm.

Figure 1. *Angora goats in the 1st farm*

Figure 2. *Angora goats in the 2nd farm*

Mohair samples from the selected goats were collected according to standard methods. Specimens of mohair (approximately 5 g) were taken from right side of goat rib with scissors. Firstly, wet incineration method was applied to the mohair before the determination of Mg (macro mineral) and Fe, Cu, Zn (micro minerals). Analyses were performed as reported in the literature (Kumaresan and Kapioh, 1984; Salehi, 2009).

Sample Preparation

The 0.5 g mohair samples were used in experimental work. Each sample in a polyethylene bottle containing 150 ml of a 1% solution of non-ionic detergent was washed by agitating on a mixer for 30 minutes at standard room temperature. After that, it was transferred to a polyethylene filter crucible and rinsed with a total of one liter of deionized water. Dry weight has been expected of about 0.5 g. At a temperature of 110 ºC, samples were weighted and transferred into 50 ml flasks. 6 ml of HNO_3 was added and allowed to react at normal room temperature. The digest was warmed and 1 ml of $HClO_4$ was added. When the process was completed, the temperature was increased to 200 ºC. Solution was transferred to a 5 ml volumetric flask and diluted to volume with deionized water. This solution was used for the determination of Mg, Fe and Cu. A further dilution was required for Zn.

Levels of Mg, Fe, Cu and Zn in mohair were determined by atomic absorption spectrophotometer (AAS) (Salvin, 1968; Field, 1988) after wet incineration method. The amounts of mineral concentrations were determined by measuring with absorption/emission amount of AAS device. Concentrations of the mineral to be determined could be made by subtracting the measurement curve after calibrating the device using standard concentration values. Standard solutions are used for calibration procedures (Demir et al., 2011). Results were measured as ppm. The final results were converted to µg/g according to express literature.

Statistical Analyses

The obtained data were statistically analyzed with SAS software package (SAS, 2002). The relationship between farms was analyzed to put forward for revealing with Pearson Correlation Coefficient at the significance level of $P<0.05$.

Results and discussion

Analyzed results of mohair mineral were presented in Table 1. Mg, Fe, Cu and Zn concentrations of mohair were published with reference ranges for 58 Angora goats in total population. Mineral contents were determined at the ranges of 10.16-39.64 µg/g for Mg, 21.28-58.52 µg/g for Fe, 2.01-8.98 µg/g for Cu and 38.32-96.40 µg/g for Zn, respectively.

Shamsaddini-Bafti et al. (2012) reported that Cu and Zn content of cashmere in Raeini goats averaged 0.00065 % and 0.01276 %, respectively. In a different study conducted on Angora goats (Imik et al., 1998), the levels of Fe, Cu and Zn of mohair were found as 41.83 µg/g, 3.93 µg/g and 83.24 µg/g in (-) control group. The levels of Fe and Zn determined in this study were lower than the values reported by Imik et al. (1998) while Cu level was higher.

Table 1. *Mineral levels of Angora goats (µg/g)*

Farm	Mg			Fe			Cu			Zn		
	N	X + Sx Min-Max	P	N	X + S x Min-Max	P	N	X + S x Min - Max	P	N	X + S x Min - Max	P
1	28	22.23±1.03 14.21-35.81		28	37.72±1.57 21.28-58.52		26	4.24± 0.29 2.01-7.99		28	60.67±2.40 43.36-96.40	
2	30	20.95±1.46 10.16-39.64	>0.05	30	32.27±1.40 22.29-56.56	<0.05	24	7.17± 0.29 4.06-8.98	<0.0001	30	62.80± 3.17 38.32-96.36	>0.05
Total	58	21.57±0.90 10.16-39.64		58	34.90±1.10 21.28-58.52		50	5.65± 0.29 2.01-8.98		58	59.71±2.00 38.32-96.40	

An average value of 4 ppm for Cu in goat mohair and hair has been reported by George and Haenlein (2009). Cu levels of the 2nd farm were higher than the result found in this study. In addition, relative high level differences of Cu may be due to different types of fresh water supply. The 2nd farm had darker-colored mohairs than the 1st. This case might result from copper colour, a metallic tone of red. Moreover, Cu is thought to result from the influence of the color enhancer. The high amount of copper, being darker than the lower is natural. Williams (2004) have also reported the genetic variation between the breeds suggesting that different responses arise from a variation in the efficiency of absorption of Cu.

As known, farms had different qualities of mohair at baseline. We have received some information prior to conducting the research from the Association of Agricultural Sale Cooperative of Angora (mohair) and wool, Ayas/Ankara. Accordingly, the 1st farm had the best (1st) quality mohair and used mains water. For all that the 2nd farm had 2nd quality mohair and used pond water (40°7'37"N 32°20'57"E). Mineral levels in drinking water of goats might be the reflection of mohair mineral levels.

Considering Mg and Zn contents, there were no statistical differences (P>0.05) between the farms of Basayas and Yagmurdede. On the other hand, the differences in Fe and Cu contents between the farms were statistically significant at the significance levels of P values (P <0.05, P<0.0001, respectively) (Table 1).

Table 2. *Correlation coefficients among mohair mineral levels in the 1st farm*

N:28	Mg	Fe	Cu	Zn
Mg	**1.000**	- 0.176 ^{NS}	0.001 ^{NS}	0.150 ^{NS}
Fe		**1.000**	0.065 ^{NS}	-0.032 ^{NS}
Cu			**1.000**	0.032 ^{NS}
Zn				**1.000**

NS: Non significant

The estimates of correlations between mohair mineral levels are shown in Table 2 for the 1st farm and Table 3 for the 2nd farm. In the 1st and 2nd farm, positive and negative correlations between minerals were discovered. The correlation between Fe and Cu was negatively significant (P<0.05) in total population (Table 4). Nevertheless, Shamsaddini-

Bafti et al. (2012) reported that there was a positive correlation between Zn and Cu content in fiber (P<0.05).

Table 3. *Correlation coefficients among mohair mineral levels in the 2nd farm*

N:30	Mg	Fe	Cu	Zn
Mg	**1.000**	0.101^{NS}	0.313^{NS}	-0.035^{NS}
Fe		**1.000**	-0.141^{NS}	-0.124^{NS}
Cu			**1.000**	0.093^{NS}
Zn				**1.000**

NS: Non significant

Table 4. *Correlation of mohair mineral levels in total population*

N:58	Mg	Fe	Cu	Zn
Mg	**1.000**	0.020^{NS}	-0.018^{NS}	0.017^{NS}
Fe		**1.000**	-0.291*	-0.102^{NS}
Cu			**1.000**	0.001^{NS}
Zn				**1.000**

NS: Non significant, *P<0.05

There are so many studies about Merino sheep but not about Angora goats yet. In a study performed on sheep, Purser (1979) reported the importance of adequate vitamins and mineral for wool growth. Folic acid and pyridoxine are especially essential for the wool growth. Zn and Cu are required for the process of fiber growth. Reduction of these minerals can reduce the wool and mohair growth. There is a limited number of studies on the mineral composition of Angora goats. Concentration of minerals of goats fleece reflects feed and nutrition quality as well as environmental states, sex, age and breed's physiological condition that can also affect the quality of hair and mohair. The pigment of sheep or goat coats affects the accumulation of some minerals such as Fe, Cu, Mn, K, Na and Mg (Patkowska-Sokola et al., 2009). The richness of minerals depends on the soil and plant concentration. Gallo et al. (1996) studied the relationship of minerals in soil, plant and animal tissue. Environmental status can also affect the mineral content of wool. High concentration of some toxic metals (Cd, Cu, Pb, Zn) could be the result of industrial emission from the air. Angora goats in this study were chosen from the ecologically clean regions. On the other hand, in Turkey Angora goat farming in areas with continental climate is based on pasture. Vegetation in areas with a continental climate with plenty of rainfall is rich only in the months of March and April. For this reason, depending on pasture conditions it is seen that the mineral and vitamin needs of animals are not met. In order to succeed in producing high quality Angoras, the fact that mineral and vitamin needs of animals should be met is crucial and will have a positive impact.

Difference between water resources might be effective on mohair quality and mineral content. It is necessary to say that Angora goat mohair quality and color are possibly associated with the mineral content. Large amounts of copper might probably be darker than mohair. Needless to say that genetic factors could not be neglected in such cases.

Conclusion

Ponds water with unknown content and fresh water of unknown origin might especially cause the accumulated minerals in the body. Investigation of water resources mineral levels with genetic factors can be effective in determining the quality and color of mohair as well as the genetic relationships between different flocks of the Angora goats

concerning the quality of mohair. The further analyses of great number of mohair minerals among blood minerals of animals and fresh water supply would be useful.

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