Slaughter Performance and Carcass Characteristics of the Hybrids Obtained by Crossbreeding between European Mouflon (*Ovis ammon musimon Pal.*) and Sheep Breed Tigaie

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Abstract
The aim of this work was to determine differences between slaughter performances and carcass characteristics of first generation hybrids (F1) obtained by crossbreeding between European Mouflon (Ovis ammon musimon Pal.) and the Romanian sheep breed Tigaie. To assess the yield at slaughter and the participation percentage of the cut parts from the whole carcass structure, crossbreeding were made between females of sheep breed Tigaie and males of mouflon (FT x MM) and between mouflon females and males of sheep breed Tigaie (FMxMT). At the age of 60 days 14 lambs were sacrificed (7 hybrids FTxMM and 7 hybrids FMxMT). Slaughter yield calculated on hot and chilled carcasses had higher values at FMxMT ($P<0.05$). The participation percentage of the cut parts from the whole carcass structure had the highest values at FMxMT hybrids compared to FTxMM hybrids. Results from this study showed that genotype significantly influenced the main characteristics and have revealed the superiority of FMxMT hybrids against FTxMM hybrids lambs.

Keywords: carcass, genotype, mouflon, slaughter yield.

1. Introduction

Sheep production systems in Romania, as well as in other European countries, are influenced by tradition and specific environmental conditions, which establish the choice of breed, housing and nutrition system as well as weight of lambs at slaughter. In several regions of the Romania as well as in Mediterranean countries, lamb meat is a common food. In Romania as in other Mediterranean countries the lambs are slaughtered at a few weeks of age [1]. Therefore, in Romania the suckling lamb is a typical product of Easter time, at which a great number of lambs are slaughtered every year. In the European countries the consumer preferences are very diverse if we refer to the weight of lamb carcass. In Portugal the consumers prefer lambs with weight carcass of 8 kg [2], while in Spain they prefer 11 kg [3]. The consumers of Nordic countries of Europe prefer lamb carcasses weighing between 16 to 23 kg [4].
Nowadays, most of the lamb's production in Romania is derived from local sheep breeds and sacrificed at a low weight and at a few weeks of age. It is a choice derived from economic bases because the milk is used for cheeses production. Thus, in the lambs carcasses obtained from local sheep breeds and from dairy sheep breeds the fatty deposits appear earlier compared to that from meat-specialized sheep breeds [5]. Crossing dairy sheep breeds with meat ones is a good choice to improve both productive performance [6] and meat quality [7, 8]. For this reason in the last years the dairy sheep have been crossbreed with meat

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sheep breeds [8]. Although in Romania the target for growing sheep was multiple (milk, meat, wool, skins), lately the major target is to increase meat production [9, 10]. Therefore in last year's the local sheep breeds as Tigaie, Turcana, Transylvanian Merinos, and Merinos of Palas have been crossbreed with meat sheep breeds to improve the carcasses and meat quality [9-14].

Analysis of sheep production systems shows that in many countries the slaughter lambs are coming from crossbreeding because growth performance and carcass quality can be improved quicker [15]. For this purpose, different breeds and crossbreeding systems are used. Thus in crossbreeding of two breed's individual heterosis is used [16].

In the sheep breeding sector of Romania the last years, the meat production represented over 70% of the income, milk production about 23% and the wool and skin production less than 5% [12]. The Tigaie breed as native breed with a good adaptability to hill, and plateau zones having a medium body development being framed in the mixed type of wool-milk-meat [17].

The sheep meat is considered meat with special organoleptic and nutritive features mainly these with a high fat content. Besides their physical and psycho-sensorial qualities the chemical composition is recommended for the human alimentation because of the high content in lysine and polyunsaturated fatty acids (PUFA), from which we mention conjugated linoleic acid (CLA) and linoleic acid (LA) [18]. While in the meat of the domestic animals the fat content vary from 1 up to 45% several studies state that in the meat of wild animals the fat content is less than 3% and the fatty acids ratio is favorable [19-23]. Sholan et al., [24] consider that mouflon meat is „lean meat" which according to studies of Paulsen et al. [25] has a high protein content (22 to 23%). Moreover Honikel et al. [26] in their study revealed a high biological value for this type of meat. Ugarković et al. [27] has shown that total fat content is below 1% and is very low vs. sheep meat which has a fat content over 8% [24, 28, 29]. In lately the meat consumers are more aware of quality, originality and specificity of products, thus a source of meat with low fat could be rediscovered by using the suckling lambs of crossbred.

In our country and abroad, although many studies has been carried out on hybrids by crossbreeding various sheep breeds, in our country there are very few studies on hybrids obtained by crossbreeding domestic sheep breeds and mouflon. We consider that studies in this respect are necessary, in order to understand the genotype response as well as to investigate the growth and slaughter performances and carcass characteristics of these types of hybrids.

The aim of this study was to evaluate slaughtering performance and carcass characteristics, of the suckling lambs of crossbred genotype obtained between European Mouflon (Ovis ammon musimon Pal.) and the Romanian sheep breed Tigaie.

2. Materials and methods

Biological material used in this study was represented by first generation hybrids (F1) obtained by crossbreeding between European Mouflon (*Ovis ammon musimon Pal.)* and the Romanian sheep breed Tigaie. Thus crossbreeding were made between females of sheep breed Tigaie and males of mouflon (FTxMM) and between mouflon females and males of sheep breed Tigaie (FMxMT).

All the sheep and mouflon females were allowed to graze in a natural pasture. In the evening, all ewes and lambs were housed indoors and ewes received ad libitum hay. All the animals had free access to water. Lambs were exclusively milk fed from birth to slaughter. At the age of 60 days fourteen lambs were sacrificed (7 male hybrids FTxMM and 7 male hybrids FMxMT respectively). They were weighed after a 12 h fasting period to obtain pre-slaughter weight (PSW). After slaughter the following procedure was followed: skinning; separation of the head at atlas-occipital joint; cutting of the limbs at carpo-metacarpal and tarso-metatarsal joints; pelvic and perirenal excision for removal of the urogenital organs, gastrointestinal tract, kidney, heart, lungs, liver and gastrointestinal fat deposits. All elements were weighed and recorded. Hot carcasses were weighed (HCW) recorded and then were chilled at 4°C for 24 h. The next day, the cold carcass weight (CCW), dressing percentage and the weight loss (WL) were recorded. Assessment of carcasses was done according to Council Regulation EEC [30, 31].

The slaughter yield is ratio between HCW or CCW and PSW, in percent expressed. The WL

was expressed as the percentage of HCW. The weight of each cut part was recorded and expressed as percentage of CCW.

After evaluation, carcasses were halved longitudinally along the midline in two symmetric parts and each carcass half were subsequently cut into: neck, shoulder, leg, rib, breast, flank, loin and leg. All measurements and joint dissections were conducted following ASPA methods [32].

Raw data obtained from measurements were processing using methods of biostatistics with Microsoft Excel spreadsheet application. Anova test was used to assess genotype effect on slaughtering, jointing and dissection performance. All the data expressed as a percentage was statistically examined after angular transformation [33, 34].

3. Results and discussion

The data referring to slaughtering performance are shown in Table 1. Live weight (PSW) of the two groups studied (FTxMM and FMxMT) were significantly different ($P \leq 0.05$).

Table 1. Slaughtering performance of lambs according to genotype

Studied traits	FTxMM Mean ± SD (n = 7)	FMxMT Mean ± SD (n = 7)
PSW (kg)	$14.28^{a} \pm 1.07$	$11.41^{b} \pm 0.68$
HCW (kg)	$8.33^{a} \pm 0.65$	$6.85^{b} \pm 0.47$
HC Slaughter yield (%)	$58.33^{b} \pm 0.81$	$59.98^{a} \pm 1.43$
CCW (kg)	$8.13^{a} \pm 0.68$	$6.69^{b} \pm 0.47$
CC Slaughter yield (%)	$56.92^{b} \pm 0.79$	$58.63^{a} \pm 1.29$
CWL (%)	2.40 ± 0.99	2.24 ± 0.52

Means followed by different superscript letters in the same row differ significantly to $P \leq 0.05$;
SD – standard deviation
PSW - pre-slaughter weight; HCW – hot carcass weight; HC – hot carcass; CCW – chilled carcass weight; CC – chilled carcass; CWL – carcass weight loss

Thus at slaughter age (60 days) the average live weight of the lambs of genotype FTxMM was 14.28 kg compared to the crossbred FMxMT where the average live weight was only 11.41 kg. We believe that the differences between the two types of interspecific hybrids of the body weight at slaughter age are due to the different genetic combinations between the two parental forms (maternal and paternal) used [35]. In this case we cannot talk about the phenomenon of heterosis that appears in crossbreeding between different breeds because was not tested the differences versus the parental forms (Mouflon and sheep breed Tigaie). Similar results was obtained by Vacca et al. [36] from crossbreeding the mouflon males with female sheep's of Sarda breed (MxS) and males Sarda with females Sarda (SxS). The authors reported a slaughter weight similar at 40 days (11.6 kg and 11.4 kg respectively) for the two genotypes studied which also does not manifested the phenomenon of heterosis.

After slaughter the average values for HCW at FTxMM was higher compared with FMxMT (8.33 kg vs. 6.85 kg), and after applying the Anova test this difference was statistically confirmed ($P \leq 0.05$). Considering the carcass weight after chilling 24 h at 4°C the differences between the two studied genotypes was maintained although the weight loss (CWL) was slightly higher (0.16) for FTxMM carcasses compared to the FMxMT genotype (2.40% vs. 2.24%). This reducing trend that carcass weight showed was due to dehydration process, which occurs normally, during refrigeration period as well as due to the chilled room characteristics. Similar results were obtained by Pascal and Nechifor [14] that studied carcass characteristics in sheep breeds Tigaie and Merinos of Palas as well as in hybrid lambs

obtained from the crossbreeding of Suffolk with F1 hybrid females Bluefaced Leicester x Merinos of Palas (L1) and Suffolk with F1 hybrid females Bluefaced Leicester x Tigaie (L2). The weight loss at refrigerated carcasses ranged from 2.82% (Tigaie) up to 3.94% (L2) and recorded an upward trend in parallel with increase in carcass weight.

Data for the participation of the cut parts in the whole carcasses structure at the two studied genotypes are shown in Table 2.

Table 2. Participation of the cut parts in the whole carcasses structure at the two studied genotypes

Studied traits	FTxMM Mean ± SD (n = 7)	FMxMT Mean ± SD (n = 7)
CCW (kg)	8.13^{a} ± 0.68	6.69^{b} ± 0.47
Leg (%)	33.91^{b} ± 0.47	35.62^{a} ± 0.41
Loin (%)	7.76^{b} ± 0.30	8.45^{a} ± 0.26
Total meat of category I (%)	**41.67^{b} ± 0.77**	**44.07^{a} ± 0.63**
Shoulder (%)	18.54 ± 0.34	18.78 ± 0.48
Neck (%)	10.78^{a} ± 0.27	9.29^{b} ± 0.32
Rib (%)	13.06 ± 0.38	13.27 ± 0.30
Total meat of category II (%)	**42.38 ± 0.99**	**41.33 ± 1.10**
Flank (%)	4.62^{a} ± 0.30	4.23^{b} ± 0.29
Breast (%)	11.33^{a} ± 0.31	10.36^{b} ± 0.33
Total meat of category III (%)	**15.95^{a} ± 0.60**	**14.59^{b} ± 0.62**

Means followed by different superscript letters in the same row differ significantly to $P \leq 0.05$;
SD – standard deviation
CCW – chilled carcass weight

After dissection of refrigerated carcasses each anatomical part was weighed and the participation percentage in the whole carcasses structure was calculated. Also, the yield of meat per category was calculated as follow: meat of category I represented leg and loin; meat of category II represented shoulder, neck and rib; and for category III flanks and breast.

The results presented in Table 2 show that the percentage of participation of the cut parts in the whole carcasses structure it was different at the two studied genotypes.

Meat percentage of category I (leg and loin) was: 44.07%, at FMxMT and 41.67% for FTxMM, respectively. Therefore, for the FMxMT genotype statistically significant ($P \leq 0.05$) higher values were obtained compared with the FTxMM hybrid (loin 8.45% vs. 7.76% and leg 35.62% vs. 33.91%). These differences were obviously influenced by the genotype of Mouflon, which is an animal with strong developed hind legs [16].

The values from this study for the FTxMM genotype were similar to those reported by Vacca et al. [36] from crossbreeding the mouflon males with female sheep's of Sarda breed (MxS), and in case of the FMxMT hybrid they were obtained superior values (loin 8.45% vs. 7.60% and leg 35.62% vs. 34.30%, respectively).

Meat percentage of category II (shoulder, neck and rib) was 41.33 and 42.38% with the values to be superior for the FTxMM hybrid, but there were no statistically significant differences ($P \leq 0.05$).

The meat percentage of category III (flank and breast) was of 14.59% in FMxMT and 15.95% at FTxMM, respectively. In this case statistically significant differences ($P \leq 0.05$) were obtained which means that the system of crossbreeding had effect on the percentage of breast and flank. Also

values obtained in this study are consistent with the results of Vacca et al. [36].

4. Conclusions

The results of our study showed differences between the two studied genotypes and had revealed superiority of the FMxMT hybrid for slaughter yield and meat percentage of category I (leg and loin). Also, our results showed a statistical influence ($P \leq 0.05$) of genotype which is due to the different genetic combinations between the two parental forms (maternal and paternal) used.

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