COMPARISON OF MEAT AND QUALITY CHARACTERISTICS BETWEEN NORWEGIAN WHITE SHEEP AND WESTERN BALKAN PRAMENKA SHEEP

M. Bjelanovic[1], G. Vucic [2], B. Markovic[3], P. Berg[4] and B. Egelandsdal[1]

[1]Dept. of Chemistry, Biotechnology and Food Science, Norwegian University of Life Science, Ås, Norway

[2] Dept. of Food science and Technology, Faculty of Technology, University of Banja Luka, Vojvode Stepe Stepanovica 73, 78 000 Banja Luka, B&H

[3]Biotechnical Faculty, Mihaila Lalića 1 81000 Podgorica, Montenegro

[4]Nortura SA, Postboks 360 Økern, 0513 Oslo, Norway

Abstract - Carcass and meat quality of three different sheep breeds - two from Western Balkan and one from Norway- were compared. *Musculus Longissimus dorsi (MLD)* samples from 44 sheep (age 4-5 years) were analyzed: Vlashichka Pramenka (VP, random selection of conformation classes) from Bosnia & Herzegovina (B&H) (n=15), Pivska Pramenka (PP, random selection of conformation classes) from Montenegro (MN) (n=15) and Norwegian White sheep (NWS, conformation class O) from Norway (N) (n=14). The Balkan breeds were nominally smaller compared to extensively breed NWS. VP had more fat then NWS and PP. The Balkan VP breed had the most tender meat. The color stability was highest for the PP breed.

Key Words – Crossbreeding, Meat quality, Norwegian White sheep, Pramenka sheep, Phenotype

- INTRODUCTION

The northern European consumers prefer meat from heavier lambs, while the southern consumers prefer meat from light lambs. 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. In order to get a more muscular sheep the NWS has been crossbred from several old sheep breeds. NWS is a man-made breed based on Dala, Rygja, Steigar and Texel breeds. It was accepted as a separate breed in 2000-2001 [1]. Through crossbreeding some phenotypic traits of the native breed are often lost on the account of some other desirable traits; muscular weight and litter size being most common to breed for. Recently breeding of NWS has become more and more criticized, because breeding makes the sheep less suitable for Norwegian ambient conditions [2]. 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 (live weight).

Sheep production on Western Balkans is characterized by extensive and semi extensive system of rearing, oriented towards utilization of grassland and pasture areas. The most widespread sheep in Western Balkan is the Pramenka (WBP) [3]. Crossbreeding of some Pramenka types with Merino sheep has been attempted but the results were generally poor [4]. The last indigenous Pramenka types currently exhibit mainly in the high mountain region of the Balkan Peninsula, where the environmental conditions and quality of pastures are less favorable for sheep grazing. Regarding the Pramenka breed 31 distinct phenotypes exist adapted for extensive breeding in WB [5]. The most common type of Pramenka in Montenegro is Pivska Pramenka (PP) (synonym jezeropivska) with female adults weighing 51-54 kg[6], while in Bosnia & Herzegovina Vlashichka Pramenka (VP) (synonym dubska) resides and female adults weigh 60-70kg [7].

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 specific breeds plus (feed) regions leading to quality labels such as Protected Geographical Indications [8]. Phenotypic characteristics are already used in promoting lamb (*e. g.* lamb from Aragosa), [8]. Today there are market interests in identifying phenotypic traits of breeds appealing to consumers.

Hitherto phenotypic meat quality characteristics like color and other physical and chemical traits of Pramenka breed are not well known. Here we report some traits from a larger investigation on breed and age, regarding the phenotypes of sheep meat traits.

- MATERIALS AND METHODS

Samples

Musculus Longissimus dorsi (MLD) from 44 female sheep 4-5 years old, NWS (n=14; from Nortura Gol), VP (n=15) and PP (n=15) were analyzed. Norway: The carcasses 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.

B&H: Sheep samples of VP were obtained from the Vlasic Mountain and slaughtered in the traditional way at the traditional slaughterhouse "BB" Kotor Varos. After slaughtering, carcasses were chilled at +4^{0}C in 24 hours; and *MLD* was cut under the same conditions as for NWS.

MN: The samples of PP were obtained from area of mountain municipality Pljevlja and also slaughtered in traditional way at the meat industry "Franca" Bijelo Polje.

Meat physical measurements

pH was recorded 24 hours *post mortem* in *MLD* using Knick Portamess Model 913. *Color stability*: The stability of the color was measured with a Konica Minolta Chroma Meter CR-400/410 (Konica Minolta Sensing Inc., Osaka, Japan). *Warner Bratzler* shear force: Heated meat (to 72C) samples were measured. Samples cut had an area 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 TextureAnalyser, Stable Micro Systems, Godalming, UK). *Cooking loss measurements:* Loss (in %) was calculated by weight loss after cooking the meat approximately 30 min in a water bath at 80°C. *Meat chemical measurements.* Heme iron analysis for raw meat was performed on meat samples, following the analytical method described by [9] with some optimizations. Briefly, meat pieces (0.155g) were dissolved in 233 l distilled Millipore water, 1.55 ml acetone and 63 l 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. All statistical analyses were performed using one way Anova or a general linear model (Minitab version 16). Significant differences were reported for $P \leq 0.05$ level.

- RESULTS AND DISCUSSION

Carcass weight, pH, tenderness, color, cooking loss and chemical composition (heme)

Weight, fat along with conformation grading, tenderness, cooking loss, pH and heme levels are variables listed in Table 1.

NWS carcasses had nominally higher slaughter weights than the carcasses from WB sheep breeds.

The VP breed was small, had more fat, but with good conformation score. The WB carcasses were not typical; the animals were slaughtered one month later than intended because of the weather conditions in 2012. The animals were therefore more fat than usual. 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 (mean and standard deviations)

Breed Region	NWS Hallingdalen	PP MN	VP B&H
Age (years)	4-5	4-5	4-5
Carcass w. (kg)	30.4(±5.2)[a]	27.3(±3.6)[ab]	25(±3.1)[b]
EU $_{fatness\ s.}$*	8.0(±1.4)[a]	7.7(±1.3)[a]	9.8(±1.0)[b]
EU $_{conf.\ s.}$**	5.0(±0)[a]	5.3(±1.5)[a]	7.9(±1.6)[b]
SF** * (N/cm^2)	52.4 (±14.4)	47.8 (±20.6)	38.6 (±11.7)
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 (±2.0)[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)	0/14	4/15	2/15
Heme (mg/ml)	0.23(0.05)[a]	0.24(0.04)[a]	(0.210.05)[a]

[x]Scale 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 pH_{24} ranged from 5.55 to 5.75. The pH indicated that the animals from NWS were not stressed when slaughtered, while the animals from Pramenka sheep had higher pH and could be more stressedor 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. The samples from NWS were most tough, while the samples from PP varied the most (Table 1). We regard meat with scores above 50 N/cm^2 as having a toughness score that the consumers could respond negatively to.

Breeding often aims at higher muscular mass, often paid for by lower tenderness and lower intramuscular fat content [9]. Cooking losses were highest for PP; 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 feeding.

Figure 1 The average changes in L* a* b* during aerobic incubation for different breeds and times. Different letters indicate significant (P<0.05) differences.

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* increased while a* and b* went through an optimum and then declined.

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

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 (Figure1) but it was less than in PP. a* was found to decline for the first time after 144 hrs for PP.

- CONCLUSION

The breed effect was significant for conformation class and fat grade. Meat color was significantly influenced by both breed and storage time. Meat tenderness was significantly higher in VP compared with NWS and PP.

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