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The wool quality of Jezersko-Solčava sheep in Slovenia

BIZJAK, Marko – ŽAN, Metka* – BOJKOVSKI, Danijela – SIMČIČ, Mojca

Department of Animal Science, University of Ljubljana, Biotechnical Faculty, Jamnikarjeva 101, Ljubljana, Slovenia

*corresponding author: metka.zan@bf.uni-lj.si

Abstract

The Jezersko-solčava sheep is one of five indigenous Slovenian sheep breeds. It is a dual-purpose breed known for the lamb and wool production. However, some breeders process all the produced fleeces at home, and quality of the wool is subjectively estimated by touch and appearance. Therefore, the study was conducted to evaluate the wool quality in young rams of Jezersko-Solčava sheep that finished the performance test for growth traits in the period 2018 - 2020 in two test stations: 447 rams from Logatec and 91 rams from Jezersko. Wool samples were classified into four quality classes according to the fibre diameter. The majority of rams (44.80%) had coarse (26.01-30.00 μm) and 47.58 % very coarse wool ($>30.00 \mu\text{m}$). We found that most wool quality traits as well as raw fleece weight were significantly affected by the year of shearing, the month of shearing, test station, age of the ram and flock of origin.

Keywords: sheep, Jezersko-Solčava sheep, wool, quality

Introduction

Jezersko-Solčava sheep is the indigenous sheep breed in Slovenia with the highest population size (Register, 2021) of about 5,564 animals and is classified as a vulnerable breed according to the FAO criteria. The Jezersko-Solčava sheep is well adapted to the local agroclimatic and geophysical conditions and is geographically widespread over the entire territory of Slovenia. The areas of origin of Jezersko-Solčava sheep are Jezersko and Solčava in the northern part of Slovenia. There, the breed has been preserved as it first appeared centuries ago and has been a well-known and valued breed since the second half of the 19th century.

Jezersko-Solčava sheep was created by improving the white domestic sheep of the eastern Alps with Bergamasca and Paduan sheep (KOMPAN et al., 1996). It has a typical convex nose profile, which is inherited from Bergamasca sheep, and good-quality wool, which is inherited from Paduan sheep (Figure 1). Jezersko-Solčava sheep has the highest wool quality compared to other indigenous Slovenian sheep breeds (SIMČIČ et al., 2019).



Figure 1. Wool products from Jezersko-Solčava sheep

In Slovenia, there are two test stations for rams: the test station in Logatec and the test station in Jezersko, where is one of two original areas of Jezersko-Solčava sheep. On the test station Logatec the feed ratio consists of hay *ad libitum* and concentrates up to 1 kg, while on the test station Jezersko the main feed ratio presents grazing on the pastures around the test station.

Wool is a natural fibre with a unique combination of properties used in the clothing industry. The wool industry, especially the production of fine wool, plays an important role in the world trade, and the price of wool depends on its quality (TAYE et al., 2021). Sheep wool is a natural animal fibre composed of 60% protein fibres, 15% moisture, 10% fat, 10% sheep sweat and 5% impurities (PARLATO et al., 2022).

Key wool characteristics include fibre diameter, comfort factor, fibre curvature, spinning fineness, staple length, staple strength and clean fleece yield (ANDERSON et al., 2009). Fibre diameter refers to the average width of a single cross-section of wool fibre and is widely recognised as the most important wool characteristic in evaluating wool quality and value (HOLMAN and MALAU-ADULI, 2012).

There are several factors that influence the parameters of wool quality. Environment and genetics are the most important factors affecting the quality and quantity of sheep wool. Breed or genotype is one of the most important genetic factors affecting the product and productivity as well as the quality of sheep wool, i.e. the fleece of different breeds differs in its physical and chemical characteristics (TAYE et al., 2021).

Scientific knowledge about the quality characteristics of Jezersko-Solčava sheep wool was very limited. Therefore, the aim of this study was to determine in which quality classes the wool of young rams could be classified and which factors affect the wool traits (fibre diameter, comfort factor, spinning fineness, fibre length and fibre curvature) and the raw fleece weight.

Material and methods

Data for Jezersko-Solčava rams were obtained from the Slovenian National Breeding Program for small ruminants recorded, according to the ICAR standards. Data included ID number, the flock of origin, date of birth, test station, shearing date, fleece weight, and the results of laboratory analysis of wool samples.

The study was conducted to evaluate the wool quality in young rams of Jezersko-Solčava sheep that finished the performance test for growth traits in the period 2018 - 2020 in two test stations: 447 rams from Logatec and 91 rams from Jezersko. Rams originated from 50 different flocks which are included in Slovenian National Breeding Program for Jezersko-Solčava sheep. On the test stations where rams were housed, there were uniform farming conditions which could influence quality traits of wool as well. The average age of rams at shearing was 266.69 ± 36.68 days. Rams were sheared according to Bowen's method. After shearing, the fleece of each ram was weighed and the wool sample was taken for laboratory analyses. Wool sample was taken from the left side of ram, in the middle of body, on an area between 30th and 31th cut according

to Bowen method (Figure 2). All wool samples were individually packed in plastic bags, marked and sent to the laboratory Art of fibre (<https://artoffibre.com/>) to Finland or Great Britain, respectively. The chosen laboratory has implemented and certificated method of determination of wool quality traits. These traits are fibre diameter, comfort factor, spinning fineness, fibre length, and fibre curvature.

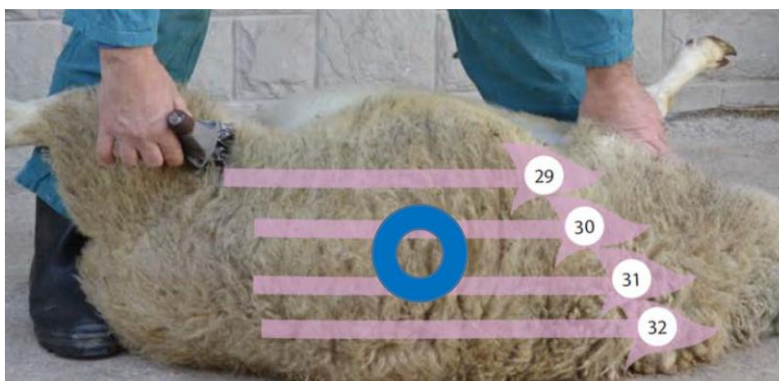


Figure 2. Location of fleece sampling on the body of the ram

Data were analysed with the MIXED procedure using SAS/STAT® Software Version 9.4 (SAS/STAT, 2016). The statistical model for wool quality traits included test station, year of shearing, and month of shearing as fixed effects while age at shearing was included as a linear covariate. In the model, there was included a random effect of flock of origin as well.

Results and discussion

The descriptive statistics for wool characteristics of young Jezersko-Solčava rams are presented in Table 1. The average raw fleece weight per ram was 1.58 ± 0.44 kg (Table 1). The average fibre diameter was 29.96 ± 2.72 μm and the average spinning fineness was 29.56 ± 2.84 μm . The average comfort factor was $57.81 \pm 15.63\%$. On average, the wool fibres were 80.90 ± 20.10 mm long and the average fibre curvature was 48.70 ± 8.36 degrees/mm.

Table 1. Descriptive statistics for wool traits of young rams of Jezersko-Solčava breed

Wool characteristics	Number of samples	Average	Standard deviation	Min	Max
Fleece weight (kg)	505	1.58	0.44	0.64	3.00
Fibre diameter (μm)	538	29.96	2.72	22.90	43.70
Comfort factor (the proportion of fibres < 30 μm , %)	538	57.81	15.63	7.70	93.60
Spinning fineness (μm)	488	29.56	2.84	22.60	42.50
Fibre length (mm)	538	80.90	20.10	30.00	140.00
Fibre curvature (degrees/mm)	538	48.70	8.36	28.40	86.50

Min – minimum, Max – maximum

Based on the fibre diameter, the wool (fleece) of each ram was classified into different quality classes. The Art of Fibre laboratory (<https://artoffibre.com>) has introduced six quality classes of wool: ultra-fine, super fine, fine, medium, coarse and very coarse (Table 2).

Table 2. Wool quality classes according to the fibre diameter

Colour code	Wool quality classes	Fibre diameter (μm)
Yellow	Ultra-fine	< 18,01
Blue	Super fine	18,01 – 20,00
Pink	Fine	20,01 – 23,00
Red	Medium	23,01 – 26,00
Green	Coarse	26,01 – 30,00
Purple	Very coarse	> 30,00

For the production of wool products, the fineness of the wool fibre is a very important characteristic, that could not be accurately estimated only by the touch.

Fibre diameter is the width of the cross-section of the fibre, assuming that fibres are approximately cylindrical (SCOBIE et al., 2015). It is the single most important characteristic of wool that determines its price and largely the products for which it is used. Wool with a smaller fiber diameter (23 μm or less) can be processed into finer yarn.

Wool samples from rams of Jezersko-Solčava sheep were classified into four quality classes according to the fibre diameter. One ram (0.19%) had fine wool (20.01-23.00 μm), 40 rams (7.43%) had medium wool (23.01-26.00 μm), 241 rams (44.80%) had coarse wool (26.01-30.00 μm) and 256 rams (47.58%) had very coarse wool (>30.00 μm) (Figure 3). Wool of medium quality was the best quality class of Jezersko-Solčava sheep (ram with fine wool was an exception).

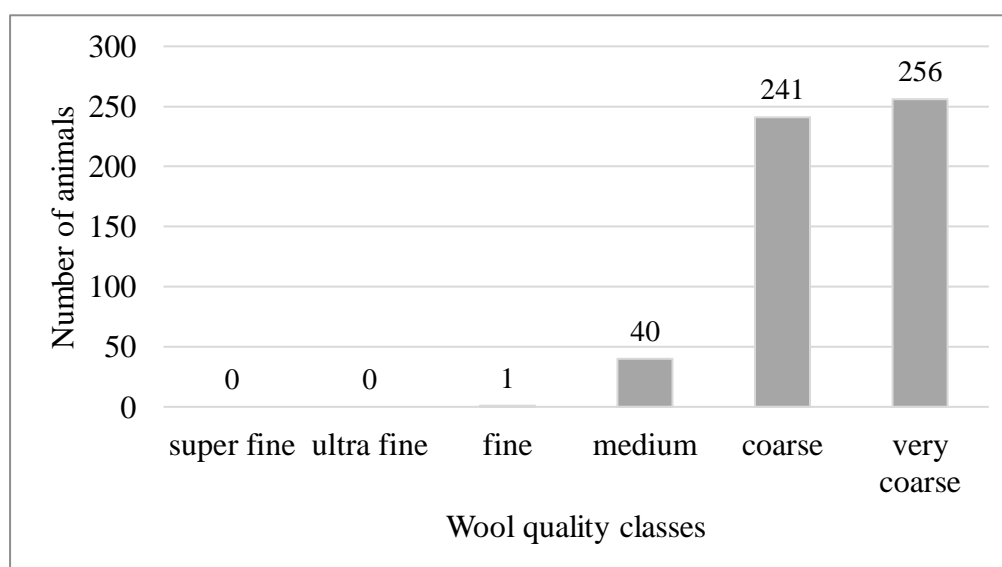


Figure 3. Number of rams of Jezersko-Solčava sheep classified in quality classes according to the fibre diameter

Wool quality is influenced by several management factors namely management, feeding, collection period, season of shearing and shearing methods which can affect the amount of clean fleece that can be obtained from sheep and its quality (TAYE et al., 2021). In general, many physiological (e.g. reproduction, sex), and environmental factors (production system, feeding, housing etc.) influence the quality and quantity of wool produced by sheep farms. These factors must be managed to optimize wool production and quality. Among the management strategies; shearing period, disease control, slaughter timing, feeding, pasture

management and reproduction management are the factors that need to be improved for better wool quality. In Table 3 are presented factors that significantly affected individual characteristics of wool quality of rams of Jezersko-Solčava sheep: test station, shearing period (year, month), age of the ram at shearing and the origin of the flock.

Table 3. Factors affecting wool quality parameters

Trait	Factor				
	Test station	Year of shearing	Month of shearing	Age of ram at shearing	Flock of origin
Fleece weight (kg)	√	√	√	√	√
Fibre diameter (μm)	√	√	√		√
Comfort factor (the proportion of fibres thinner than 30 μm %)	√	√	√		√
Spinning fineness (μm)	√	√	√		√
Fibre length (mm)	√		√	√	√
Fibre curvature (degrees/mm)		√	√		√

It is evident that the month of shearing and flock of origin affected all wool quality parameters as well as fleece weight. Test station affected fleece weight and all wool quality parameters with an exception of fibre curvature while the year of shearing affected fleece weight and all wool quality parameters with an exception of fibre length. On the other hand, the age of ram at shearing affected just fleece weight and fibre length. A strong correlation was found between fibre diameter and comfort factor, between fibre diameter and spinning fineness, and between comfort factor and spinning fineness.

The flock of origin was also included in the analysis as a random effect because we predicted differences between flocks of breeders using wool for products and flocks of breeders not using wool for products. Previously, the subjective evaluation of wool from Jezersko-Solčava sheep was introduced, so the differences were expected.

Table 4. Proportion of phenotypic variance explained by random influence of the flock of origin

Trait	Proportion of explained variance
Fleece weight (kg)	0.16
Fibre diameter (μm)	0.09
Comfort factor (%)	0.11
Spinning fineness (μm)	0.05
Fibre length (mm)	0.09
Fibre curvature (degrees /mm)	0.12

The highest proportion of explained variance with the flock of origin was for fleece weight (0.16), followed by fibre curvature (0.12) and comfort factor (0.11). Fibre diameter and fibre length had the same proportion of explained variance with the flock of origin (0.09). The lowest proportion of explained variance with the flock of origin was for spinning fineness (0.05; Table 4).

Conclusion and recommendation

The wool quality traits of Jezersko-Solčava sheep are highly variable. Therefore, breeders have decided to include the trait fibre diameter as a breeding objective in the breeding programme. In addition, in the areas of origin of the Jezersko-Solčava sheep, in the Jezersko and Solčava areas, there is a strong association called Bicka, which processes wool and sells various products such as knickers, clothing, bags, toys, jewellery and various other products. Knowing the quality characteristics of the wool can help to control the final products, consumer comfort and processing intensity. Therefore, it is important to understand the factors that affect the physical and chemical properties of wool in order to improve the quality of wool through genetic and management conditions.

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