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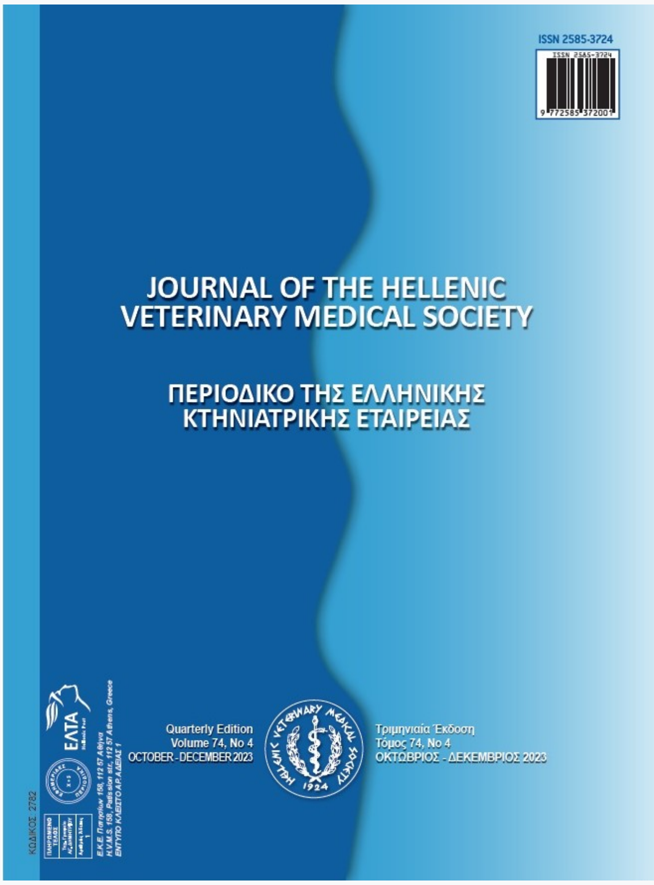

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Research article
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The effect on carcass characteristics of different silage types used in the rations of fattening lambs

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ABSTRACT: This study was carried out to investigate the effects on carcass characteristics of lambs fed with different silage types(corn silage, sunflower silage and their mixtures) and their mixtures at different levels. In the study, rumen volatile fatty acids levels and rumen pH of the lambs used in the experiment were determined at the beginning and end of fattening. For corn silage and sunflower silages, aerobic stability and lactic acid bacteria and yeast-mold counts were determined. In the treatment, 40 Kıvırcık male lambs aged 2.5-3 months were used as animal material. Lambs were divided into 5 different silage groups (100% corn silage, 75% corn+25% sunflower silage, 50% corn silage+50% sunflower silage, 25% corn silage+75% sunflower silage, 100% sunflower silage) and it was planned to have 8 lambs in each group. The lambs were housed in individual compartments during the experiment and the animals were individually fed. Silages were given to the lambs *ad libitum* and in addition to silage 700, 900 and 1400 g concentrated feed were given daily between 0-21, 21-42 and 42-56 days, respectively. As a result, it can be said that feeding with different silage types does not have a significant effect on carcass characteristics of lambs, and silages prepared with corn silage, sunflower silage and their mixtures can be used successfully in lamb fattening.

***Keywords*:** Aerobic stability; carcass characteristics; silage; lamb;rumen volatile fatty acids.

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INTRODUCTION

The nutritional requirements of ruminant animals cannot be met only with concentrated feeds. It is possible to realize both economical and rational feeding by adding silage as well as concentrated feed and roughage to the rations (Filya, 2007). It is possible to meet the green fodder requirements of animals freshly from nature only in certain periods of the year due to vegetation conditions. Producers therefore have to meet the fresh and green roughage needs of animals from different sources during the rest of the year. Green and fresh roughage given to animals by grazing or mowing during vegetation periods cannot be stored for a long time without spoiling due to the high water content they contain. For this reason, in order to protect the roughage rich in water, it should be stored with different methods until the period of use (Filya, 2001).

One of the methods used to preserve green and water-rich roughage for a long time without spoiling is silo storage. The main event that occurs during the ensiling process is that lactic acid bacteria, under anaerobic conditions, convert the water-soluble carbohydrates naturally found in the plant material, especially glucose and fructose, to lactic acid, acetic acid, butyric acid, etc. conversion to organic acids. As a result of this transformation, the pH of the silage decreases and the plant product rich in water is protected from microorganisms that cause spoilage (Weinberg et al., 1993).

Among the forage crops produced for silage, cereals such as corn, wheat and sorghum, which have high water-soluble carbohydrate content and low buffer capacity, come first. However, corn silage constitutes more than 80% of the total silage in general production (Yaylak and Alçiçek, 2003).

The reason why corn is the most preferred plant material for silage production is its high dry matter content, low buffering capacity and sufficient amount of water-soluble carbohydrates, which are essential for lactic acid fermentation. Corn silage is used intensively in the feeding of beef cattle, dairy and beef cattle in modern livestock enterprises. However, since corn silage alone cannot adequately meet the nutritional requirements of animals, it must be supplemented in terms of protein, energy, vitamins and minerals (Kaymakçı et al., 2000; Filya, 2001; Filya, 2007; Özen et al., 2016).

However, some regions with high altitude, low temperature and short development period are not suitable for corn cultivation, which is a hot climate plant. For this reason, silage plants that can be an alternative to corn silage in terms of sustainability and continuity of silage production are on the agenda and various studies are carried out on this subject.

Sunflower, an industrial plant, is thought to be an alternative to corn in silage production in some regions. Although sunflower is grown for different purposes (oil, pulp and snack food, etc.) around the world, it is also grown as a silage plant in many countries (Yıldız, 2017). Sunflower cultivation is easier than corn, and it can be produced for silage as an alternative to corn, especially in regions that do not receive much precipitation and irrigation facilities are limited. It has been reported that it is possible to benefit from sunflower as an important forage plant, thanks to its ability to be silage in a shorter time than corn, its tolerance to high and low temperatures, and its high adaptability to various soil conditions (Yıldız, 2017). Due to these features, it can be said that it would be more appropriate and economical to prefer sunflower instead of corn for silage in regions with limited irrigation opportunities and cold climates. In these regions, sunflower silage can be considered as an important alternative roughage source in meeting the roughage needs of cattle and small ruminant. Sunflower is a good silage plant due to its high yield, water soluble carbohydrates content and easy fermentation. In the silo, the fermentation time is the same as for corn and other sorghum types (Keskin, 2016). Although sunflower silage has not yet found a widespread production and usage area in the world, it is used significantly in many countries. As a matter of fact, in the region Montana of the United States, which has a high altitude in the north, the use of sunflower as a silage material is higher than corn. In some South American countries, silage sunflower varieties have been developed for use in animal feeding (Tomich et al., 2003).

Although silage is one of the most important sources of roughage used in the feeding of cattle as well as sheep and goats in countries with developed livestock, almost all of the silage produced in some countries is used in the nutrition of dairy cows and beef cattle. However, it has been reported that there has been an increase in the use of silage in the rations of sheep and goats in recent years (Öztürk, 2000).

Considering the feed value and production cost of silage, the importance of its widespread use in sheep breeding is better understood. Since the rations of small ruminant are mostly roughage, animals can easily consume silage provided that they do not exceed a certain level. The recommended silage consumption amounts for sheep are between 1 kg for breeding sheep and 0.5-1.3 kg for fattening lambs per day. Küçükersan (2015) reported that the daily amount of silage that can be given to sheep can be up to 5 kg per animal.

In this study, it was aimed to determine the effects of feeding with corn silage and sunflower silage (pure or mixed in different proportions) on the carcass characteristics of fattening lambs as well as concentrated feed and it was aimed to determine the possibilities of using sunflower silage in lamb fattening.

MATERIAL AND METHODS

This study was carried out in a semi-open barn in a sheep farm during the April-June period. During the fattening period, the average temperature in the barn was 23 °C and the humidity was 57%. In the experiment, 40 Kıvırcık male lambs aged 2.5-3 months and average body weight between 23-25 kg were used as animal material. The fattened lambs were housed in individual compartments during the 56-day trial period and individual feeding was applied to the animals. Corn silage was cultivated in the same period as the sunflower silage used in the experiment and was ensiled with the same method.

The lambs were divided into 5 different silage groups and each group was fed *ad libitum* with its own silage type. Silage groups are designed as 100% corn silage, 75% corn+25% sunflower silage, 50% corn silage+50% sunflower silage, 25% corn silage+75% sunflower silage and 100% sunflower silage. The raw materials used in the preparation of the concentrated feed used in the experiment are given in Table1.

Moreover, in addition to the silages consumed by the lambs, 700 g of concentrated feed per animal was given in the first 3 weeks of the experiment. Later, this amount was increased to 900 g for 3 weeks, and to 1400 g in the last 2 weeks of the experiment.

In order to determine the dry matter content of the feed samples, the samples were dried in an oven at 105 °C for 3 hours, for the raw ash content, they were burned in a muffle furnace at 550 °C for 4 hours, and the nitrogen content was determined using the Kjeldahl method.

Table 1. The composition of the concentrated feed.

Raw materials	Ratio (%)
Barley	51.3
Sunflower seed meal	27.0
Corn	20.0
Dicalcium phosphate (DCP)	1.5
Salt	1.0
Mineral-vitamin mixture*	0.2

*Per kg: Vit. A 300.000 IU, Vit. D_3 50.000 IU, Vit. E 1250 mg, manganese (oxide) 3000 mg, iron (sulphate) 3000 mg, zinc (oxide) 4500 mg, copper (sulphate) 1000 mg, cobalt (mono carbonate) 30 mg, iodine (calcium iodate) 45 mg, selenium (sodium) selenite) 12 mg, filler (razmol or $CaCO_3$) 969.066 mg.

Table 2. Nutrient composition of corn silage, sunflower silage and concentrated feed used in the experiment.

Nutritional content (%)	Corn silage	Sunflower silage	Concentrated feed
Dry matter	29.61	25.62	87.57
Crude oil	1.92	8.73	1.02
Crude cellulose	18.60	23.75	7.26
Crude ash	4.4	11.05	5.60
Cellulose	25.74	32.65	3.94
Hemicellulose	16.20	7.69	8.97
Nitrogen free core substances	20.12	12.24	63.87
NDF	42.99	46.69	14.13
ADF	26.79	39.00	5.16
ADL	1.05	6.35	1.22
Crude protein	7.20	8.77	13.20
ME, kcal/kg OM	2318	1749	3083

NDF: Neutral Detergent Fiber, ADF: Acid Detergent Fiber, ADL: Acid Detergent Lignin, ME: Metabolic Energy, OM: Organic Matter.

Crude oil content was determined by ether extraction according to the methods reported in AOAC (1990).

Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL), which constitute the cell wall components of feed raw materials and trial rations, were determined according to the methods reported by Van Soest et al., (1991). Cellulose (ADF-ADL) and hemicellulose (NDF-ADF) levels were calculated by calculation.

The method developed by Ashbell et al. (1991) was used to determine the aerobic stability of silages. On the 5th day of aerobic stability, pH of silage samples were measured and CO_2 production was determined. In addition, Filya et al. (2000) visual molding of silages was observed and yeast and mold numbers of silages were calculated.

Rumen fluid was taken from the experimental animals with a special vacuum pump of 50-100 ml. Lambs were fasted for 12 hours before rumen fluid intake. The device used to collect rumen fluid from animals was cleaned by washing with water after each rumen fluid collection and was used again for the second time. The pH of the collected rumen fluid was measured with a Sartorius PB-20 digital pH meter with a sensitivity of 0.01 as soon as the samples were taken. Total volatile fatty acids and its composition (acetic, propionic, butyric, isobutyric, isovaleric and valeric acid) in rumen fluid samples taken during the fattening period were determined by Gas Chromatography device (Agilent Technologies 6890N, column properties: 6 × 2 mm ID glass column Supelco, Bellefonte, PA) (Wiedmeier et al. 1987).

In the study, silage mixtures to be given to the lambs were prepared and given daily just before the time of feeding. Fresh and clean drinking water was always available in front of the lambs.

All of the lambs used in the experiment were slaughtered on the same day in a slaughterhouse at the end of the fattening period. The animals were starved for 12 hours before slaughtering and were slaughtered after weighing in the slaughterhouse. A 100 g precision scale was used to measure the slaughter weight of the lambs. Immediately after slaughter, the animals were skinned and their internal organs were removed. After the hot carcass weights were taken, the carcasses were rested in the cold storage at +4 ^{o}C for 24 hours. The carcass shredding method described by Colomer-Rocher et al. (1987) was used to break up the carcasses and determine the carcass characteristics. MLD cross-sectional area and ridge fat thickness were determined by the method reported by Boggs and Merkel (1993). The MLD area was calculated with the help of a planimeter by drawing the right and left muscle areas on tracing paper from the section between the 12th and 13th ribs.

One-way analysis of variance was used in the statistical evaluation of the data obtained from the research, and for this purpose, the SPSS 23.0 package program was used. Duncan Multiple Comparison test was used to determine the significance level of the differences between the means.

RESULTS

Rumen volatile fatty acids

Differences between groups in terms of contents at the beginning and end of fattening of lambs were not significant for acetic acid, butyric acid and valeric acid, but significant (P<0.05, P<0.01) for propionic acid, isobutyric and isovaleric acid (Table 3).

Table 3. Mean values and standard errors of rumen volatile fatty acids (mmol/L) and rumen pH at the beginning and end of fattening of lambs belonging to the experimental groups.

Group	Acetic	Propionic	Isobutyric	Butyric	Isovaleric	Valeric	pH
1	43.29±1.79	24.07±1.28^{a}	1.93±0.24^{ab}	9.93±1.10	2.43±0.35^{ab}	1.84±0.29	7.04±0.12
2	43.89±1.56	24.04±2.42^{a}	1.64±0.26^{ab}	10.42±2.62	2.01±0.48^{a}	1.45±0.32	7.05±0.24
3	44.74±1.44	22.40±1.07^{ab}	1.82±0.20^{ab}	10.64±1.37	2.41±0.36^{ab}	1.72±0.26	7.20±0.17
4	44.28±1.15	22.67±1.72^{ab}	1.40±0.16^{b}	11.89±1.87	1.71±0.27^{b}	1.51±0.21	7.09±0.24
5	46.78±1.07	18.19±0.77^{b}	2.28±0.24^{a}	11.64±1.55	3.22±0.33^{a}	1.28±0.09	7.35±0.18
P	NS	*	*	NS	**	NS	NS
Period							
I	47.16±0.67^{b}	24.50±0.84^{b}	1.58±0.13^{a}	7.40±0.77^{a}	1.79±0.20^{a}	1.26±0.14^{a}	7.60±0.06
II	42.03±0.67^{a}	20.05±0.84^{a}	2.05±0.13^{b}	14.41±0.77^{b}	2.91±0.19^{b}	1.86±0.14^{b}	6.69±0.06
P	**	**	*	**	**	**	NS

^{a,b}: Differences between means with different letters in the same column are significant. *: P<0.05, **: P<0.01, NS: Non-significant. Group 1: 100% corn, Group 2: 75% corn+25% sunflower, Group 3: 50% corn+50% sunflower, Group 4: 25% corn+75% sunflower, Group 5: 100% sunflower.

The lowest value was observed in group 5 for propionic acid, group 4 for isobutyric acid and group 4 for isovaleric acid. When evaluated as the beginning and end of fattening, the values obtained in terms of volatile fatty acids between the two periods showed significant (P<0.01) differences. In terms of pH values, the differences between the experimental groups and different periods were found to be insignificant.

Aerobic stability and number of viable microorganisms in silages

The lactic acid bacteria and yeast-mold counts contained in sunflower and corn silages are given in Table 4.

The number of lactic acid bacteria in the sunflower silage used in the experiment was found to be higher than the corn silage, and yeast and mold growth were not found in both silages. When the silages were evaluated in terms of their aerobic stability, it was observed that the aerobic stability of sunflower silage was higher than that of corn silage.

Carcass characteristics

The values related to the carcass characteristics of lambs fed with corn silage or sunflower silage or their mixtures in different ratios are shown in Table 5.

Pre-slaughter weights of lambs fed with rations prepared with corn or sunflower silages or their mixtures at different levels were found to be similar and the differences between the averages obtained were insignificant. The average values of the slaughter weights of the lambs varied between 35.94-37.44 kg.

After the slaughter of the lambs, the head, skin, internal organs and feet were removed, the remaining carcasses were weighed and the hot carcass weights were determined. The values related to the hot carcass weights changed between 16.03 and 16.70 kg. According to the results of the statistical analysis, it was determined that the differences between the warm carcass weights were not significant. The hot carcass percentage values calculated as the ratio of hot carcass to slaughter weight varied between 44.15-44.75%. The differences between the averages of the obtained hot carcass yield were found to be insignificant. It was observed that corn silage and sunflower silage or their mixtures were not effective on the hot carcass weight and hot carcass yield of the experimental groups.

Cold carcass weights were determined by weighing the carcasses of the lambs after they were kept at +4˚C for 24 hours after slaughter. The values obtained from the groups varied between 16.49-15.86 kg and the differences between the mean values were found to be insignificant. It was observed that different silage types were not effective on cold carcass weights of lambs. The percentages of cold carcasses of different silage groups varied between 44.20-43.53%. The differences between the values were found to be statistically insignificant. It can be said that the cold carcass percentage of lambs are not affected by feeding with different silage types.

Carcass losses is the weight difference lost as a result of weighing the carcass after it has been kept at +4˚C for 24 hours after slaughter. Carcass losses values obtained by subtracting the cold carcass weight

Table 4. Results regarding the number of viable microorganisms contained in the silages used in the experiment (cfu/ml).

Silage types	Number of lactic acid bacteria	Number of yeast-molds	Aerobic stability (CO_2 g/kg DM)
Corn silage	3.4×10^6	-	11.4
Sunflower silage	7.1×10^6	-	12.6

DM: Dry Matter.

Table 5. Mean values and standard errors related to slaughter weight, carcass weight and carcass percentage of lambs.

Carcass traits	Silage types and ratios					P
	100% corn	75% corn+25% sunflower	50% corn+50% sunflower	25% corn+75% sunflower	100% sunflower	
Slaughter weight, kg	37.44±0.81	37.36±0.83	37.38±1.35	35.94±0.92	36.25±0.95	NS
Hot carcass weight, kg	16.70±0.62	16.53±0.27	16.50±0.61	16.03±0.54	16.23±0.46	NS
Hot carcass percentage, %	44.54±1.01	44.32±0.87	44.15±0.48	44.56±0.67	44.75±0.49	NS
Cold carcass weight, kg	16.49±0.61	16.25±0.29	16.26±0.59	15.86±0.53	16.03±0.46	NS
Cold carcass percentage, %	43.98±1.00	43.58±0.84	43.53±0.48	44.11±0.67	44.20±0.49	NS
Carcass losses, kg	0.56±0.07	0.75±0.11	0.62±0.08	0.45±0.05	0.55±0.01	NS

Differences between means in the same row are insignificant. NS: Non-significant.

from the hot carcass weight varied between 0.45 and 0.75 kg. The differences between the carcass losses weight obtained from the experimental groups were found to be statistically insignificant. Different silage types were not effective on carcass losses. The values of some carcass parts and internal organ weights of lambs fed with rations using pure or mixed corn silage or sunflower silage are given in Table 6.

The front half weights of the carcasses varied between 8.0-8.18 kg, and the front half ratios varied between 49.20-50.65%. The differences between the means of the mentioned characteristics were found to be statistically insignificant. After the removal between the 12th and 13th ribs on the carcasses, the remaining back half weights were between 7.01-7.52 kg, and the back half ratios varied between 44.13 and 45.59%. It was determined that the differences between the values and the averages were insignificant. As a result, it was determined that the front and back half weights and the front and back half ratios were not affected by the silage type.

The amount of internal fat obtained from lambs after slaughter was determined by weighting. In addition, internal fat percentages were calculated by proportioning the measured internal fat weights to the live weights. The internal fat weights of the experimental groups were 0.28-0.37 kg, and the internal fat percentages varied between 0.75-1.0%. The differences between the obtained values were not statistically significant.

The fat thickness measurement on the muscle area obtained after carcasses are cut from the 12th rib is called back fat thickness. The dorsal shell fat thickness of the lambs belonging to the experimental groups varied between 3.19-3.94 mm. The differences between the measured values were found to be insignificant.

The differences between the right and left MLD areas taken from the section between the 12th and 13th ribs of the carcasses were statistically insignificant. The obtained MLD area values were determined as 14.75-15.28 cm^2. It was observed that different silage types were not effective on MLD area.

Lung+liver+spleen+heart weights obtained from lambs after slaughter were measured. It was determined that the lung+liver+spleen+heart weights obtained from the groups varied between 1.56-1.63 kg, and the lung+liver+spleen+heart percentages between 4.19-4.37%. The differences between these values were found to be insignificant. The kidneys of the lambs taken in the fattening were weighed and then the kidney percentage values were calculated by proportioning the carcass weight. The kidney weight values obtained were between 0.10-0.11 kg, and kidney percentage varied between 0.60 and 0.65%. Differences between kidney weights and kidney percentages of lambs belonging to silage groups were found

Table 6. Mean values and standard errors of some carcass parts and internal organ weights of lambs fed with different silage types.

Carcass parts	Silage types and ratios					P
	100% corn	75% corn+25% sunflower	50% corn+50% sunflower	25% corn+75% sunflower	100% sunflower	
Front half body, kg	8.11±0.26	8.00±0.16	8.18±0.31	8.04±0.30	8.03±0.23	NS
Front half percent., %	49.25±0.68	49.20±0.35	50.29±0.65	50.65±0.45	50.12±0.59	NS
Back half body, kg	7.52±0.34	7.32±0.15	7.24±0.24	7.01±0.26	7.19±0.21	NS
Back half percent., %	45.59±0.99	45.02±0.44	44.57±0.80	44.13±0.27	44.92±0.96	NS
Internal fat weight, kg	0.28±0.02	0.33±0.02	0.32±0.05	0.34±0.02	0.37±0.05	NS
Internal fat percent., %	0.75±0.04	0.89±0.06	0.85±0.14	0.95±0.05	1.00±0.11	NS
Back fat thick., mm	3.77±0.52	3.94±0.28	3.19±0.25	3.62±0.20	3.66±0.39	NS
MLD area, cm^2	15.13±0.35	14.75±0.36	15.14±0.36	15.26±0.54	15.08±0.47	NS
Lung+liver+heart +spleen weight, kg	1.60±0.03	1.56±0.03	1.63±0.05	1.55±0.05	1.57±0.02	NS
Lung+liver+heart +spleen percent., %	4.28±0.09	4.19±0.11	4.37±0.09	4.31±0.08	4.35±0.08	NS
Kidney weight, kg	0.11±0.00	0.10±0.00	0.10±0.00	0.10±0.00	0.10±0.00	NS
Kidney percent., %	0.65±0.03	0.60±0.02	0.63±0.01	0.60±0.02	0.65±0.03	NS
Kidney fat weight, kg	0.15±0.03	0.13±0.01	0.12±0.02	0.10±0.01	0.10±0.01	NS
Kidney fat percent. %	0.91±0.13	0.82±0.06	0.71±0.07	0.67±0.07	0.61±0.06	NS

Differences between means in the same row are insignificant. NS: Non-significant. MLD: *Musculus Longissimus dorsi.*

to be statistically insignificant. Kidney fat found by weighing the fat on the kidneys of the lambs. Kidney fat percentage was found by proportioning the kidney fat weight by the carcass weight. It varied between 0.10-0.15 kg and 0.61-0.91%, respectively. The differences between the averages of these values were found to be insignificant.

DISCUSSION

Differences between the groups in terms of rumen volatile fatty acids contents at the beginning and end of fattening of lambs were not significant for acetic acid, butyric acid and valeric acid, but significant ($P<0.05$, $P<0.01$) for propionic acid, isobuturic and isovaleric acid. The lowest value was observed in group V for propionic acid, group IV for isobutyric acid and group IV for isovaleric acid. When evaluated as the beginning and end of fattening, the values obtained in terms of volatile fatty acids between the two periods showed significant ($P<0.01$) differences. In terms of pH values, the differences between the experimental groups and different periods were not found significant.

The number of lactic acid bacteria in the sunflower silage used in the experiment was found to be higher than the corn silage, and yeast and mold growth were not found in both silages. When the silages were evaluated in terms of their aerobic stability, it was seen that the aerobic stability of corn silage was better than sunflower silage.

Feeding with different silage types did not affect the slaughter weight of the lambs and the results were similar. Findings of slaughter weight of lambs fed with different types of silage were similar to the results of many studies (Keleş et al., 2018, Malisetty et al., 2013; De Vyver et al., 2014; Azambuja Ribeiro et al., 2002).

No significant differences were observed between the hot carcasses weights of slaughtered lambs measured after slaughter. Findings on warm carcass weights and carcass percentage of lambs are similar to the results reported by different researchers (Nolan, 1974; Azambuja Ribeiro et al., 2002; Almeida Junior et al., 2004; Keleş et al., 2018; De Sousa et al., 2008). The cold carcass weight and percentage values of lambs fed with different silage types were also not significant between the groups. It can be said that the treatments did not affect the cold carcass weight. Almeida Junior et al., (2004), De Vyver et al., (2014) and Keleş et al., (2018) reported similar results. In terms of cold carcass weight and percentage, no significant differences were observed between the treatment groups. Results of carcass losses of lambs, Almeida Junior et al., (2004) and Keleş et al. (2018) agreed with the reported findings, but was higher than the results reported by Nolan (1974).

The front and back half weights of lambs belonging to different groups were measured, but no statistically significant differences were found between the values obtained. It can be said that the silage type is not effective on the front and back half weight of lambs. Nolan (1974) explained the front half weights of Galway x Suffolk lambs as 8.05, 8.74 and 8.84 kg, these results are similar to the results we obtained.

The effect of silage on internal fat weight, internal fat percentage and back fat thickness in lambs was insignificant. Azambuja Ribeiro et al. (2002) reported the internal fat percentages of lambs fed with corn, sorghum and sunflower silage as 6.09%, 4.64% and 4.97%, these results are higher than our results. De Sousa et al. (2008) reported the back fat thickness they fed with sunflower and corn silage as 3.26 and 1.89 mm, these values are lower than the results we obtained. MLD areas measured in lamb carcasses did not differ between groups. It was observed that the silage difference did not affect the MLD area. After slaughter, the lamb's lungs, liver, heart and spleen were weighed and recorded. The results obtained were similar between the groups and did not show significant differences.

Lung+liver+spleen+heart weights were not affected by the type of silage. Data obtained from Azambuja Ribeiro et al. (2002) found lower than the results we found but It was found to be higher than the lung+liver+spleen+heart weights obtained by De Sousa et al. (2008)'s. In the measurements, kidney weight, kidney percentage, kidney fat and kidney fat percentages did not show significant differences between silage groups. It can be said that silage is not effective in terms of kidney-related properties. De Sousa et al. (2008) reported that the kidney weights of sheep fed with sunflower and corn silage were measured as 0.12 and 0.16 kg, respectively. These reported results were found to be similar to the values we obtained.

Considering the drought risk faced by countries due to global climate change, sunflower cultivation may become more attractive in the following years due to dry farming and low agricultural activity costs.

Expanding the production of sunflower for silage, which is currently intensively produced in the northern regions of the United States and Canada, in cold regions where silage corn production is difficult and costly, will make a significant contribution to meeting the need for fresh green fodder in winter.

CONCLUSION

The results showed that carcass characteristics and internal organ weights of lambs were similar for all silage groups. It has been observed that corn silage, sunflower silage or their mixtures at different rates can be used successfully in lamb fattening. In addition, it can be said that sunflower silage can be an alternative to corn silage depending on the cost/price situation in the region or period in which it is produced.

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