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**Božidarka MARKOVIĆ, Milena BJELANOVIĆ,
Goran VUČIĆ, Per BERG and Bjorg EGELANDSDAL¹**

COMPARISON OF CARCASS CHARACTERISTICS AND MEAT QUALITY OF NORWEGIAN WHITE SHEEP BREED WITH TWO WESTERN BALKAN PRAMENKA SHEEP BREEDS

SUMMARY

The aim of this study was comparison of the carcasses and meat quality parameters of three sheep breeds - two local breeds from Western Balkan countries and one from Norway. *Musculus Longissimus Dorsi* (MLD) samples from 44 sheep carcasses of three different breeds, 4-5 year old, were analyzed: Vlashichka Pramenka breed (VP) from Bosnia & Herzegovina (n=15), Pivska Pramenka breed (PP) from Montenegro (n=15) and Norwegian White Sheep (NWS) from Norway (n=14). The carcasses of PP and VP were randomly selected based on conformation of classes, while carcasses of NWS were selected only from class O. VP breed had less average carcass weight (25 kg) than PP and NWS breeds (27.3 and 30.4 kg, respectively), but higher average point of carcass conformation (7.9) than PP and NWS, where it was 5.3 and 5.0. Both breeds from West Balkan countries (VP and PP) had more fat on carcasses than Norwegian white sheep. VP breed had the more tender meat (38.6 N/cm²), than PP (47.8) and NWS (52.4), while the color stability was highest for the PP breed.

Keywords: sheep breeds, carcass conformation, meat quality parameters

INTRODUCTION

Meat is the most important product of sheep production in terms of its value. Sheep meat generally (light lambs' meat, heavier lambs' meat or mutton) competes with beef, pork and poultry meat for consumers' preferences who have many choices of high quality meats. In this competitive environment, the sheep industry must monitor preferences of consumers and react appropriately.

In the North Europe consumers prefer meat from heavier lambs, while the consumers from the southern prefer meat from light lambs (Sañudoa *et al.*, 2007).

Sheep meat is generally more difficult to sell, presumably due to the strong flavor, but traditional recipes exist that to some extent handles flavor challenges.

¹ Božidarka MARKOVIĆ, (corresponding author: bmarkovic@t-com.me), Department of Livestock Science, Biotechnical Faculty, University of Montenegro, Podgorica, Montenegro, Milena BJELANOVIĆ, Bjorg EGELANDSDAL, Department of Chemistry, Biotechnology and Food Science, Norwegian University of Life Science, Ås, Norway, Goran VUČIĆ, Department of Food science and Technology, Faculty of Technology, University of Banja Luka, Vojvode Stepe Stepanovica 73, 78 000 Banja Luka, Bosnia and Herzegovina, Per BERG, Nortura SA, Postboks 360 Økern, 0513 Oslo, Norway.

Important differences of meat quality exist between breeds of sheep. It is still little known about effects of breed on meat quality.

Thus, this research was conducted to compare the carcass and meat quality of different sheep breeds. The breeds chosen for this comparison are: Norwegian White Sheep breed (NWS) from Norway, Vlashichka Pramenka breed (VP) from Bosnia & Herzegovina and Pivska Pramenka (PP) breed from Montenegro.

Norwegian White Sheep breed is a relatively new breed, made by crossing of several local sheep breeds (Dala, Rygja, Steigar) and Texel breed. It was accepted as a separate breed in 2000-2001 (Boman *et al.*, 2010). Through crossbreeding some phenotypic traits of the native breeds are often repressed, in favor of some other desirable traits; muscular weight and litter size being the most common to breed for meat. Recently, the breeding program of NWS has been criticized more and more, because it makes the breed less suitable for Norwegian ambient conditions (Hansen *et al.*, 2001). Rearing of NWS is characterized as intensive and all breeding is focused on fast-growing lambs and the best meat yield. An adult sheep can weigh up to 100 kg.



Picture 1: Norwegian White sheep (NWS)

Sheep production in Western Balkans countries, as Montenegro and Bosnia & Herzegovina, is characterized by semi extensive system of rearing of mostly autochthonous breeds, using grassland and pasture areas (Cinkulov *et al.*, 2008). The most sheep breeds from this region belong to the big group of coarse wool sheep breeds called Pramenka. All Pramenka breeds are characterized by good adaptability ability to severe environment and exceptional disease resistance (Porcu & Markovic, 2006).

Vlashichka Pramenka is the most important autochthonous breed in Bosnia and Herzegovina. The typical area of rearing is the central part of Bosnia and Herzegovina, wider area around mountain Vlasica, where it could be promoted as part of a traditional lifestyle. It is a breed with combined production traits (meat,

milk and wool). Body weight of adult female animals is 60 – 70 kg, while for males it is 80-100 kg (Krajinovic, 2006).

Pivska pramenka is an autochthonous sheep breed in Montenegro. This is the most numerous sheep breed in Montenegro. The rearing region of typical Pivska Pramenka animals is in north west, and the central part of Montenegro, special mountain areas of Durmitor and Sinjajevina, where it is very well adapted for the rearing in the cold mountain climate. The average body weight of adult breeding animals is 70 kg, with height to withers of about 71 cm (Markovic *et al.*, 2013).



Picture 2: Pivska pramenka (PP)



Picture 3: Vlashichka pramenka (VP)

The quality and acceptability of meat is determined by several physico-chemical characteristics of meat, like color and tenderness, but also chemical characteristics of sensory and nutritional importance. Meat quality is also associated with effect of breed, plus (feed) regions leading to quality labels such as Protected Designation of Origin or Protected Geographic Indication (Negrini *et al.*, 2008). Phenotypic characteristics are already used in the promotion of lamb meat, *e.g.* lamb from Aragosa, (Martinez-Royo *et al.*, 2008). Today there are market interests in identifying phenotypic traits of breeds appealing to consumers.

Meat quality characteristics, such as color and other physical and chemical traits of Pramenka breeds are not well known, so far. Here we report sheep and lamb meat traits from a larger investigation on breed and age.

MATERIAL AND METHODS

Samples. *Musculus Longissimus Dorsi* (MLD) from 44 female animals, 4-5 years old, NWS (n=14; from Nortura Gol), VP (n=15) and PP (n=15) were analyzed. The carcasses of NWS were exposed to low voltage electrical stimulation before chilling. Next day, *MLD* was cut at the cold boning line and vacuum-packed within 5 hours at 10 °C, and then transported on ice to our lab. After receiving the muscles, they were cut in requested sample sizes and vacuum packaged.

Meat samples of VP were obtained from sheep reared in the area of Vlasic mountain and slaughtered on the traditional way at the traditional slaughterhouse "BB" Kotor Varos. After slaughtering, carcasses were chilled at +4°C in 24 hours, grading according to EUROP standard and MLD was cut under the same conditions as for NWS.

The meat samples of PP were obtained from sheep reared in the municipality Pljevlja (area of mountain Ljubisnja) and slaughtered in slaughterhouse of Meat industry "Franca" in Bijelo Polje. Carcasses are randomly selected, and grading according to EUROP standard. After chilling of carcasses at +4°C in 24 hours MLD was cut and vacuum packed.

Meat physical measurements:

pH was recorded 24 hours post mortem in MLD using Knick Portamess Model 913. Color stability: was measured with a Konica Minolta Chroma Meter CR-400/410.

Warner Bratzler shear force were measured on heated meat (to 72 °C) samples. Samples cut on pieces with 1cm x 1cm x 4-5 cm; the longer direction parallel to the fiber direction. Warner Bratzler shear cell (knife blade HDP/BSK), load cell 25 kg, TA-HDi Texture Analyzer.

Cooking loss measurements (in %) was calculated by weight loss after cooking the meat approximately 30 min in a water bath at 80°C.

$$\text{Cooking loss \%} = \frac{(\text{weight of raw meat} - \text{weight of cooked meat})}{(\text{weight of raw meat})} \times 100$$

Meat chemical characteristic measurements. Heme iron analysis for raw meat was performed on meat samples, following the analytical method described by (Lombardi-Boccia, Martínez-Domínguez, Aguzzi, & Rincón-León, 2002) with some optimizations. Meat pieces (0.155g) were dissolved in 233 µl distilled Millipore water, 1.55 ml acetone and 63 µl concentrated HCL (37%) in capped Eppendorf tubes. The mixture was vortexed heavily and centrifuged (VWR by Hitachi Koki, CT 15E Japan) at 16000 rpm (24462 g) for 10 min at 4 °C. The supernatant was extracted and the absorbance was measured at 407 nm against an appropriate blank.

Statistical analysis was performed by using one way Anova Multiple Range test (Statgraphics Plus 5.1). Statistically, the significant differences were considered at $P \leq 0.05$ level.

RESULTS AND DISCUSSION

Carcass weight, fat cover and conformation grading, tenderness, cooking loss, pH and heme levels are the variables listed in Table 1.

The NWS breed had higher slaughter weights than VP and PP breeds. VP breed, in comparison to the other two breeds had the lowest carcass weight, with higher fat cover grading, and better conformation score (7.9 or R). The differences between breeds were significant ($P < 0.05$). The fat cover grade was quite high, particularly for VP and PP. One of the reasons could be that the

animals of VP and PP breed were slaughtered one month later (the end of November) than animals of NWS. Assumingly it was a season with pasture in surplus. The selected Norwegian White Sheep carcasses were typical of the age group.

Table 1: Carcass and meat quality assessments

Parameter	NWS Norway	PP MNE	VP B&H
Carcass weight(kg)	30.4(±5.2) ^a	27.3(±3.6) ^{ab}	25(±3.1) ^b
EU _{fatness s.} [*]	7.8(±1.4) ^a	8.13(±1.3) ^a	9.8(±1.0) ^b
EU _{conf. s.} ^x	5.0(±0) ^a	5.3(±1.5) ^a	7.9(±1.6) ^b
SF** (N/cm ²)	52.4 (±14.4) ^a	47.8 (±20.6) ^b	38.6 (±11.7) ^c
Range	38-70	28-83	25-66
> 50 (N/cm ²)	4/14	3/15	1/15
Cooking loss %	20.5 (±5.1) ^a	25.1 (±1.99) ^b	18.1 (±1.7) ^a
pH	5.55 (±0.12) ^a	5.75 (±0.1) ^b	5.75 (±0.25) ^b
(>pH 5.8)	0	4	2
Heme (mg/ml)	0.23 (±0.05) ^a	0.24 (±0.04) ^a	0.21 (±0.05) ^a

^xScale 1-15 points:1=P-; 2=P (poor);3=P+; 4=O-; 5=O(normal); 6=O+; 7=R-; 8=R (good), 9=R+; 10=U-;

11=U(very good); 12=U+, 13=E-; 14=E (excellent), and 15=E+

**Scale 1-15 points:1=1-; 2=1(very scarce); 3=1+; 4=2-;5=2 (scarce); 6=2+; 7=3-; 8= 3 (medium); 9=3+; 10=4-; 11=4 (important), 12=4+; 13=5-; 14=5 (excellent), and 15=5+

***8 days *p.m.* Figures in parenthesis are standard deviations. Different letters indicate significant ($P < 0.05$) differences.

The pH₂₄ ranged from 5.55 (NWS) to 5.75 (VP and PP). The pH indicated that the animals from NWS were not stressed when slaughtered, while the animals from both Pramenka breeds had higher pH and could be more stressed (Martinez -Cerezo *et al.*, 2005, Braggins, 1996) or had more type I fibers. Meat with pH>5.8 is often not desirable for shelf life reasons.

Meat samples from VP were generally more tender and varied less in tenderness than meat from NWS and PP; and differences between breeds were significant ($P < 0.05$). The samples from NWS were the toughest, while the samples from PP varied the most. We regard meat with scores above 50 N/cm² as having a toughness score that the consumers could respond negatively too. Breeding often aims at the higher muscular mass, often paid for by lower tenderness and lower intramuscular fat content (Więcek *et al.*, 2008; Kristensen *et al.*, 2002). Cooking losses of PP was the highest, significantly higher ($P < 0.05$) than for two another breeds; the reason being unclear.

The content of heme was nominally highest in PP (0.24 mg/ml), while VP had the nominally lowest concentration (0.21 mg/ml) while NWS had a concentration equal to 0.23 mg/ml. It seemed that heme was not influenced by breed and/or by feeding.

Surface meat color (L*a*b*) was measured in triplicate on the meat samples wrapped with oxygen-permeable polyvinyl chloride film (PVC) during

storage (measurements after 1, 4, 24, 72 and 144 hours). With time L^* (lightness) increased while a^* (redness) and b^* (yellowness) went through an optimum and then declined.

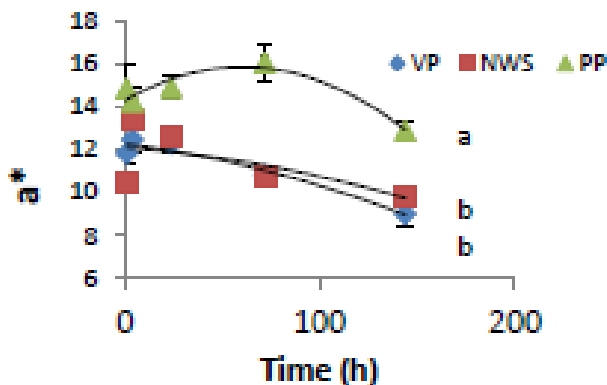


Figure1: The average changes in color stability for a^* (different letter means significant differences $P < 0.05$)

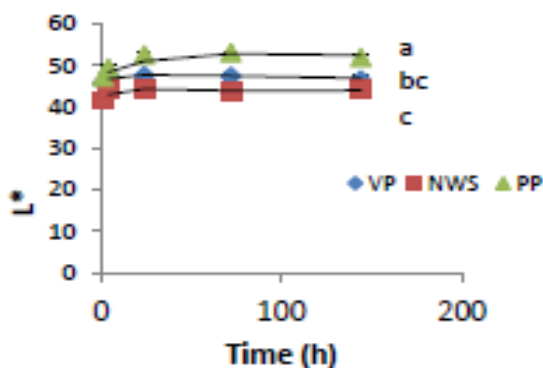


Figure 2: The average changes in color stability for L^* .

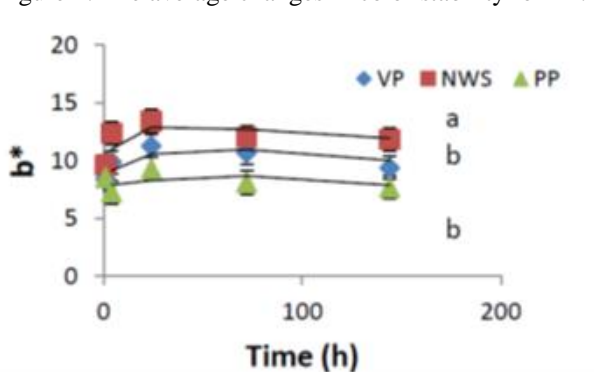


Figure 3: The average changes in color stability for b^*

For NWS and VP a^* began to decrease after 24 hours. This indicated that oxymyoglobin started to change into metmyoglobin after approximately 24 hours

for these two breeds. The red color stability was similar in NWS and VP (Figure 1) but it was less than in PP. The a^* value was found to decline for the first time after 144 hours for PP.

The color parameter L^* (lightness) showed significant variation amongst breeds (Figure 2). L^* values were higher in the PP breed than in the two other breeds. Also a^* and b^* were breed dependent. Typically the PP breed had higher a^* and lower b^* (Figure 3). This suggested that the PP breed contained more fat (were more white), at least in measured areas.

CONCLUSIONS

The breed effect on conformation class and fat grade was significant. Meat color was significantly influenced by both breed and storage time. Meat tenderness was significantly higher in VP compared to NWS and PP. Only the content of heme was not affected by the breed.

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**Božidarka MARKOVIĆ, Milena BJELANOVIĆ,
Goran VUČIĆ, Per BERG and Bjorg EGELANDSDAL**

**POREĐENJE OSOBINA TRUPA I KVALITETA MESA
NORVEŠKE BIJELE OVCE I DVIJE RASE PRAMENKI SA
PROSTORA ZAPADNOG BALKANA**

SAŽETAK

Cilj ovog rada jeste proučavanje i usporedba osobina trupova i kvaliteta mesa tri rase ovaca – dvije autohtone rase sa područja Zapadnog Balkana i jedne rase ovaca iz Norveške. Analizirani su trupovi i uzorci dugog leđnog mišića (*musculus longissimus dorsi*)- MLD sa 44 trupa ovaca i to: 15 uzraka od vlašićke pramenke (VP), 15 uzoraka od pivske pramenke (PP) i 14 uzoraka od norveške bijele ovce (NWS). Trupovi PP i VP su u pogledu konformacijske klase slučajno odabrani sa linije klanja, dok su trupovi NWS odabrani svi iz klase O.

Trupovi VP su u prosjeku imali manju masu (25 kg) od trupova PP i NWS (27,3 i 30,4 kg), ali veći ocjenu za konformaciju trupa (7,9) nego što je utvrđeno za PP i NWS, gdje je prosječna ocjena za konformaciju iznosila 5,3 i 5,0. Obje rase sa prostora Zapadnog Balkana (VP i PP) imale su veću prekrivenost lojem nego norveška bijela ovca. VP je imala bolje vrijednosti za nježenost mesa (38,6 N/cm²) nego PP i NWS (47,8 i 52,4 N/cm²), dok je PP imala bolje vrijednosti za boju mesa.

Ključne riječi: rase ovaca, konformacija trupova, parametri kvaliteta mesa