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Comparative analysis and environmental impact in dynamics of body weight growth, the fattening and slaughtering characteristics of lambs from the Sharri sheep breed and the Kosova sheep breed

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Abstract

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Comparative studies were carried out on the fattening of the lambs from the Sharri and Kosova strains of sheep raised in a traditional way, which is still practiced in Kosova today. To examine the weight, 24 lambs of each strain (Sharri and Kosova) were taken and were reared in the traditional way for up to 100 days.

The dynamics of the body mass of the lambs was monitored every 10 days. The average birth weight of the lambs from the Sharri breed is 4.156 kg and for the Kosova breed 3.558 kg. The lambs from both strains have doubled the male yeast on the 20th day, when the Sharri strain of lambs have a live weight of 8.381 kg, and the Kosova strain has a live weight of 7.637 kg. The lambs are with their mothers until the 40th day and are fed with meadow hay and ground corn. On the 40th day, the lambs from the Sharri strain had achieved a dry weight of 11.116 kg, while those from the Kosovar strain reached 10.593 kg.

The lambs from the 40th day to the 100th day are separated from their mothers during the day and are fed with meadow hay and ground corn, the sheep crawl at night and then the lambs are let loose and stay overnight with their mothers until the 100th day. On the 100th day when they were slaughtered, the lambs of the Sharri strain achieved a live weight of 24.903 kg and the Kosova strain of 23.191 kg. The slaughter rate of lambs from the Sharri strain is 52.06% and for the Kosova strain 49.02%. The share of muscle tissue in the mass of the carcass in the Sharri strain is 56.586%, fat tissue with 19.914% and bone tissue with 23.631%, in the Kosova strain, muscle tissue is represented by 55.384%, fat by 18.752% and bone by 26.586%.

The average daily growth rates obtained is a result of the breed and the diet.

Keywords: Growth; Carcass; traditional; Sharri; Lambs

Introduction

The increase in the world's population also requires increased food production. The situation is becoming more complex and difficult as a result of the competition between man and animals in the utilization of plant food. In order to solve this situation, ruminant animals find a special place, which are not competitors to man in using the bulk food that is produced on natural meadows and pastures. As a result of the increased birth rate in the coming period, it is expected that the fields will be increasingly used for the production of food for humans, and the pastures and meadows for raising sheep and cattle. Sheep and cattle are the only animals that can use the rumen and produce high-quality products (milk and meat) of excellent quality, without significant investments in the construction of facilities for their accommodation.

Sheep have greater advantages over cattle in the use of coarse forage, as they are able to use high mountain pastures during early spring, summer and late autumn. Kosova sheep farming is characterized by a semi-intensive way of farming. According to statistical data, the number of sheep in 2001 was 215.520 sheep, and in 2020 there was a drop in the number, which according to the Kosovo Statistical Agency amounted to 212.131 sheep. The structure of the racial composition of sheep in Kosovo, the Sharri sheep strain is represented by 48.82%, Bardhoka with 27.68%, Kosova strain with 14.81%, Balusha with 3.60%, other races with 2.24% and mixed breeds 2.75%. As can be seen from the presented data on the numerical condition of the sheep, the Sharri strain of the strand is mostly cultivated. The native area of cultivation is the Sharri Mountain and the lowlands as well as the highlands (Mehmeti, 2000).

In Kosova, the most common breed of sheep is the Sharri-Mountain strain of Pramenka. The Sharri strain of Pramenka belongs to the short-tailed sheep group and is thought to be descended from the European mouflon but also has blood from the steppe sheep. The second breed of sheep that is mostly grown in Kosova is the Kosova breed of sheep. The Kosova strain of sheep is an autochthon strand that is grown in the plains of Kosova. Lamb production in Kosova is still traditional. An understanding of the factors which influence the development and growth of lambs will permit changes in the breeding and management schemes to minimize influences, which reduce production efficiency (Bermejo et al., 2010).

Information on factors influencing birth weight is of interest to farmers as well as the animal breeders (Zapasnikiene, 2002). The feeding of the lambs starts after the 40th day. During the day, the lambs are separated from their mothers and fed with hay and concentrate, while the sheeps are grazing. After returning the ewes to the barn, the ewes are milked and the lambs are allowed to suckle and spend the night with their mothers. The next day, the lambs are separated from their mothers. This way of rearing the lambs continues until they reach a live mass of 15 to 20 kg. The purpose of this way of rearing lambs is to obtain more milk, since it has a higher price, and the lamb is of secondary importance.

Indeed, the importance of the environment in which the fetus develops, rather than its genome, on birth weight is best illustrated by embryo transfer studies in the human, horse, and sheep (Brooks et al.,1995; Arthur Walton and John Hammond,1938; Dickinson et al., 1962). These original studies suggest that the largest influence on birth weight is the maternal environment.

The Sharri strain and the Kosova strain of sheep are used for meat production. These two strains of sheep are autochthons, which have always been bred in Kosova and are quite modest in terms of breeding conditions (accommodation, nutrition, resistance to parasitic and other diseases). Lamb production has recently become more relevant as consumer demands increase. Lambs for meat production are reared until the holidays and are slaughtered and ewes are milked. The lambs are slaughtered at the age of about 100 days and live weight from 15 kg to 20 kg.

According to its nutritional composition, lamb meat is a product with high nutritional value. The main source is protein, so 100 g of lamb meat is enough to satisfy 60% of the body's daily protein needs (Fumic & Mikus, 2011). Lamb meat is a rich source of vitamins from group B, mineral substances, without the content of trans-fatty acids and has a low energy value of 243 kcal. Lamb meat contains all the necessary nutrients needed by the human body. In lamb meat, especially in MLD (*musculus longissimus dorsi*), the content of total lipids is 5.7% of which 83% are neutral and 10% are phospholipids (Santos-Silva et al., 2002). The content of neutral lipids and phospholipids are desirable ingredients in meat (Krvavica et al., 2015). The purpose of this research is aimed at examining the growth and slaughter characteristics of lambs from the Sharri and Kosova strains of sheep raised in the traditional way in Kosova.

Material and Methods

The 24 lambs each from the Sharri and Kosova sheep strains were used as material for examining the comparative indicators of the fattening and slaughtering characteristics of lambs from the Sharri and Kosova sheep breeds raised in a traditional way. During the control period of 100 days, the lambs were reared and fed in the traditional way practiced in Kosova. Growth dynamics of lambs from both strains were monitored every 10 days. The birth weight and live weight of the lambs were measured with a digital scale with an accuracy of 1 g. During the experimental period, the lambs were fed with mother's milk and supplemented with ground puppy and meadow hay. The lambs are fed only with mother's milk until the 10th day. When the lambs are 10 days old, in addition to their mother's milk, ground corn, meadow hay and clean drinking water are available to them. This way of eating is up to 40 days of age. After the 40th day, lambs are weaned from their mothers during the day and fed with ground corn and meadow hay. The sheep graze during the day, and after returning to the barn, milking is done and the lambs are released with their mothers. The lambs stay with their mothers overnight and are weaned the next morning. This way of rearing the lambs is until the 100th day, after which the lambs are slaughtered and the sheeps are milked.

The lambs were slaughtered at the age of 100 days. The lambs are transported by truck. Lambs are weighed just before loading into the hearth. After the truck arrives at the slaughterhouse, the lambs are weighed again to calculate the transport weight. The lambs are slaughtered in a vertical position. During the lambs' knees, a chronological measurement was made of all the parts obtained during slaughter (live mass before bleeding, mass of the carcass after bleeding, mass of the goat, horns, legs, internal organs, mass of a warm carcass, mass of a cold carcass). The pH value is measured at 60 min after slaughter and immediately after cooling.

The carcasses of the slaughtered lambs were measured before entering the cooling chamber and immediately after cooling, i. e. after 24 h, they were measured again to calculate the cooling rate. The examination of the tissue composition of the carcasses was performed by cutting the loin cut *(Loinchop)*. To examine the chemical composition of the meat, samples were taken from each group of lambs. From the chemical analyzes of meat, the following tests were performed:

– Water content according to the ISO 1442:1997 method;
– The content of proteins according to the Keldhal method ISO 937:1978;
– The fat content according to the Soxhlet-Henkel method ISO 1443:1973, and
– The content of mineral substances by combustion according to the SOR 197 method.

The results obtained from the above tests on the comparative indicators of the fattening and slaughtering characteristics of the lambs from the Sharri and Kosova strains of sheep raised in a traditional way were processed according to the usual variational statistical methods used for scientific purposes, while using computer technology from the Microsoft program Excel, from the Microsoft Office suite.

Results and Discussion

The results obtained from the above tests on the birth weight and growth dynamics of the lambs from the Sharri and Kosova strains of sheep reared in a traditional way up to 100 days of age are given in the tables.

As can be seen from the data presented in Table 1 the average birth weight of the lambs from the Sharri breed of sheep is 4.156 kg with variations from 3.510 to 4.840 kg, while for the Kosova breed it is 3.558 kg with variations from 2.550 to 4.440 kg. The differences in the birth weight of the lambs from the Sharri and Kosova strain are statistically very significant ($p < 0.001$). The results obtained in our research on the birth weight of the lambs from the Sharri and Kosova sheep strains, compared with research by other authors, are

Table 1. Dynamics of body weight growth of Sharri and Kosova strains

Weight	N	Sharri strains					Kosova strains					P
		$X \pm s_x$	S	C v	min	max	$X \pm s_x$	S	C v	min	max	
Birth weight	24	4.156 ± 0.134	0.463	11.149	3.51	4.84	3.558 ± 0.184	0.638	17.923	2.55	4.44	***
Day 10	24	6.648 ± 0.242	0.804	12.095	5.61	7.92	5.942± 0.270	0.935	15.733	4.80	7.24	*
Day 20	24	8.381 ± 0.348	1.207	14.397	6.85	10.01	7.637± 0.318	1.102	14.439	6.45	9.15	*
Day 30	24	9.972 ± 0.407	1.412	14.060	8.22	12.61	9.171± 0.397	1.377	15.022	7.75	11.6	*
Day 40	24	11.116 ± 0.343	1.189	10.693	9.35	14.19	10.592 ± 0.406	1.409	13.306	9.55	12.65	*
Day 50	24	13.714 ± 0.470	1.626	12.325	10.40	16.58	12.162 ± 0.459	1.591	13.078	10.45	14.85	*
Day 60	24	15.325 ± 0.570	1.975	12.865	12.25	19.82	13.962 ± 0.463	1.606	11.728	11.65	16.45	**
Day 70	24	18.377 ± 0.662	2.294	12.474	14.02	22.62	15.359 ± 0.515	1.785	11.623	13.20	18.15	**
Day 80	24	20.629 ± 0.717	2.485	12.049	16.31	24.87	17.136 ± 0.564	1.953	11.396	15.15	20.90	***
Day 90	24	22.975 ± 0.856	2.967	12.914	18.30	28.31	19.075 ± 0.614	2.126	11.144	16.85	22.95	***
Day 100	24	24.903 ± 0.813	3.185	12.790	19.85	30.45	23.191 ± 0.742	2.450	10.563	20.10	27.75	**

N = number of animals; S = standard deviation; Cv = coefficient of variation; *P < 0.05; **P < 0.01; ***P < 0.001

identical. The dynamics of the decadal growth of lambs from the Sharri and Kosova strains of lambs are presented in Table 1. From the data presented in Tab. 1 shows that the lambs have doubled their birth weight on day 20. The live weight of the lambs from the Sharri strain on the 20th day is 8.831 kg, for the lambs of the Kosova strain 7.637 kg. For that period of time, the average daily gain of lambs from the Sharri breed is 0.234 kg, while that of the Kosova breed is 0.204 kg. The differences in daily increments for 20 days are not statistically significant.

Lambs from birth to 40 days of age are with their mothers. On the 10th day, the lambs are given meadow hay and ground corn to accustom them to self-feeding. The average live weight of the lambs from the Sharri strain on the 40th day is 11.116 kg with a total gain of 6.460 kg and a daily gain of 0.174 kg. while the live weight of the lambs from the Kosova strain is 10.592 kg with a total gain of 7.003 kg and a daily gain of 0.175 kg. After the 40th day, the lambs are weaned from their mothers in the morning and during the day they are fed with ground corn, meadow hay and have clean drinking water available. The mothers are grazing during the day and in the evening when they return to the farm they are milked and the lambs are then released to the mothers and stay overnight. This method of cultivation lasts until the 100th day. The average live weight of lambs from the Sharri breed on the 100th day is 24.903 kg, while it is 23.191 kg for the Kosova breed. The lambs from the Shari breed have achieved a total gain of 20.747 kg during 100 days, that is, the average daily gain is 0.207 kg, and the lambs from the Kosova strain have achieved a total gain of 19.632 kg and a daily gain of 0.196 kg.

The average daily growth rates obtained in our research are lower than those in the available literature, and this is a result of the breed (straw) and the diet (ground corn and meadow hay).

The lambs are transported from the farm to the slaughterhouse by motor vehicle. During the transport, the lambs are stressed in a certain way and this leads to certain losses of body mass, urination and dung. All this leads to the appearance of a transport callus. The transport calo of the lambs of the Sharri strains and Kosova strains is given in Table 2.

As can be seen from the presented data from Table 2 the average transport calo in the lambs of the Sharri breed is 2.53% and in the Kosova breed 1.490%.

After measuring the body weight of the lambs upon arrival at the slaughterhouse, they are placed in the slaughterhouse depot. Clean drinking water was made available to the lambs during their rest period. Losses in weight of lambs during the resting period in the slaughterhouse are given in Table 3.

As can be seen from the presented data from Table 3 lambs have lost body weight during the rest period in the slaughterhouse. Thus, in the lambs of the Sharri breed, they are on average 0.841 kg per lamb, or expressed in relative indicators of 3.465%, and in the Kosova breed of lambs, the fat loss is 0.600 kg or 2.374%.

The results obtained after the slaughtering of the lambs from the Sharri and Kosova sheep strains and the cooling of the carcasses of the slaughtered lambs are given in Table 4.

From the presented data from Table 4, it can be seen that the slaughter efficiency of the hot tap in the lambs of the Sharri strain is 49.885% and of the cooled 48.938%. While in lambs of the Kosova strain, the yield on a warm carcass is lower and it amounts to 48.532% and on a cold carcass 47.022%. Losses in the mass of the carcasses during 24 h of cooling in the Sharri strain of lambs is 1.889% and in the Kosova strain 1.510%.

Comparing the results obtained from our research with the results of other authors, it can be concluded that they are indeed identical. Thus, according to researches, slaughter yield of lambs from the Santa Ynez breed in a warm carcass is 47.58% and in a cold carcass 44.47%. While the yield of lambs without head of the Lake Solcav sheep is 43.36% (Cividini et al., 2007).

Table 2. Losses during transport

Breed	N	Weight on the farm (kg)	Weight in the slaughterhouse (kg)	Loss (kg)	Loss (%)
Sharri strains	24	24.903	24.273	0.630	2.53
Kosova strains	24	23.191	22.845	0.346	1.49

N = number of animals

Table 3. Losses on the slaughterhouse

Breed	N	Weight on the farm, kg	Weight before slaughter, kg	Loss, kg	Loss, %
Sharri strains	24	24.273	23.432	0.841	3.465
Kosova strains	24	22.845	22.245	0.600	2.374

N = number

Table 4. Lamb slaughter results

Variables	Breed			
	Sharri strains		Kosova strains	
	kg	%	kg	%
Live weight of lambs before bleeding	24.903	100.00	23.191	100.00
Live weight of lambs after bleeding	23.432	94.093	22.245	95.921
hot carcass weight	12.423	49.167	11.255	48.532
Cooled carcass weight	12.187	48.938	10.905	47.022
Cold callus	0.236	0.229	0.350	1.510

During the slaughtering of the lambs, edible and inedible parts are obtained. The proportion of edible and inedible parts of slaughtered lambs is presented in Table 5.

As can be seen from the data presented in Table 5 the average live weight of the lambs of the Sharri strain before slaughter is 23.432 kg, and after slaughter, the mass of the warm carcass is 12.423 kg and the share of the part that is eaten and not eaten is 11.009 kg. The largest share in the inedible parts is the skin (2.554 kg). The quantity of the edible parts of the Sharri strain is 1.238 kg, the inedible parts are 4.136 kg and the content in the intestines is 3.607 kg.

The average live weight of the lambs of the Kosova strain before slaughter is 22.245 kg and the weight of the warm carcass is 11.709 kg on average. The edible and non-edible parts in the live mass of the slaughtered lambs of the Kosova strain is 10.432 kg, where the largest share is the skin (2.618 kg). Edible parts accounted for 1.243 kg, non-edible parts 4.367 kg and gut contents of 2.414 kg. The results obtained from our research on the mass of the edible and non-edible parts are in accordance with the results obtained by other authors, although there is some deviation, which we believe is the result of the characteristics of the breeds and the age of the lambs at the time of slaughter.

Immediately after the slaughter of the lambs, the carcasses are squeezed on the tracks and then brought into a cooling chamber with controlled conditions (relative humidity, temperature, speed of air circulation and ventilation). The results obtained from the tests performed on the pH value in lamb meat are given in Table 6.

As can be seen from the data presented in Table 6, the initial pH_1 in the carcasses of slaughtered Sharri lambs is 6.38,

Table 6. pH value in lamb

Breed	pH_1	pH_2
Sharri strain	6.38	5.55
Kosova strain	6.35	5.59

Table 5. Slaughterhouse indicators for the participation of edible and non-edible parts in the carcasses of lambs from the Sharri and Kosova sheep strains

Organs	Sharri strains				Kosova strains			
	Mean	S	CV	%	Mean	S	CV	%
Live weight	23.432	2.781	11.870	100.00	22.245	2.581	11.603	100.00
Hot carcass weight	12.423	1.634	13.155	53.017	11.255	1.364	11.495	50.596
Blood	0.854	0.142	16.64	3.644	1.077	0.218	20.269	4.841
The first legs	0.334	0.037	11.216	1.425	0.337	0.045	13.348	1.515
Hind legs	0.322	0.035	10.815	1.374	0.347	0.036	10.481	1.560
Horns	0.072	0.019	26.994	0.320				
Skin	2.554	0.426	4.263	10.899	2.618	0.489	14.848	11.769
Scarf	0.085	0.049	57.296	0.363	0.134	0.083	61.651	0.602
Liver	0.478	0.072	15.062	2.040	0.492	0.069	13.966	2.212
Spleen	0.084	0.027	32.224	0.358	0.061	0.016	26.932	0.274
Lungs	0.484	0.076	15.781	2.065	0.418	0.081	19.340	1.879
Heart	0.107	0.018	17.162	0.456	0.137	0.029	21.447	0.616
Stomach intestine	2.028	0.312	15.398	8.655	2.502	0.365	14.587	11.247
Content. of food, etc.	3.607	–	–	13.025	2.413	–	–	10.847
Weight of portions to be eaten	1.238	–	–	5.283	1.242	–	–	5.583
Weight of inedible parts	4.136	–	–	17.651	4.379	–	–	19.685

S = standard deviation; Cv = coefficient of variation

Table 7. Tissue composition in carcasses (%)

Tissue	Sharri strain					Kosova strain				
	$\bar{X}$	S	C v	min	max	$\bar{X}$	S	C v	min	max
Muscular	56.586	1.831	3.236	53.676	60.593	55.384	2.234	4.035	52.318	56.800
Adipose tissue	19.914	0.778	3.909	18.915	21.323	18.752	2.036	10.588	13.793	20.769
Bone tissue	23.631	1.611	6.816	20.492	26.470	26.565	3.091	11.634	22.727	33.103

x = mean; S = standard deviation; Cv = coefficient of variation

Table 8. Tissue composition in carcasses, %

Breed	N	Contents, %			
		Water	Protein	Fat	Minerals
Sharri strains	24	74.976	19.639	4.378	1.016
Kosova strains	24	74.293	19.886	4.722	1.099

N = number of animals

and pH_2, that is, after 24 h of cooling, it is 5.55, while in the lambs from the Kosova strain, the initial pH_1 value is 6.39 and the final or pH_2 is 5.59. Obtained pH_1 and pH_2 in both strains of lambs are within normal limits, which means that the cooling and ripening of the meat from the slaughtered lambs is normal, which means obtaining meat with all the properties and attributes for quality lamb meat.

The results obtained from our research, compared to other authors, are identical. Thus, according in the carcasses of slaughtered lambs from the Ezerosolchav sheep breed, pH_1 measured after 2 h of slaughter in light and heavy lambs is 6.33, while pH_{24} in light lambs is 5.17, and in heavy lambs 5.72 (Zgur et al., 2003).

In Bonsmara was found that pH_1 in carcasses of heifers raised in environmental conditions pH_1 measured 2 hours after slaughter is 6.05, while pH_{24} measured after cooling the meat is 6.23, while pH_2 after 24 h meat cooling is 5.83 (Esterhuizen et al., 2008).

Immediately after cooling the carcasses of the slaughtered lambs, the physical composition of the carcasses was examined by dissection of the loin cut (Loin chop). The results obtained from our tests on the tissue composition of the carcasses of the slaughtered lambs are given in Table 7.

The total share of muscle tissue in the carcasses of slaughtered lambs from the Sharri strain is represented by 56.568%, fat by 19.914 and bone by 23.623%, while in lambs from the Kosova strain muscle tissue is represented by 55.538%, fat by 18.752% and bone by 26.565%. The lambs from the Sharri strain have a slightly higher representation of muscle and fat tissue, while in the lambs from the Kosova strain the bone tissue is represented in a larger amount, which is 26.565% and in the Sharri strain 23.623%.

Comparing our results with the results of other authors researches are identical. Based on researching about Manchego-breed suckling lambs the share of muscle tissue is 53.18%, fat tissue 17.57%, and bone tissue 22.95% (Diaz et al., 2003).

Meat represents a set of various tissues that are susceptible to changes caused by various endogenous and exogenous factors. The quality of meat depends on the ratio of muscle and lean tissue. Depending on the degree of fatness, the age of the lambs at slaughter, etc., the chemical composition of the meat is subject to changes, and as a result, it shows smaller or larger deviations. The results obtained from the tests performed on the chemical composition of the lamb meat from the Sharri and Kosova strains of sheep are given in Table 8.

As can be seen from the data presented in Table 8, the water content in the meat from MLD in lambs from the Sharri strain is 74.967%, in protein 19.639%, in fat 4.378% and in mineral substances 1.016%, while in the Kosova strain, the water content in MLD meat is 74.293%, proteins 18.886%, fats 4.722% and mineral substances 1.099%. The differences in the chemical composition of the meat from the Sharri and Kosova strains are identical, there are almost no differences.

Until the 40th day, the lambs are with their mothers all the time and are fed with meadow hay, ground corn, etc. On that day, the lambs from the Sharri strain have reached a live weight of 11.11 kg and the Kosova strain of 10.592 kg. From the 40th day, the lambs of both breeds are weaned from their mothers during the day, they are fed meadow hay and ground corn during the day, the sheep are milked in the evening and then the lambs are released with their mothers and stay overnight. The way of breeding is until the 100th day when they are slaughtered.

Conclusions

During the transport, the lambs are stressed in a certain way and this leads to certain losses of body mass, urination and dung.

The birth weight of lambs from the Sharri breed is 4.156 kg, and for the Kosova breed 3.558 kg.

The lambs have doubled their birth weight on the 20th day, which is 8.838 kg for the Sharri breed and 7.637 kg for the Kosova breed.

The average daily growth rates obtained in our research is a result of the breed (straw) and the diet (ground corn and meadow hay).

Lambs from the Sharri breed have achieved a live weight of 24.903 kg, and from the Kosova breed of 23.191 kg.

The average live weight of the lambs of the Sharri strain before slaughter is 23.432 kg, and after slaughter, the mass of the warm carcass is 12.423 kg and the share of the part that is eaten and not eaten is 11.009 kg, while the average live weight of the lambs of the Kosova strain before slaughter is 22.245 kg and the weight of the warm carcass is 11.709 kg on average. The edible and non-edible parts in the live mass of the slaughtered lambs of the Kosova strain is 10.432 kg.

Obtained pH_1 and pH_2 in both strains of lambs are within normal limits, which means obtaining meat with all the properties and attributes for quality lamb meat.

All animal experiments comply with the Laws of Republic of Kosova.

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