

Meat quality of autochthonous Sjenica Zackel sheep - Basis for sustainable production of genetic resource on the Sjenica-Pester plateau

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ABSTRACT

Sjenica sheep is the largest type of autochthonous Zackel sheep reared in Serbia. It is well adapted to harsh climatic and environmental conditions, which exist on the High Nature Value Sjenica-Pester plateau of the mountain regions of south-west Serbia. The Sjenica sheep is considered as vulnerable due to increasing dilution of the populations under the influence of meliorators, such as Wurttemberg sheep. Therefore, it is necessary to undertake protective measures, such as in vivo conservation, with special attention to advanced phenotypic characterization of adaptive and productive breed traits, as a strategy for a rational utilization of sheep resources. The objective of the study was to perform and evaluate the advanced phenotypic characterization of Sjenica sheep, especially its productive potential and meat quality traits. In this paper the evaluation of sensory characteristics (odour intensity, flavour intensity, flavour quality and overall acceptability) and the fatty acid composition of meat (*M. longissimus dorsi*) samples of Sjenica sheep were done. The results indicated desirable sensory characteristics of tested lamb meat, with high overall acceptability score (6.12 ± 0.25). Furthermore, favourable fatty acid composition has been found in the meat samples of Sjenica sheep. The CLA content was at a high level (4.12 ± 0.48), also the n-6:n-3 ratio was desirable (1.88 ± 0.32), which can partly be explained by the influence of the traditional habitat, such as specific floristic composition in which animals are reared.

Keywords: Zackel sheep, autochthonous, meat quality, characterization.

INTRODUCTION

The knowledge of the importance of animal genetic resources and the management of these resources are very important objectives of current livestock production. Bad influence of climate changes and occurrence of new diseases in sheep make the conservation of locally adapted sheep breeds extremely important (FAO, 2010; Hoffman, 2010). Autochthonous locally adapted domestic animals gained resistance and adaptability through the evolution of breeds in their given ecosystems (Hiemstra 2010). Keeping this fact in mind, the Faculty of Veterinary Medicine – Belgrade, for last decade undertakes a permanent characterisation and strategy for rational use of animal genetic resources (Savić et al., 2011). The most important autochthonous sheep breed in Serbia is Zackel sheep. This breed has been developed under modest biogeographic conditions and exhibits a high degree of adaptation to environmental conditions, such as climate and specific phytocenotic conditions. Zackel sheep is triple purpose (meat, lamb, wool) low production breed, with prominent phenotype diversity (Becskei, 2011).

Sjenica sheep is locally adapted, autochthonous Zackel sheep type, inhabiting the mountain regions of south-western Serbia, traditionally reared in Sjenica-Pester plateau (900 -1400 m altitude). Sjenica-Pester plateau belongs to High Nature Value region and is well known on its rich biodiversity with favourable floristical composition of the pastures (47300 ha) and meadows (26200 ha). The region has a specific microclimate with harsh and long winters, often with low temperatures up to -37°C. In addition to temperature, one of the important factors of climate influence on the vegetation is the amount of rainfall and its distribution throughout the year as well as relative humidity. The annual rainfall precipitation is as much as 700 mm per square meters per year.

According to the FAO classification Sjenica sheep is not on the Endangered breed list (FAODAD-IS, 2012). However, due to the popular trend of crossbreeding with exotic breeds such as Wurttemberg and Ile de France, population of Sjenica sheep is vulnerable. The total number of purebred Sjenica sheep is constantly decreasing. According to the results, autochthonous Sjenica sheep have an adaptive and selective advantage and represents a breed of choice for sustainable management in hilly-mountainous region. Traditional meat and milk products (Sjenica lamb, Sjenica cheese, etc.) contribute to the promotion of the region and development of rural areas, thus directly increasing the value of Sjenica breed (Savić et al., 2011).

The objective of the study was to perform and evaluate the advanced phenotypic characterization of Sjenica Zackel sheep, especially its productive potentials regarding to meat-quality traits.

MATERIAL AND METHODS

The survey was carried out on 12 autochthonous Sjenica sheep lambs. The lambs were produced in an extensive, sustainable management system in the region of the Sjenica-Pester plateau. Their diet was based on grazing on native pastures. The lambs of both sexes were slaughtered at the age of 90-100 days, with mean weight of 26.50 ± 1.80 kg. The lamb carcasses were refrigerated at +4°C for 24 h before sampling for analysis. The next day, muscle samples from cold carcasses were taken. Two slices of *M. longissimus dorsi* (at the first lumbar vertebra) were sampled for sensory and intramuscular fatty acid analysis.

The selection and training of the evaluators were conducted in accordance with ISO 8586-2:2012 (Sensor Features - General guidance for the selection, training and monitoring of assessors; Part 2: Sensory assessors (experts). Quantitative descriptive analysis (evaluation of the acceptability-odour) was performed according to ISO 6564:1985, the structural intensity scale / eligibility of seven points, with the score of 7 being the maximum intensity / eligibility, and score of less than 3.5 marked the product as unacceptable. The odour intensity, flavour intensity, flavour quality and overall acceptability were scored. Colour and odour of the meat samples were analysed before thermal treatment. Before cooking the fat was removed from the *M. longissimus dorsi*. The samples of *M. longissimus dorsi* were grilled (70°C internal temperature) and cut into thin slices. Sensory analysis was done by an eight member trained taste panel professional commission.

For fatty acid composition of the *M. longissimus dorsi* samples stored as described above were used immediately after thawing. Subcutaneous fat was removed over the *M. longissimus dorsi*. Analysis was performed in accordance with ISO 5508 and ISO 5509 norms. For the determination of fatty acids, total lipids were extracted by the method of rapid extraction with a solvent mixture of n-hexane and iso-propanol (60:40 v/v) on Dionex ASE 200 apparatus. The obtained extracts were evaporated under a stream of nitrogen (Dionex SE 500 apparatus), at 50°C until a dry lipid residue was obtained. The extracted lipid was used for the determination of fatty acids. Fatty acid methyl esters were prepared by trans-esterification with trimethylsulfonium hydroxide, according to the method EN ISO 5509:2007. Methyl esters were separated on a HP-88 column (column length 100 m, inner diameter 0.25 mm, film thickness 0.20 µm, J & W Scientific, USA) by capillary gas chromatography with a flame ionization detector (Shimadzu 2010, Kyoto, Japan). The injector temperature was 250°C and the detector temperature was set at 280°C. The carrier gas was nitrogen with a flow rate of 1.33 ml/min and a split ratio of 1:50. The injected volume was 1 µl, and the total run time 50.5 min. Fatty acid methyl esters were identified based on retention time compared to the retention times of a mixture of fatty acid methyl esters present in the Supelco Component 37 FAME mix standard (Supelco, Bellefonte, USA).

RESULTS

Some of the meat quality characteristics (*M. longissimus dorsi*) were evaluated for 12 Sjenica sheep lambs. All the tested meat samples had a fine structure, high juiciness and tenderness. Very favourable meat aroma and overall acceptability were detected in all samples. Table 1 summarises the sensory characteristics of tested lamb meat samples.

The other research goal was to analyse the fatty acid content of Sjenica lamb meat samples. Special attention was paid on conjugated linoleic acid (CLA) content and polyunsaturated fatty acid n-6:n-3 ratio, as it is well known that these have positive effects on human health. The result shows desirable fatty acid composition of saturated and unsaturated fatty acids. The polyunsaturated fatty acid content (\sum PUFA) was 3.40 ± 0.56 with favourable ratio of n-6:n-3 (1.88 ± 0.32) The detected CLA content is high (4.49 ± 0.59) Data summary on the fatty acid content (% by weight of total fatty acids) are presented in Table 2.

Table 1. Sensory characteristics of Sjenica lamb meat

Scores of sensory characteristics of Sjenica lamb meat M \pm SD					
Colour	Odour	Juiciness	Tenderness	Odour Flavour (Aroma)	and Overall acceptability
5.96 ± 0.34	5.78 ± 0.32	5.89 ± 0.32	5.86 ± 0.28	6.12 ± 0.23	6.12 ± 0.25

M – mean value; SD – standard deviation.

Table 2. Fatty acid composition (% by weight of total fatty acids) of Sjenica lamb meat samples (*M. longissimus dorsi*)

Fatty acids	M ± SD
C14:0	2.83 ± 0.24
C15:0	0.41 ± 0.06
C16:0	24.35 ± 2.40
C16:1	1.55 ± 0.24
C17:0	1.25 ± 0.28
C18:0	25.92 ± 3.58
C18:1 cis9	35.81 ± 2.53
C18:2 n-6	2.46 ± 0.24
C18:3 n-3	1.11 ± 0.22
C20:0	0.23 ± 0.01
C20:3 n-6	0.02 ± 0.01
C20:5 n-3	0.02 ± 0.01
C22:1 + C20:4	0.11 ± 0.02
22:5 n-3	0.16 ± 0.05
Σ SFA (Saturated fatty acids)	53.16 ± 2.96
Σ MUFA (Monounsaturated fatty acids)	36.98 ± 2.82
Σ PUFA (Polyunsaturated fatty acids)	3.72 ± 0.56
CLA	4.12 ± 0.48
Σ n-3 PUFA	1.29 ± 0.36
Σ n-6 PUFA	2.43 ± 0.22
n-6/n-3 ratio	1.88 ± 0.32

M – mean value; SD – standard deviation.

DISCUSSION

Autochthonous types of Zackel sheep in Serbia are considered to be severely endangered. A major route for endangering autochthonous breeds in Serbia has been uncontrolled cross-breeding and crossing with highly selected exotics breeds like Wurttemberg and Ile de France. Consequently, certain local breeds are already extinct while other populations are endangered and consistently declining in number. Sjenica sheep is the biggest strain of Zackel breed, traditionally grown in Sjenica-Pester plateau, fully adapted to the challenges of the environment (Jovanović *et al.*, 2009).

In the recent years there is a growing interest for the consumption of animal products with a favourable content of fatty acids with a positive effect on human health. Great attention has been laid on the relative proportion of n-6 and n-3 fatty acids, which can be a preventive factor for cardiovascular diseases, certain malignant and autoimmune diseases, such as lupus, rheumatoid arthritis, etc (Popović *et al.*, 2011; Schmid *et al.*, 2006). The interest in investigating lamb meat characteristics has been increasing, considering that lamb meat used in the weaning diet of children is presumed to have a lower allergenicity than other red meat (Nudda *et al.*, 2011). The established results are in accordance with a number of studies. They have confirmed that interaction between a breed and nutritional regimens with specific grass composition of pastures in the traditional habitat has a large impact on odour and flavour of lamb meat (Demirel *et al.*, 2006; Ramirez-Retamal *et al.*, 2014).

The results of sensory analysis of tested meat samples classified Sjenica sheep as a breed with very attractive sensory characteristics. Botanical analysis of plants from High Nature Value pastures and meadows of Pester-plateau shows a high biodiversity. The most frequent herbs are from the families of grasses 48.4%, legumes 9.6% and other herbs 42.0%. Floristic analysis proves that grasses and legumes of high and mild quality are predominantly present. A large number of grass species were detected. From the family of *Poacea*: *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Briza media*, *Danthona calycina*, *Bromus raceomus*, *Agrostis vulgaris*, *Dactylis glomerata*, *Festuca rubra*, *Festuca ovina*, *Phleum pretense*. The family of *Fabacea* were mainly presented by *Genista sagittalis*, *Lathyrus latifolius*, *Lotus corniculatus*, *Trifolium pretense*, *Vicia cracca*, *Trifolium alpense*, *Trifolium alpestre*, *Trifolium panonicum*, *Trifolium montanum* (Vučković *et al.*, 2004, 2010). The specific botanical composition and high diversity of favourable plants in grasslands of pastures and meadows in Sjenica-pester plateau provides specific, high quality lamb meat products.

The results of this researches are in accordance with a number of studies, where traditional habitat conditions have an influence on the fatty acid composition and flavour of lamb meat (Demirel et al., 2006; Ramirez-Retamal et al., 2014). Favourable fatty acid profile and sensory characteristics were obtained in Sjenica sheep meat. This results confirm the favourable content of CLA (4.12 ± 0.48) and of n-6:n-3 ratio (1.88 ± 0.32). This knowledge contributes to the advanced phenotypic characterization of Sjenica sheep; it helps determination of the value of locally adapted Sjenica breed. Furthermore, it facilitates realistic decision making for the promotion of sustainable use of Sjenica sheep. The favorable fatty acid profile, important for human health and especially for infant and children nutrition, raises the interest for sustainable production of Sjenica sheep. By recognizing that locally adapted animal breeds gained genetic resistance and adaptability through the evolutionary process, breeding strategies in sustainable farming practices today are far more attuned to the need for preserving and utilizing Sjenica sheep as a valuable genetic resource.

CONCLUSIONS

For achieving better productive results of Sjenica sheep, an integrated approach is necessary. The approach must contain all aspects of sheep keeping, feeding, breeding and disease prevention, as well as pasture management. Investigations of specific characteristics of autochthonous sheep breeds, especially advanced phenotype characterization of the productive potentials and specific product characteristics are important topics for a sustainable conservation strategy.

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