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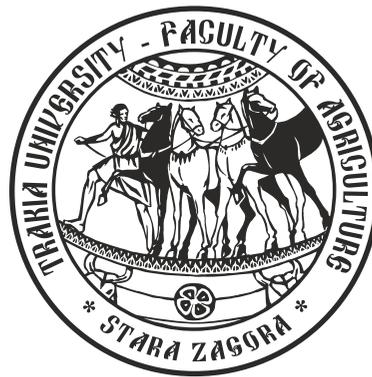
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Quantity and quality of wool yolk in Caucasian Merino rams

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Abstract. The aim of this study was to determine the quality and quantity of the wool yolk of the rams from Caucasian merino breed in order to improve their technological features. The analyses included seven rams at 2.5 years of age and eleven male lambs at the age of 18 months. Thirty-six individual wool samples from two parts of the body (side and thigh) were studied. The following wool parameters were investigated: percentage of the dirty areas of the wool (on the side and the thigh), fat amount, sweat amount, pH of sweat, laboratory wool yield, and color of greasy wool on the side. Percentage of the dirty areas of the wool by categories and topographic ranges varied from 30.79% to 41.52%, indicating that the wool yolk of Caucasian rams was of sufficient quantity and good quality. The percentage of the fats in wool yolk to the greasy wool was relatively high (23.25% in the male lambs at the age of 18 months and 25% in the rams) and had a negative impact on the wool yield. The ratio of fat/sweat was 1.91:1 in rams at 2.5 years of age and 1.44:1 in male lambs at the age of 18 months). The higher relative part of the fat compared to the sweat was an indicator of good protective properties of the wool yolk. That allowed to protect the technological properties of the wool.

Keywords: Caucasian breed, merino wool, wool yolk, fat amount, sweat amount, pH of sweat

Introduction

The advantages of wool as a natural fibre are undisputable despite the increasing use of cheaper synthetic chemical fibres during the last years. Wool's high hygroscopicity, elasticity, strength, good insulation properties and low electrostatic discharge make it an excellent raw material for textile industry. The continuously increasing demands of consumers to textile are a prerequisite for production of high-quality wool fabrics and therefore, implies closer cooperation between producers, processing and selection managers.

The main disadvantages of wool in processing enterprises are its dirtiness, reduced strength and yellowness. They could be eliminated through complete nutrition and good housing conditions of animals, and through selection for some quantitative and quality traits of the wool, including wool yolk (Bogdanova, 2015). The main role for preservation of physico-mechanical properties of wool throughout its growth and storage is that of wool yolk (Lyubavina et al., 1987; Dimitirik, 2010; Scoryh et al., 2016). The extent of wool dirt in depth is a criterion for its quality and amount. Deficiency or inadequate yolk amount deteriorates technological properties of wool, whole its higher content reduces yield of pure fibre and increases feeding costs (Ivanov et al., 1985).

The amount and quality of wool yolk are determined by the structure and activity of sebaceous and sweat glands. The secretion of the former comprises two fractions: wool oil and wool wax with oil being more important for preservation of wool (Nedelchev, 1983). While the amount of wool grease is genetically influenced at a significant extent, the effect of the environment on the secretion sweat glands (specialised structures for thermal regulation) is more considerable (Mezentsev, 1971).

The aim of the present study was to evaluate the quantity and quality of wool yolk in Caucasian rams with regard to improvement of

selection traits levels.

Material and methods

The study was conducted with 18 Caucasian Merino sheep: 7 rams and 11 male lambs owned by Kabiuk state enterprise – town of Shoumen, reared and fed uniformly. All male breeders were reared in a separate stud of the enterprise. The production system was free-stall with grazing on pasture, semi-intensive. The feeding was *ad libitum* with dynamic composition of the ration according to pasture resources and the workload of breeders during the artificial insemination and breeding campaign. The main fodders offered during the stall period were corn silage, alfalfa hay, corn, barley and oats, while during the pasture period, fodder was given upon necessity to complement grazing. Before the beginning of the breeding campaign, despite the rich pasture, protein and vitamin-mineral dietary supplements were included for attainment of good reproductive condition and excellent semen production.

For analysis of wool yolk components, a total of 36 wool samples were collected from 18 rams (7 at 2.5 years of age and 11 at 18 months of age). The samples were taken from two topographic areas: side and leg. The dirt percentage was determined on both. On side samples only, the amount of fat, amount of sweat, pH of sweat, laboratory yield, wool yolk colour were determined.

The wool yolk components were analysed at the wool research lab at the Sheep Breeding unit, Faculty of Agriculture, Trakia University – Stara Zagora.

The expert analysis of amount and quality of wool yolk was done by determination of wool dirt percentage in 10 areas of each wool sample. The dirt percentage was calculated as:

$$\% \text{ dirt} = \frac{l_1}{l_2} \cdot 100,$$

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Where: l_1 – dirty area in cm; l_2 – natural wool length, cm.

Fat and sweat were extracted by means of Soxhlet extractor using the method of Sidortsov (1974). Sweat pH was determined by means of stationary pH-meter „LAB – 850“. Wool yolk colour was evaluated visually.

The data from laboratory analyses were processed using the “Statistica 06” software. The significance of differences between groups was evaluated with t- Test Two Sample Assuming Unequal Variances.

Results and discussion

Amount and colour of wool yolk, dirt percentage

According to the results, the wool dirt percentage in rams was on the average 30.79% of staple length on the side and 34.74% on the leg (Table 1). In male lambs, dirt percentage of leg wool was higher and attained 41.52%. The differences between side and leg wool dirt percentage was statistically significant at $p < 0.001$.

Table 1. Dirt percentage of side and leg wool in rams at 18 months and 2.5 years of age, %

Category	Side			Leg		
	n	Mean±SEM	CV, %	n	Mean±SEM	CV, %
Rams	70	30.79±2.344	20.14	70	34.74±1.916	14.59
Male lambs	110	32.74±0.811 ^a	15.06	110	41.52±1.732 ^a	13.84

*horizontally: a - $p < 0.001$

Higher dirtiness of wool was established by Slavov (2007) in rams from the Dobrudzha type of North East Bulgarian Finewool breed and its crosses with Australian merino and Booroola sheep. In purebred rams, the dirt percentage of side wool was 33.18% and of leg wool 38.29%. In 1/2- and 1/4-blood crosses with Australian Merino, the trait values were 32.17-32.88% and 34.72-34.05%, respectively while in 1/4- and 1/8-blood crosses with Booroola – 33.81-33.32% (side) and 38.59-38.11% (leg). In male rams from the same groups, dirt percentage values were comparable to ours for the side wool (32.12-33.92%), and for leg wool – lower (34.22-36.69%). The investigations of Panayotov (1988) demonstrated a larger range of variation of wool dirt percentage in Trakia Finewool breed – from 30.9% to 45%. Wool dirt was influenced not only by the amount of yolk, but also by its quality evaluated through colour and consistency (Kosilov et al., 2016).

One of the main requirements to wool yolk is its resistance to washing. Tsoy et al. (1992) established that white wool yolk had the best protective properties. In samples with white wool yolk, the dirt percentage was from 41.9% to 54.6% of the staple length, while in those with creamy wool yolk: between 51.3 and 91.2%.

Figure 1 presents the distribution of animals according to wool yolk colour. In studied categories, yolk colour varied within a relatively narrow range. In rams, wool yolk was mainly light creamy and creamy, and in male lambs: creamy wool yolk was predominant – 84.21%.

The results obtained showed that despite the high prevalence of creamy and light creamy wool yolk colours in studied animals, the dirt percentage of side and leg wool was relatively lower.

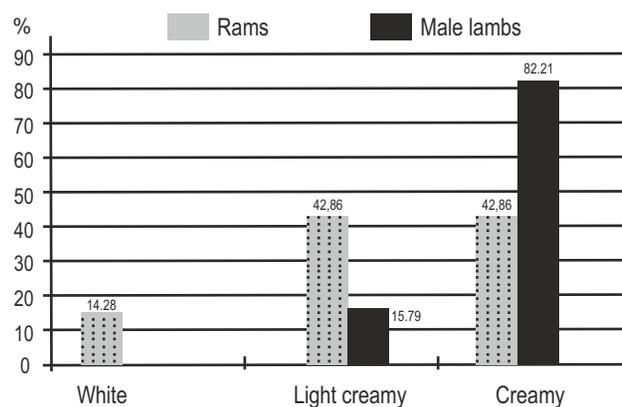


Figure 1. Wool yolk colour

Quantity of main wool yolk components. Laboratory yield.

Wool fat is essential for preservation of wool technological properties. Both the deficiency and excess are unwanted as in technological properties of wool are worse in case of deficiency and on the contrary, twice more nutrients are spent for production of 1g fat than for 1g clean wool. Wool fat is referred to the group of waxes according to its chemical composition – complex esters of higher fatty acids with aliphatic and aromatic alcohols. Most of these esters are water-insoluble and are hardly oxidised. Nevertheless, under the influence of solar radiation, humidity and various pollutants, they undergo some changes.

In rams and male lambs the percentage of wool fat from greasy wool was within 25.00–23.25%, and from clean non-defatted wool: 35.64–36.36% (Table 2). Similar results were published by Ivanov et al. (1985). The authors reported that wool fat percentage in Stavropol rams varied from 22.7 to 32.1%, and animals with 14.3% wool fat were also encountered. In Caucasian rams, Chizhova (1985) affirmed that wool fat in the yolk was 23.8% on the average, with a range from 15–20% to 30–32%. Lower values of the traits vs greasy and non-defatted clean wool were reported by Slavov (2007) in rams from the Dobrudzha type of the North-east Bulgarian Finewool breed (16.66 and 26.35%, respectively), in 1/2- and 1/4-blood crosses with Australian Merino (15.99-16.24% and 23.47-24.15%). In male lambs, the values of the trait were also lower than in this study – 16.66% and 26.35% in purebred and 15.59-16.14% and 23.09-23.99% in crosses. Boykovski et al. (2009) published data for average wool fat content of 14.03% in greasy Caucasian sheep wool and 16.72% in North-East Bulgarian Finewool breed – Shoumen type, created with its participation. The values were lower as compared to ours.

The second important component of wool yolk is sweat. Its higher content worsen wool technological properties. The sweat content in wool yolk of Caucasian rams and male lambs was lower than that of wool fat – 0.656 and 0.808g respectively vs 1.252 and 1.162g (Table 2). The values presented as percentage from greasy wool were 13.89% and 17.30%, and from clean wool (+ fat and water-soluble mechanical impurities) – 19.14% and 20.32%. The differences between wool yolk fat and sweat contents in rams and male lambs were not relevant. Coefficients of variation for sweat content were higher demonstrating larger phenotypic variation with regard to this trait.

Our results were close to those of Ivanov et al. (1985) for sweat content of greasy wool in Stavropol rams – 9.8–18.1%. Higher sweat percentages from greasy and clean wool were obtained by Slavov (2007) in 2.5-year-old North-East Bulgarian Finewool rams – 18.86%

% and 29.18% respectively. According to Chizhova (1985) sweat percentage in Caucasian Merino rams varied from 8–13% to 22–25%. Boykovski (1995) reported values comparable to ours in Caucasian Merino – from 13.13% to 15.17% sweat in greasy wool and from 13.58% to 15.83% in North-East Bulgarian Finewool breed.

The protective role of wool yolk depends not only from its fat and sweat content but rather from their ratio (Kosilov et al., 2016). The fat/sweat ratio, sweat pH and fatty acid content of wool fat determine wool yolk quality. In both categories, the fat/sweat ratio was in favour of fat: 1.91:1 in rams and 1.44:1 in male lambs. As sweat pH was regarded, it was alkaline in rams and male lambs: 7.71 and 8.56, respectively, with statistically significant differences between categories ($p < 0.01$). Lower sweat pH values were reported by Slavov (2007) in male lambs from the North-East Bulgarian Finewool breed and crosses with different percentage of blood from Australian Merino and Booroola – 5.84–6.94.

Apart clean fibre, fat and sweat, greasy wool contains also mechanical impurities. Their amount was statistically significantly lower ($p < 0.01$) in the wool of rams compared to that of male lambs (0.565g vs 0.686g). Expressed as percent of greasy wool, the relative proportion of mechanical impurities was lower in the wool of rams (11.95%) than in that of male lambs (14.66%), but the difference was small and insignificant (2.71%). Higher values of this trait were observed by Slavov (2007) in North-East Bulgarian Finewool rams (18.46%) and their crosses with different percentage of Australian Merino blood (13.94–14.31%). In male lambs, our values were similar to those reported in male lamb crosses with $\frac{1}{2}$ (14.22%) and $\frac{1}{4}$ (14.39%) Australian Merino blood, but were lower as compared to purebred lambs (18%).

The content of fat, sweat and mechanical impurities influenced directly the wool yield. In studied categories of animals, the amount of wool fat, sweat and mechanical impurities was lower in rams which exhibited high laboratory wool yield – 47.70%. In male lambs, obtained values were lower (43.22%), as their wool contained more

sweat and mechanical impurities. The difference of 4.48% between the groups was not significant. Stefanova et al. (2005) established higher laboratory yields in the studied breed – 53.89% at 2.5 years of age and 53.81% at 18 months of age. With regard to the category, Slavov (2007) reported lower values in North-East Bulgarian Finewool rams (45.78%) in higher values in purebred male lambs (46.84%). Staykova and Stancheva (2010) also observed higher than ours wool yield for the other Russian wool sheep breed Ascanian Merino successfully introduced in our country: 53.02% at 2.5 years of age and 52.61% at 18 months of age.

Conclusion

It was found that: (1) The dirt percentage of wool according to animal category and topographic area of Caucasian rams varied between 30.79% and 41.52%, which determinant wool yolk as sufficient and its quality as good. (2) The percentage of fat in wool yolk vs greasy wool is relatively high (23.25% in male lambs and 25% in rams) and had a negative effect on wool yields. (3) The wool fat/sweat ratio in both categories (1.91:1 in rams and 1.44:1 in male lambs) was in favour of fat. The higher relative proportion of wool fat vs sweat was a parameter of good protective properties of yolk allowing for preservation of wool technological properties.

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Table 2. Wool yolk composition and laboratory yield

Signs	Rams			Male lambs		
	n	Mean±SEM	CV, %	n	Mean±SEM	CV, %
Wool fat, g	7	1.252±0.077	16.34	11	1.162±0.088	25.19
- from greasy wool, %	7	25.00±1.543	16.33	11	23.25±1.752	25.02
- from clean non-defatted wool, %	7	35.64±1.651	12.26	11	36.36±2.222	20.27
Sweat, g	7	0.656±0.067	27.15	11	0.808±0.084	34.50
- from greasy wool, %	7	13.89±1.454	27.70	11	17.30±1.812	34.74
- from clean wool	7	19.14±2.615	36.15	11	20.32±2.170	35.42
(+ fat and water-soluble mechanical impurities), %						
Sweat pH	7	7.71±0.123 ^a	4.22	11	8.56±0.105 ^a	4.05
Mechanical impurities, g	7	0.565±0.081 ^b	38.07	11	0.686±0.037 ^b	17.70
- from greasy wool, %	7	11.95±1.721	38.11	11	14.66±0.754	17.06
Laboratory wool yield, %	7	47.70±1.903	10.56	11	43.22±1.767	13.56

*horizontally: a: $p < 0.01$; b: $p < 0.001$

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Conclusion: The most important consequences for the science and practice resulting from the conducted research should be summarized in a few sentences. The conclusions shouldn't be numbered and no new paragraphs be used. Contributions are the core of conclusions.

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Todorov N and Mitev J, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows, IXth International Conference on Production Diseases in Farm Animals, September 11-14, Berlin, Germany.

Thesis:

Hristova D, 2013. Investigation on genetic diversity in local sheep breeds using DNA markers. Thesis for PhD, Trakia University, Stara Zagora, Bulgaria, (Bg).

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