The Influence of Sheep Age at First Calving on the Productive Performance of Lambs from Tsigai breed

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Abstract
The aim of this study was to determine the effects of age on reproductive indices and on growth performances, carcass and meat quality of Tsigai lambs coming from young females (8 months age), in order to improve meat quality and meat sensory characteristics of lambs. 222 adult ewes and 51 young females were pursued in the breeding and calving season 2020-2021. The fecundity, prolificacy and weaning rate was 78.43%, 105% and 78.57% to young females and 94.60%, 105.24% and 91.40% to adult ewes, respectively. Thirty lambs (L1, n = 14 heads coming from young females and L2, n = 16 heads from adult ewes) were used in the experiment from birth up to end of intensive fattening of 100 days. No significant differences ($p > 0.05$) were found between the two lots with regard at final weight and average daily gain during fattening period, but significant differences ($p < 0.001$) were found for average daily gain from birth to the end of fattening. Significant differences ($p <0.001$) were also recorded between meat from the two groups with regard to juiciness and overall difference. The meat of lambs from L1 has showed improved eating qualities, resulting in a more juicy and tender meat, in which the specific lamb taste was attenuated.

Keywords: age, fecundity, lambs, prolificacy,Tsigai, weaning rate

1. Introduction

The livestock sector plays a significant role in Romania. The main local sheep breeds are Turcana, Tsigai and Merino. The meat yield characteristics of these indigenous sheep breeds are usually lower than those of exotic or improved breeds. High reproductive performance, carcass quality, and low input cost are important to ensure profitable production in sheep breeding [1]. The efficiency of lamb production is affected by reproduction, mothering ability and milk production of the ewes, and growth rate and survival rate of the lambs [2, 3, 4]. On the other hand, selection for prolificacy in sheep is a slow process due to the low heritability traits, 0.03–0.18 for the reproduction characters [4, 5, 6].

The Tsigai sheep is the second most important sheep breed in Romania with 24.3 % of the national sheep herds (the first is the Turcana sheep with 52.4 %). Tsigai breeds are kept extensively in mountainous and sub-mountainous regions with large pasture areas. Like Turcana, Tsigai sheep is a multi-purpose breed with focus on cheese production. Lamb production has become of more interest in the last years due to export opportunities in the EU [7].

Generally, the ewes of Tsigai breed are inserted at reproduction at the age of 18 months. The early introduction to breeding of young females (8-10 months age), offers a number of advantages to the sheep breeders. These include higher net profits, increased efficiency, early recognition of fertility potential, improved fertility level throughout the flock, increased rates of genetic gain and improved lifetime production of the ewe by

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breeding her at a younger age [8, 9]. However, [10] reported that the main reason the farmers do not breed young ewe is a perceived negative effect on breeding performance at 18–19 months of age.
The aim of this study was to determine the effects of age on reproductive indices and on growth performances, carcass and meat quality of Tsigai lambs coming from young females (8 months age), in order to improve meat quality and meat sensory characteristics of lambs.

2. Materials and methods

The present research was conducted in Experimental Base Reghin of Research Institute for Sheep and Goat Palas Constanta, Mures County, 46°46' N/ 22°42'E; 395 m altitude; annual rain fall varies between 650-700 mm; average temperatures 19/–3°C during summer/winter).
A total of 222 Tsigai pure breed adult ewes and 51 young ewes in the age of cca. 8 months was used to natural controlled mating with Tsigai rams (the rapport ewe/ram being calculated 25 ewes/ram for adult ewes and 17 young ewes/ram) and were observed reproductive indices, growth performances, carcass and meat quality of Tsigai lambs.
In the mating period (20.08.2020-20.10.2020) the adult ewes were kept in the pastures, and the rams in the shelter organized on pastures. For young ewes, the mating period (08.10.2020-08.12.2020) were organized in shelter.
In the August – November period (mating period and first 3 months of gestation), the adult sheep grazed on medium quality pastures, whose floristic composition is 90% grasses of spontaneous flora (in which the share of *Deschampsia cespitosa* is over 50%, along with *Festuca pratensis*, *Dactilylis glomerata* and *Lolium perenne*) and 10% legumes (*Trifolium repens*), and were provided 0.3 kg barley grain per ewe. In the last 2 months of gestation, in winter period (beginning of December until beginning Februar), the animals were held in the shelter and provided 0.25 kg maize, 0.25 kg barley and 1.5 kg hill heu per ewe, and in the suckling period (beginning Februar until beginning April) were provided 0.45 kg corn flour, 0.45 kg barley flour and 2.0 kg hill heu. For young ewes, all these periods are 2 months later, because the mating period ended only at the beginning of December.
Lambs from adult ewes were born in January-March interval and from young ewes in March-May. At birth or shortly thereafter, lambs were identified with ear tags and weighed (±0.1 kg). Sex, date of birth, type of birth, dam and ram group were recorded. The lambs were also weighed monthly (±0.1 kg) up 176 days for lambs from young females and 203 days for lambs from adult ewes. Ewes and their lambs were kept together under the same management condition. Up to weaning, the lambs were creep fed (*ad libitum*, 16% BP and 2600 kcal ME) and weaned at 76 days of age to lambs from young ewes, and 103 days from adult ewes respectively.
After weaning, two lots of lambs of Tsigai breed (L1 – 14 heads from young ewes and L2 – 16 heads from adult ewes) were submitted to intensive fattening for 100 days, the lambs are raised on shelter, and the fed was offer *ad libitum*.
During the fattening period, the structure of the concentrated fodder was different, so that the combined feed was present in the ration only in the first period of fattening (30 days), later being the concentrated fodder only of corn grain and barley (Table 1).

Table 1. Structure of concentrate fodder used in fattening experiment with lambs from Tsigai sheep

Characteristics	After weaning	
	Periods	
	Beginning of fattening-30 days	31 days-100 days
Combined fodder (%)	40	-
Corn grain (%)	30	25
Barley grain (%)	30	75
Dry matter g/kg concentrate fodder	880	870
DP g/kg dry matter	130.34	90.52
NE MJ/kg dry matter	8.97	9.50

Calculated composition was derived from tabular values based on ingredient composition of the experimental diet (NRC, 2007).

Water and salt were at discretion. Additionally, for both lots, in the ration was added hill hay.
At the end of the fattening, 6 Tsigai male lambs (3 from each lot) were brought to the abattoir for small and large animals from Reghin city. The lambs were subjected to a fast of 24-hour, were weighed and then slaughtered after electrical stunning. After the removal of non-carcass components, lamb carcasses were weighed and

chilled at 4 ◦C for 24 h and then carcass weights were recorded.

The research activities were performed in accordance with the European Union' Directive for animal experimentation (Directive 2010/63/EU).

Commercial dressing percentage was calculated based on pre-slaughter live weight, while warm and cold slaughter yield was calculated based on empty body weight. Carcasses were split into two halves and the: gigot, shoulder + arm, cutlet and rest carcasses were determined. For determining of the *Longissimus dorsi* (LD) area, the semi-carcass was sectioned between the D12 and D13 vertebra, perpendicularly on the axis of the backbone, the shape of the *Longissimus dorsi* muscle being copied on transparent paper. The leg muscle section area from the half of the femur was sectioned, perpendicularly on its longitudinal axe, the shape of this section being copied on transparent paper. The size of the areas was determined on the computer.

In order to be used in meat quality analyses, LD muscle was removed from right side of the carcasses at 24 h post-slaughter and were packed. For sensory evaluation, meat samples were frozen and kept at – 18°C until the day before the panel evaluation. Meat samples, which were served to untrained panellists, were prepared according to the methodology described by AMSA (2015). Sensory characteristics of cooked samples were assessed by 26 panellists using the degree of difference test. The panellists assessed the lambs breed difference in juiciness, tenderness, flavour, appearance, the difference of specific lamb taste and overall difference. The scale used has a seven-point category (scale 1= no difference, 2 = very small difference, 3 = small difference, 4 = moderate difference, 5 = big difference, 6 = very big difference, 7 = extremely big difference).

The traits investigated were classified as lamb, carcass, and meat traits. Early growth traits consisted of birth weight (BW); weaning weight (WW), average daily gain (ADG). Carcass traits included warm carcass weight (WCW), cold carcass weight (CCW), hot slaughter yield (HSY), cold slaughter yield (CSY) and commercial yield (CY). Meat sensory characteristic refers to juiciness, tenderness, flavour, appearance, the difference of specific lamb taste and overall difference. In order to determine the effect of age on growth performance, carcass and meat quality characteristics, the mean comparisons between the two groups of the variables were carried out using independent samples Tuckey-test of the JASP procedure.

3. Results and discussion

The reproductive indices obtained from adult and young ewes are presented in Table 2.

Table 2. The reproductive indices of Tsigai sheep – rusty variety

Characteristics	Adult ewes	Young ewes
Fertility (%)	94.60	78.43
Prolificacy (%)	105.24	105.00
Weaning rate (%)	91.4	78.57

In this study, the average fertility rate and weaning rate of the young ewes are superior to the values reported of the [11] (76.4, and 76.9%, respectively).

Body weight evolution of lambs from birth up to weaning are presented in Table 3.

Table 3. Body weight evolution of the lambs in the birth-weaning period

Characteristics	Lambs from adult ewes (n = 202)	Lambs from young ewes (n = 33)
BW, kg	3.97 ± 0.04^{a}	3.77 ± 0.09^{a}
WW, kg	18.25 ± 0.22^{a}	18.32 ± 0.63^{a}
Total gain, kg	14.28 ± 0.21^{a}	14.54 ± 0.63^{a}
ADG birth-weaning, g	221.61 ± 2.97^{a}	196.98 ± 7.57^{a}
Weaning age, days	64.83 ± 8.68^{a}	73.76 ± 1.44^{b}

Averages with a different superscript in each row indicate differences ($p < 0.05$);

The data from Table 3 show that the average BW was 3.97 kg in adult sheep and 3.77 kg in the young females, the differences between the 2 groups not being significant ($p > 0.05$).

Regarding the WW, there are no significant differences between the 2 groups, but it is observed that the weaning was done at an average age of cca. 65 days for lambs from adult sheep and 74 days in lambs from the young ewes, the difference recorded of 9 days being significant ($p < 0.001$).

With regard at total gain and ADG, there were recorded no significant differences (p> 0.05) in the birth-weaning period.

It is important to note that the lambs from the young females had a lower ADG of approx. 25 g compared to the lambs from adult sheep, which translates into higher milk production in adult sheep, given that during the suckling period, the growth performances of lambs is mainly based on the production of suckled milk.

The evolution of body weight of the lambs from the 2 experimental groups is presented in table 4.

No significant differences (p>0.05) were found with regard at weight at beginning and end of fattening, total gain and AVG. Significant differences (p<0.001) were also recorded regarding the weaning age, so that the age of L1 in absolute values was 26.42 days lower than that of L2.

Analysing the evolution of the body weight of the lambs in the 2 groups, it is found that the AVG in the fattening period was higher at L1 (190.53 g) at the lambs from young females compared to L2 (181.32 g).

Table 4. The evolution of body weight at the lambs submitted to intensive fattening

Characteristics	L1 n = 14	L2 n = 16
Weight at beginning of fattening, kg	21.39 ± 0.48	22.03 ± 0.51
Weight at the end of fattening, kg	40.44 ± 0.74	40.16 ± 0.76
Total gain, kg	19.05 ± 0.57	18.13 ± 0.71
ADG, g	190.53 ± 5.73	181.32 ± 7.11
Age at beginning of fattening, days	76.64 ± 1.64[a]	103.06 ± 2.82[b]

Averages with a different superscript in each row indicate differences (p <0.001);

The values obtained regarding daily dry matter intake, net energy and digestible protein are given in Table 5. The data table shows that during fattening, the highest dry matter intake was recorded in L2. The specific consumption (SC) of feed during fattening period are shown in Table 6.

Table 5. Daily dry matter intake (DMI), NE (net energy) and digestible protein (DP) during fattening period

Characteristics	L1	L2
DMI kg/animal	0.89	0.96
NE MJ/animal	13.06	11.83
DP g/kg animal	99.07	104.58

Table 6. Specific consumption (SC) during fattening period

Characteristics	L1	L2
NE MJ/kg gain	41.71	47.00
DP g/kg gain	520.05	576.84

Regarding the quantitative indices of the carcasses (hot, cold and commercial slaughter yield - Table 7), the differences registered were no significant (p>0.05). There were significant differences (p<0.05) only for live weight at slaughter.

The lambs from L1 presented higher live weight, hot and warm carcass weight, while in L2 were registered higher value for slaughter yield (hot, warm and commercial). With regard at leg of mutton and *LD* muscle section area, there were no significant differences between the two lots (p>0.05).

Table 7. Carcass weight and slaughter yield to lambs from Tsigai breed

Characteristics	Lot 1 (n = 3)	Lot 2 (n = 3)
Live weight, kg	37.13 ± 0.01[a]	35.67 ± 0.67[b]
HCW, kg	17.80 ± 0.31	17.47 ± 0.90
CCW, kg	17.57 ± 0.28	17.19 ± 0.91
HSY, %	47.94 ± 0.92	48.92 ± 1.63
CSY, %	47.32 ± 0.86	48.12 ± 1.65
CY, %	52.20 ± 0.78	52.64 ± 1.32
Leg of mutton muscle section area, cm^2	113.90 ± 3.08	105.71 ± 4.95
LD muscle section area at 12^{st} ribs, cm^2	14.48 ± 0.12	14.24 ± 0.06

Averages with a different superscript in each row indicate differences (p<0.05);

The juiciness and overall difference perception of the difference (Table 8) between the members of the panel evaluation were strongly influenced by

the meat from younger lambs, being registered significant differences ($p<0.001$) between the meat from the two groups. On a scale of 1 to 7, it is found that the juiciness has an average value of 5.19 in group 1 and 3.11 in group 2. The perception of the panellists indicated differences represented statistically ($p<0.05$) between the 2 groups regarding the tenderness and the specific lamb taste. No differences ($p> 0.05$) were found between the two groups in terms of flavour and appearance.

Moreover, there were positive and very significant correlations ($p <0.001$) between all eating qualities of lamb meat, except correlations between appearance and juiciness, as like between appearance and overall differences, who the correlations were positive, small to medium (according to the Pearson correlation results - Table 9).

Table 8. Means ± SE for meat sensory characteristics of lambs reared intensively

Characteristics	L1	L2
Juiciness	5.19 ± 0.22^{A}	3.11 ± 0.25^{B}
Tenderness	4.46 ± 0.25^{a}	3.81 ± 0.26^{b}
Flavour	3.96 ± 0.33	3.65 ± 0.26
Appearance	4.31 ± 0.21	4.12 ± 0.26
The difference of specific lamb taste	4.73 ± 0.30^{a}	3.96 ± 0.25^{b}
Overall difference	5.58 ± 0.27^{A}	4.04 ± 0.32^{B}

$^{A, B}$ Means in the same line with different superscripts are significantly different ($p < 0.001$).

^{a,b} Means in the same line with different superscripts are significantly different ($p < 0.05$).

Table 9. Coefficient of correlation among for meat sensory characteristic

Characteristics	Juiciness	Tenderness	Flavour	Appearance	The difference of specific lamb taste	Overall difference
Juiciness	1.00					
Tenderness	0.77***	1.00				
Flavour	0.48***	0.69***	1,00			
Appearance	0.28	0.47***	0.50***	1.00		
The difference of specific lamb taste	0.57***	0.63***	0.60***	0.48***	1.00	
Overall difference	0.62***	0.64***	0.49***	0.38	0.55***	1.00

*** $p < 0.001$.

4. Conclusions

Improving of reproductive performances of the sheep through early introduction at breeding of young females is a measure to improve the economic efficiency of the farms. Based on our findings, we consider that due to the improved lifetime production of the ewe by breeding her at a younger age and growth performances of lambs, increase the net profit of the farm.

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