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PHYSICO-MECHANICAL PROPERTIES OF DUPSKA PRAMENKA WOOL AS BREED CHARACTERIZATION DESCRIPTORS

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SUMMARY

The characterization of animal genetic resources includes morphometric, production and genetic characterization. This paper aims to determine the annual yield, staple length, and physico-mechanical properties of the wool of the Dupska Pramenka sheep. The average annual wool yields of a total of 130 ewes and 14 rams enrolled in the study were 2.120 kg and 3.340 kg, respectively. Wool samples were taken from the left shoulder, posterior rib, and pelvis of a total of 50 sheep (36 ewes and 14 rams). The lengths of wool staples collected from three body sites of the ewes were 20.92 cm, 21.75 cm, and 22.25 cm, respectively. The lengths of wool staples collected from three body sites of rams were 23.50 cm, 22.14 cm, and 23.64 cm, respectively. The height and length of wool fibers of the ewes were 21.97 cm and 22.85 cm on the shoulder, 22.38 cm and 23.10 cm on the posterior rib, and 23.06 cm and 23.77 cm on the pelvis. The height and length of wool fibers of the rams were 22.00 cm and 22.89 cm on the shoulder, 22.54 cm and 23.26 cm on the posterior rib, and 22.61 cm and 23.40 cm on the pelvis. The average fineness of wool fibers of the ewes was 43.08 μ , whereas the fineness of wool fibers of the rams was 45.43 μ . The Dupska Pramenka sheep were found to have mixed fibers: axillary (over 45 μ), accounting for 51.64% in the ewes and 54.91% in the rams, and transitional (30–45 μ), accounting for 28.76% in the ewes and 32.80% in the rams. Fiber fluff (10–30 μ) accounted for 19.83% and 12.98% in the fleeces of ewes and rams considered, respectively.

Key words:

characterization,
wool yield, wool
staples, wool fiber,
wool fineness

INTRODUCTION

The preservation of local and protected indigenous sheep breeds should be systematically and consistently planned with regard to the actual condition and future needs of the breeds. The inventory and characterization of indigenous sheep breeds should offer basic information, which can be used for establishing adequate breeding (conservation) programs and systematic monitoring (Caput et al., 2010). The Dupska Pramenka is an indigenous strain of the Pramenka sheep breed. It is a triple-purpose breed developed for milk, meat and wool. The Dupska Pramenka originated in the central part of Bosnia and Herzegovina, particularly on Mountain Vlašić and its surroundings. In the

period 1991–1995, the Dupska Pramenka expanded its original habitat, reaching the northern part of Republika Srpska, i.e. the area of the Una-Sana Canton, and the Republic of Croatia.

The characterization of animal genetic resources must consider an appropriate system of individual identification and a quantitative and qualitative description of the breed, habitat and production systems in which the animals are raised and adapted to (Caput et al., 2010). The goal of genetic characterization is to gain more knowledge about resources, their current and potential future use in food production under defined environmental conditions, and their current status regarding endangerment (FAO, 1984; Rege, 1992). The equipment used in breed characterization is diverse, ranging from the simplest tools such as the Lydtin's stick and tape to sophisticated tools for DNA analysis, new computer programs, etc. Simple equipment is used to measure external traits in order to determine breed standards, whereas DNA analyzers are used for phylogenetic studies, DNA marker recognition, and the implementation of conservation programs (Caput et al., 2010).

The genetic characterization of a breed can be based on three parameters: external traits, production characteristics, and genetic structure. Važić et al. (2017a) have already done the morphometric characterization of the Dupska Pramenka strain. Moreover, Važić et al. (2017b) also compared three strains of the Dupska Pramenka (Dupski, Privorski and Kupreški) according to the morphometric criteria. Novoselec et al. (2020) estimated the body weight of the Dupska (Travnik) Pramenka sheep in the area of Croatia. The milk yield of the Dupska Pramenka breed in the period of lactation was also reported (Važić et al., 2003). Momić (2014) reported the classification, linear measurements, texture and meat colour of Dupska Pramenka lambs, whereas Držaić et al. (2017) report the effect of sex on slaughter traits and measurements of the Travnik (Dupska) Pramenka sheep lamb. In addition to the morphometric and production characterization of the Dupska Pramenka strain, genetic characterization was also performed through hemoglobin polymorphism (Važić et al., 2015; Važić et al., 2017c), as well as DNA characterization, establishing genetic distances between the Dupska Pramenka and other strains of Pramenka from the Balkan Peninsula. Furthermore, the genetic distance between the Dupska Pramenka strain and other well-known breeds of sheep in Europe was established (Činkulov et al., 2008; Čurković et al., 2016). The Dupska (Travnik) Pramenka was enrolled in a study on the inheritance of birth weights in crosses between different sheep breeds (Pocnić & Dzidić, 2021).

On balance, the genetic characterization of the Dupska Pramenka, as an indigenous strain, has not been performed according to the yield and physico-mechanical properties of the wool. The purpose of this study is to examine the annual yield and physico-mechanical properties of Dupska Pramenka wool for the purpose of a more complete Dupska Pramenka breed characterization and genome preservation.

MATERIAL AND METHODS

Under the ecological conditions of the Balkan Peninsula, sheep are sheared once a year at the end of the spring, depending on weather conditions. If the spring is too warm with less precipitation, sheep can be sheared at the beginning of the spring. However, if the weather is too cold with a lot of precipitation, shearing can be postponed until the end of the spring.

Wool sampling

In the case of coarse-bred sheep such as the Dupska Pramenka, wool samples are taken from three body sites: the left shoulder, posterior rib and pelvis (directly next to the acetabulum). Staple samples are taken from these sites with scissors by cutting directly to the skin. The thickness of staple samples collected was 2–3 cm. For each sample collected, the following data were collated: animal ID, sex, and topographical site on the animal's body. Furthermore, the samples collected were washed to remove impurities and greasiness. After washing, the wool was dried and prepared for further analysis.

Measuring the amount of sheared wool (wool yield)

The amount of sheared wool was measured immediately after shearing 130 ewes and 14 rams. The fleece was weighed with a decimal scale with a precision of ± 50 g.

Measuring the length of staples

The lengths of staples obtained from 36 ewes and 14 rams were measured. Staple measurements were performed immediately before shearing, by spreading the fleece on the shoulder, back rib and croup of animals considered. The measurement process was performed using a ruler with a millimeter division. One end of the ruler was placed on the skin and the other on the tip of the majority of wool fibers, where the length of staples was recorded.

Measuring the height of the wool fiber

The height of wool fibers was measured with a ruler in their natural state, i.e. natural wool fiber coils. The length from the base to the top of the fiber was recorded. The fiber height was also measured at the three body sites mentioned above. The heights of 30 fibers were measured from each body site, totaling 90 wool fibers per sheep, or 3,240 fibers obtained from 36 ewes and 1,260 fibers from 14 rams.

Measuring the length of wool fibers

The length of a wool fiber is a distance between the base and top of the fiber. Before measuring the fiber length, all curly fibers are straightened, but not stretched. The length of the wool fibers was measured with a ruler. In total, the length of 4,500 wool fibers was measured from 150 wool samples per sheep.

Measuring the thickness of wool fibers

To measure the thickness of wool fibers, 84 samples were obtained from 28 ewes and 42 samples from 14 rams. The staples were cut following the procedure described above. The wool fiber thickness was established by measuring short fiber cuts from the base, middle, and top of staples using a lanometer. The total number of measured ewes' wool fibers was 22,561, whereas the total number of measured rams' wool fibers was 9,517, i.e. 806 wool staples measured per each ewe and 680 wool staples per each ram. The staples were measured until the biometric curve was formed.

Data analysis

Descriptive statistics was performed for the wool staple length, height, and length and thickness of wool fibers of the Dupska Pramenka sheep enrolled in the study. The statistical program SPSS 22.0 was used for data processing (IBM SPSS Statistics Version 22.0).

RESULTS AND DISCUSSION

Amount of sheared wool

The fleece of the Pramenka sheep breed is open, consisting of pointed staples that make a clearly defined division along the spine. The head and lower parts of the legs are covered with wool. Sheep shearing is done once a year, mostly at the end of May or the beginning of June, depending on the climatic conditions. The annual yields of Dupska Pramenka wool fleece are presented in Table 1.

Table 1. Annual yields of Dupska Pramenka wool fleece (kg)

Sex	Mean	SD	SE	CV	Min	Max
Ewes	2.12	0.48	0.04	22.64	1.10	3.50
Rams	3.34	0.58	0.16	17.37	2.05	4.35

Legend: SD - standard deviation; SE - standard error of the arithmetic mean; CV - coefficient of variation

As seen in Table 1, the average annual yields of unwashed (greasy) fleece were 2,120 kg and 3,340 kg in the ewes and rams, respectively. Končar and Markotić (Markotić & Čaušević, 1957) reported the average annual wool yield of 2.07 kg in the selected herds of Dupska Pramenka on the Vlašić agricultural holding. In 1955, the Dupska Pramenka average annual wool yield (n = 281) was 2.23 kg, ranging from a minimum value of 1.25 kg to a maximum value of 3.50 kg. In 1956, the average annual wool yield was 1.75 kg (n = 193), ranging from a minimum value of 0.65 kg to a maximum value of 3.00 kg (Markotić & Čaušević, 1957).

Length of staples

The Dupska Pramenka fleece is composed of pointed staples, in which there are mixed fibers of different thicknesses and lengths. Table 2 displays the results of Dupska Pramenka staple length measurements.

Table 2. Wool staple lengths of the Dupska Pramenka (cm)

Sex	Body place	Mean	SD	SE	CV	Min	Max
Ewes	Shoulder	20.92	3.47	0.59	16.59	15.00	31.00
	Posterior rib	21.75	3.37	0.57	15.52	14.00	27.00
	Pelvis	22.25	3.83	0.65	17.21	13.00	31.00
Rams	Shoulder	23.50	3.25	0.91	13.83	19.00	28.00
	Posterior rib	22.14	3.36	0.93	15.18	17.00	28.00

Pelvis	23.64	3.90	1.08	16.50	18.00	32.00
Legend: SD - standard deviation; SE - standard error of the arithmetic mean; CV - coefficient of variation						

The results obtained indicate that the longest staples were measured on the withers of both ewes and rams.

Height and length of wool fibers

The length and height of wool fibers are important properties for the utilization of wool in the textile industry. The textile industry requires wool fibers to be the longest possible with the smallest possible diameter. During the processing of wool made of such fibers, higher quality clothing is produced with less losses. The heights and lengths of Dupska Pramenka wool fibers obtained are shown in Table 3.

Table 3. Heights and lengths of wool fibers of the Dupska Pramenka ewes and rams (cm)

Body place	Ewes	Mean	SD	SE	CV
Shoulder	Height	21.97	3.46	0.58	15.75
	Length	22.85	3.29	0.56	14.40
Posterior rib	Height	22.38	3.60	0.61	16.09
	Length	23.10	3.57	0.60	15.45
Pelvis	Height	23.06	3.08	0.52	13.36
	Length	23.77	3.16	0.53	13.29
Body place	Rams	Mean	SD	SE	CV
Shoulder	Height	22.00	3.19	0.89	14.50
	Length	22.89	3.26	0.91	14.24
Posterior rib	Height	22.54	2.95	0.82	13.09
	Length	23.26	2.98	0.83	12.81
Pelvis	Height	22.61	3.92	1.09	17.34
	Length	23.40	3.90	1.08	16.67
Legend: SD - standard deviation; SE - standard error of the arithmetic mean; CV - coefficient of variation					

The heights and lengths of wool fibers were found to be approximately the same in both ewes and rams, which is an indicator of low tortuosity and large fiber diameter. The ratios of wool fiber heights and lengths of the Dupska Pramenka ewes and rams considered are presented in Table 4.

Table 4. Ratios of wool fiber heights and lengths of the Dupska Pramenka ewes and rams

Sex	Shoulder	Posterior rib	Pelvis	Average
Ewes	100 : 104.01	100 : 103.22	100 : 103.08	100 : 103.44
Rams	100 : 104.05	100 : 103.19	100 : 103.49	100 : 103.57

The highest ratio between the height and length of wool fibers was found on the shoulder in both sexes. The average height-to-length ratio obtained indicates that the Dupska Pramenka has extremely straight fibers with few curls, which is a characteristic of coarse wool. However, coarse wool can hardly achieve a satisfactory market price.

Wool fineness

The fineness of sheep wool has the greatest impact on the quality and use of wool. A large number of factors influence wool fineness such as sheep breed, sex, age, health, nutritional conditions, keeping conditions, climate, soil, altitude, etc. The Dupska Pramenka is a breed with coarse wool, which is mainly processed on farms to obtain coarse fabric. Clothing items made from such wool fibers represent good protection against the cold. The diameter of wool fibers of the Dupska Pramenka ewes and rams considered is presented in Table 5.

Table 5. Wool fineness of the Dupska Pramenka sheep considered (μ)

Body place	Ewes	Mean	SD	SE	CV	Min	Max
Shoulder	7333	42.63	13.70	2.52	32.04	38.61	47.24
Posterior rib	7666	42.37	15.70	2.97	33.07	38.10	53.23
Pelvis	7562	44.23	14.09	2.66	31.86	39.28	53.17
Average	22561	43.08	14.50	2.72	32.32	38.66	51.21
Body place	Rams	Mean	SD	SE	CV	Min	Max
Shoulder	3167	45.12	13.24	3.54	29.34	40.33	48.55
Posterior rib	3152	45.20	13.07	3.49	29.11	41.03	50.45

Pelvis	3198	45.97	13.09	3.50	28.86	41.21	52.28
Average	9517	45.43	13.13	3.51	29.10	40.86	50.43
Legend: SD - standard deviation; SE - standard error of the arithmetic mean; CV - coefficient of variation							

The average thickness of wool fibers of the Dupska Pramenka ewes considered was 43.08 μ . The wool fibers with the largest diameter were measured on the pelvis of the ewes. The average thickness of wool fibers of the Dupska Pramenka rams considered was 45.43 μ . The wool fibers with the largest diameter were also measured on the pelvis of the rams.

Wool assortment

To create a complete picture of the Dupska Pramenka wool fineness and wool fiber uniformity, all the fibers measured were classified into the corresponding assortments according to Lehman (Tab. 6 and 7).

Table 6. Assortments of Dupska Pramenka ewes' wool

Assortment (μ)	Shoulder		Posterior rib		Pelvis		Total	
	No	%	No	%	No	%	No	%
5A < 18	47	0.64	80	1.04	45	0.60	172	0.76
4A 18-20	105	1.43	121	1.58	83	1.10	309	1.37
3A 20-22	163	2.22	176	2.30	132	1.75	471	2.09
2A 22-24	234	3.19	237	3.09	202	2.67	673	2.98
A 24-26	272	3.71	311	4.06	231	3.05	814	3.61
B ₁ 26-28	312	4.25	348	4.54	248	3.28	908	4.02
B ₂ 28-30	360	4.91	417	5.44	351	4.64	1128	5.00
C 30-37	975	13.30	997	13.02	913	12.02	2885	12.79
D 37-45	1263	17.22	1155	15.08	1190	15.74	3603	15.97
E 45-60	1377	18.78	1435	18.73	1520	20.10	4332	19.20
F > 60	2243	30.59	2383	31.11	2657	35.14	7283	32.28
Total	7333	100	7660	100	7562	100	22561	100

The Dupska Pramenka wool assortment analysis shows that the F assortment is predominant in the ewes (32.28%), followed by the E assortment (19.20%), the D assortment (15.97%), and the C assortment (12.79%). However, the assortments of finer wool are very poorly represented.

Table 7. Assortments of Dupska Pramenka rams' wool

Assortment (μ)	Shoulder		Posterior rib		Pelvis		Total	
	No	%	No	%	No	%	No	%
5A < 18	10	0.32	18	0.57	20	0.63	48	0.50
4A 18-20	24	0.76	23	0.73	22	0.69	69	0.73
3A 20-22	31	0.98	38	1.21	24	0.75	93	0.98
2A 22-24	58	1.83	53	1.68	46	1.44	157	1.65
A 24-26	78	2.46	78	2.47	61	1.91	217	2.28
B ₁ 26-28	94	2.97	92	2.92	78	2.44	264	2.77
B ₂ 28-30	122	3.85	131	4.16	134	4.19	387	4.07
C 30-37	443	13.99	396	12.56	425	13.29	1264	13.28
D 37-45	641	20.24	611	19.38	606	18.95	1858	19.52
E 45-60	770	24.31	785	24.90	743	23.23	2298	24.15
F > 60	959	30.28	927	29.41	1041	32.55	2927	30.76
Total	3167	100	3152	100	3198	100	9517	100

Similar to that of the ewes, the fleece of the rams considered was mostly categorized in the F assortment (30.76%), followed by the E assortment (24.15%), the D assortment (19.52%), and the C assortment (13.99%). The C, D and E assortments were found to be significantly larger in the rams than in the ewes.

The characterization of a sheep breed or strain is quite expensive and can usually be done at certain time intervals. Nowadays, sheep breeds change rapidly under the influence of selection, modern reproduction methods, and breeding policies, thus ultimately requiring more frequent morphometric and production characterization. For this reason, it would be desirable to perform the characterization of a sheep breed or strain every five years.

CONCLUSION

Originated in the central part of Bosnia and Herzegovina, the Dupska Pramenka is an indigenous strain of the Pramenka sheep breed. It is a triple-purpose breed developed for milk, meat and wool. The results obtained indicate that the Dupska Pramenka is characterized by an open fleece, consisting of pointed staples. The annual Dupska Pramenka wool yield is comparable to that of larger Pramenka strains with coarse wool. Its fleece is made up of long and spiky wool fiber locks. The relationship between the height and length of Dupska Pramenka wool fibers is not pronounced, suggesting that the fibers do not have increased tortuosity. According to its diameter, the Dupska Pramenka staple is extremely coarse, characterized by mixed wool fineness and fiber uniformity. The Dupska Pramenka wool assortment analysis shows that the F assortment is predominant in both the ewes and rams considered, followed by the E, D, and C assortments, respectively. Coarse fabrics are made from the Dupska Pramenka wool, featuring distinct thermal insulation (which could be one of its primary processing purposes in the future).

Conflict of interest: The authors declare that they have no conflict of interest.

REFERENCES

- Caput P., Ivanković A., Mioč B. (2010): *Očuvanje biološke raznolikosti u stočarstvu*. Hrvatska mljekarska udruga, Zagreb.
- Činkulov M., Popovski Z., Porce K., Tanaskovski B., Hodža A., Bytyqi H., Mehmeti H., Margeta V., Djedović R., Hoda A., Trailović R., Brka M., Marković B., Važić B., Vegara M., Olsaker I., Knatanen J. (2008): Genetic diversity and structure of the West Balkan pramenka sheep type as revealed by microsatellite and mitochondrial DNA analysis. *Journal of Animal Breeding and Genetics*, 125: 417-426.
- Ćurković M., Ramljak J., Ivanković S., Mioč B., Ivanković A., Pavić V., Brka M., Veit-Kensch C., Međugorac I. (2016): The genetic diversity and structure of 18 sheep breeds exposed to isolation and selection. *Journal of Animal Breeding and Genetics*, 133: 71-80.
- Držaić V., Aščić Š., Antunović Z., Mioč B. (2017): Effect of sex on slaughter traits and carcass measurements of Travnik pramenka sheep lambs. *Journal of Central European Agriculture*, 18(4): 918-928.
- FAO (1984): Animal Genetic Resources Conservation by Management, Data Banks and Training. FAO Anim. Prod. and Health, Paper 44/1.
- IBM SPSS Statistics for Windows Version 22.0. IBM Corp. Released 2013. Armonk, NY.
- Markotić B. & Čaušević Z. (1957): Rad na melioraciji dupske ovce preko ovčarskog ogranka, Zemljoradničke zadruge "Mehurić" kod Travnika. *Poljoprivredni pregled*, 1-2, Sarajevo.
- Momić S. (2014): Klasifikacija, linearne mjere, tekstura i boja mesa jagnjećih trupova različitih genotipova, MSc. thesis, University of Banja Luka.
- Novoselac J., Gregurinčić I., Klir Ž., Mioč B., Držaić V., & Antunović Z. (2020): The estimation of body weight from body measurements of Travnik Pramenka sheep in the area of Bilogora, Croatia. *Journal of Central European Agriculture*, 21(2): 207-214.
- Pocrnić I. & Dzidic A. (2021): Inheritance of the birth weights in crosses between Istrian, Awassi, East-Friesian and Travnik Pramenka sheep in Croatia: a case study. *Journal of Central European Agriculture*, 22(2): 250-259.
- Rege J.E.O. (1992): Background to ILCA animal genetic resources characterization project, objectives and agenda for the research planning workshop. In: Animal genetic resources: their characterization, conservation and utilization. Research planning workshop, ILCA, 19-21.02.1992., Addis Ababa, Ethiopia.
- Važić B., Drinić M., Matarugić D., Marković Z. (2003): Proizvodnja mlijeka i sadržaj mliječne masti kod ovaca dupske pramenke u muznom periodu laktacije. *Agroznanje*, 2: 246-258.
- Važić B., Rogić B., Drinić M., Savić N. (2015): Polymorphism of pramenka sheep haemoglobin in central Bosnia. *Journal of Agricultural Sciences*, 60(3): 315-324.
- Važić B., Rogić B., Pihler I., Drinić M., Savić N. (2017a): Morphometric characterization and body measurement correlation in Dupska pramenka sheep. *Contemporary Agriculture*, 66(1-2): 38-43.
- Važić B., Rogić B., Drinić M., Savić N. (2017b): Morphometric similarities and differences between three genotypes of pramenka sheep from central Bosnia. *Biotechnology in Animal Husbandry*, 33(3): 291-298.
- Važić B., Rogić B., Drinić M., Pržulj N. (2017c): Relationship between the genetic hemoglobin polymorphism, morphometry and fertility of pramenka sheep breed from central Bosnia. *Genetika*, 49(1): 151-160.