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Determination of tail fat fatty acids profile in some local sheep breeds of Black Sea Region

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ABSTRACT
In the study, the contents of tail fat fatty acid composition of 6-month-old male lambs in the breeds of Artlı, Çepni, Karayaka and Of grown in the Black Sea Region were examined. The content of saturated fatty acids in tail fat for the breeds of Artlı, Çepni, Karayaka and Of were respectively; 52.08%, 51.66%, 42.67%, 52.92% while the monounsaturated fatty acid contents were 33.25%, 33.12%, 33.07%, 32.34% respectively. The content of polyunsaturated fatty acids was determined as 0.76%, 1.20%, 0.64% and 0.87%, respectively. The presence of fatty acids desired for health was determined as 46.94% in Artlı, 51.03% in Çepni, 51.51% in Karayaka and 49.51% in the breeds of Of. In terms of polyunsaturated fatty acids in the composition of fatty acids, the highest rate was found in the Çepni breeds and the lowest in the Karayaka breeds. It has been determined that the fatty acid content has significant differences between breeds.

Keywords:
Artlı sheep
Çepni sheep
Of sheep
Tail fat fatty acids
Fattening

Karadeniz Bölgesi bazı yerel koyun ırklarında kuyruk yağı yağ asitleri profilinin belirlenmesi

ÖZET
Çalışmada Karadeniz Bölgesinde yetiştirilmekte olan Artlı, Çepni, Karayaka ve Of ırkında 6 aylık yaştaki erkek kuzuların kuyruk yağı yağ asitleri kompozisyonları ve yağ asidi miktarları incelenmiştir. Artlı, Çepni, Karayaka ve Of ırkı için sırasıyla kuyruk yağında doymuş yağ asitleri içeriği; %52.08, %51.66, %42.67, %52.92 olarak, tekli doymamış yağ asitleri içeriği aynı sırayla %33.25, %33.12, %33.07 ve %32.34 olarak bulunmuştur. Çoklu doymamış yağ asitleri içerikleri ise aynı sırayla %0.76, %1.20, %0.64 ve %0.87 olarak bulunmuştur. Sağlık açısından olması istenen yağ asitleri Artlı ırkı kuzularda %46.94, Çepni ırkı kuzularda %51.03, Karayaka ırkı kuzularda %51.51 ve Of ırkı kuzularda %49.51 olarak belirlenmiştir. Çoklu doymamış yağ asitleri bakımından en yüksek oran Çepni ırkında ve en düşük oran ise Karayaka ırkında tespit edilmiştir. Yağ asitleri içeriğinin ırklar arasında önemli farklılıklar taşıdığı saptanmıştır.

Anahtar Sözcükler:
Artlı koyunu
Çepni koyunu
Of koyunu
Kuyruk yağı yağ asitleri
Besi

1. Introduction

As in many countries, the economic importance of products derived from sheep and sheep in Turkey, and its share in meeting the nutritional needs of the animal population is quite large. Changes in the socio-economic structure, cultural developments and population growth have increased the interest of Turkish people in animal protein and especially meat consumption. The climate conditions, the landscape, and pastures being more conducive to the sheep breeding in Turkey, as well as intensive livestock farming can not be made, industry is still in the stage of development, and mutton demand, increases the importance of the choice of sheep (Tekin and Akçapınar, 1994; Akçapınar, 2000; Kaymakçı 2006; Öztürk and Odabaşıoğlu, 2011; Aksoy and Yavuz, 2012).

As a result of the climate and environmental conditions of different settlements, human migrations, changes in the priorities for benefiting from animals and genetic improvement studies, nearly 2000 sheep breeds have occurred in the world. The most important morphological difference between these sheep breeds with different morphological and physiological characteristics is their tail structure (Akçapınar and Özbeyaz, 1999; Akçapınar, 2000). Fat in the tail serves as an energy source when nutrient intake is not sufficient (Kashan et al., 2005; Teke et al., 2018). One of the products obtained from the slaughter of cattle and fat-tailed sheep is tallow fat and tail fat. Sheep tail fat is the main source of aroma especially in the production of kebabs and some dishes. Animal fats are the second most important source of fat raw materials produced in our country (Ünal and Karakaya, 2017).

Animal fats can be used for cooking, as well as being used as an ingredient in various foods and especially as an essential component of meat products, in addition, animal fats have a particularly significant effect on the textural parameters of meat products (Forrest et al., 1975; Pehlivanoğlu et al., 2018). The increase in the use of animal fats in nutrition, which started in the 1950s, has continued exponentially and this increase continues today. Fats are the most energy-dense nutrients, with 9 calories per gram of fat. The energy contained in fats is 2.25 times or higher than resources such as starch, digestible crude fiber and cereal grains. Due to its high energy value, it is a feed substance that is widely used in the feeding of dairy and beef cattle and sheep and poultry rations, and its usage area is expanding day by day (Donna et al., 2002; Canbolat and Karabulut 2003). Vegetable and animal oils can also be used as alternative fuel. Animal fats can also be converted into biodiesel with simple reactions (Karaosmanoğlu, 2002; Üstün, 2006; Utlu, 2007; Behçet et al., 2012).

Although the saturation of body fat varies between animal species and according to breeds within the same species, ruminants store more saturated fat than non-ruminant animals (Öztürkcan et al., 1996). The most important factors affecting the fatty acid composition; genotype, feeding and breeding methods, age, sex, type of fat storage and anatomical region. The main factor determining the quality of the oil is its fatty acid composition (Lunn and Theobald, 2006). Since cultivation in intensive and extensive conditions is directly related to nutrition, tissue fatty acid composition is affected. The general view is that unsaturated fatty acids increase in animals fed on pasture, but the amounts of C16: 0 and C18: 0 fatty acids are also increasing in parallel (Wood et al., 2003; Demirel et al., 2004; Raes et al., 2004).

The fact that there are many uses of animal fats both as food and as an alternative has made it necessary to examine the physical properties of these fats. In this study, the contents of tail fat fatty acid composition of 6-month-old male lambs with genotypes Artlı, Çepni, Of and Karayaka, raised in the Black Sea Region, were investigated.

2. Materials and Methods

The animal material of the study consists of a total of 48 male lambs, 12 from each of the 4-4.5 months old Karayaka, Of, Artlı, Çepni genotypes in Trabzon, Artvin and Ordu region. Samples were taken for tail fat fatty acid from 10 of 12 lambs that were slaughtered. The animals were brought to Ondokuzmayıs University Agricultural Application and Research Center Livestock Enterprise and placed in individual compartments of at least 1.00 x 1.50 m in size. The lambs were sheared before being taken to trial. In these compartments, fattening trials were started after 15 days of feeding and acclimation to the environment. In animal nutrition, a mixture of wheat, oats and alfalfa was used with dry grass and commercial concentrated full-fat fattening feed as much as they could eat. The trial was continued for 60 days. The nutrient needs of the lambs were determined according to NRC (2007), and clean drinking water was given to the animals freely throughout the trial.

At the end of the fattening, all of the animals belonging to each group were slaughtered in order to determine the desired characteristics of the groups. Tail fat samples were taken after the carcasses were kept at +4 ° C for 24 hours after slaughter. The samples taken to determine the fatty acid composition were kept in the deep freezer at -18 ° C until the time of analysis, were sent to Food Institute of Marmara Research Center of Scientific and Technical Research Council of Turkey in ice molds at the time of analysis and without breaking the cold chain, and meat fatty

acid analysis was performed through service procurement. Analysis of fatty acids was carried out according to the method of IUPAC IID19.

The GLM multivariate procedure SPSS (Ver 25) was used to determine differences in tail fat fatty acids between races. DUNCAN multiple comparison test was used to compare the means. Breeds are taken as a fixed factor.

3. Results and Discussion

In the experimental groups, the values related to the live weights at the beginning and end of the trial and the hot and cold carcass weight are given in Table 1. The difference in weight per trial in the groups included in the experiment was attributed to differences in environmental conditions and genotypes up to 4 months of age. In order to compensate for this difference in the common environment, the body weight per trial was taken as coveryet in the analyzes. In this case, it was determined that the breeds had no effect on the live weights at the end of the trial. Total live weight gain in the breeds of Artlı, Çepni, Karayaka and Of was 9.45; 10.55 kg; 11.43 and 11.48 kg. According to the findings obtained in the study, tail weight for the breeds of Artlı, Çepni, Karayaka and Of was found to be respectively; 4.54 kg; 0.66 kg; 0.55 kg, and 1.69 kg. When we look at the ratio of tail weight and tail weight to cold carcass, it is seen that the difference between breeds is significant.

Table 1. Average values for some slaughterhouse and carcass traits in lamb breeds

Groups	Çepni	Karayaka	Artlı	Of	P
Starting live weights	37.59 ± 1.19^{a}	26.10 ± 0.42^{c}	29.02 ± 0.82^{c}	31.91 ± 1.54^{b}	*
Finishing live weights	48.072±1.99	37.247±1.028	38.470±0.880	43.326±0.910	ns
Hot carcass weight	19.287±0.502	18.215±0.416	20.281±0.400	19.859±0.407	ns
Cold carcass weight	18.735±0.503	17.828±0.417	19.871±0.400	19.531±0.408	ns
Tail weight	0.663 ± 0.208^{c}	0.552 ± 0.172^{c}	4.542 ± 0.165^{a}	1.690 ± 0.168^{b}	**
Starting tail length	37.83 ± 1.727^{c}	38.00 ± 1.115^{c}	42.08 ± 1.246^{c}	52.27 ± 2.677^{a}	****
Starting tail width	16.67 ± 2.213^{b}	11.75 ± 0.579^{c}	25.92 ± 1.730^{a}	18.36 ± 1.545^{b}	****
Finishing tail length	48.13 ± 1.811^{c}	50.29 ± 1.983^{bc}	52.25 ± 1.349^{b}	54.82 ± 1.710^{ab}	*
Finishing tail width	18.08 ± 1.630^{b}	14.17 ± 0.638^{c}	27.50 ± 1.598^{a}	17.73 ± 0.740^{b}	**

$^{a.b.c}$: The means indicated with different letters in the same row are significantly different; * $P < 0.05$; ** $P < 0.01$; ns: not significant

Evaluations in terms of tail fatty acid profile were made on tail fat samples of four breeds. When the presence, amount and breeds of the fatty acids found in tail fat were evaluated in terms of having these fatty acids, some differences were found. It has been found that the difference between breeds is very significant in terms of saturated fatty acids, monounsaturated and polyunsaturated fatty acids. There are significant differences between species in terms of fatty acid composition. Body fat saturation varies among animal species and according to breeds within the same species (Öztürkcan et al., 1996; Banskalieva et al., 2000).

According to the findings of the study, the content of saturated fatty acids in tail fat for the breeds of Artlı, Çepni, Karayaka and Of, respectively; 52.08%, 51.66%, 42.67% and Of 52.92% ($P < 0.05$), while the monounsaturated fatty acid contents were 33.25%, 33.12%, 33.07%, and 32.34% respectively. In terms of content of polyunsaturated fatty acids, it was determined as 0.76%, 1.20%, 0.64% and 0.87%, respectively. The presence of fatty acids desired for health was determined as 46.94% in Artlı, 51.03% in Çepni, 51.51% in Karayaka and 49.51% ($P < 0.05$) in the breed of Of. In terms of polyunsaturated fatty acids in the composition of fatty acids, the highest rate was found in the Çepni breed and the lowest in the Karayaka breed (Table 2).

Studies reveal a relationship between people's eating habits and diseases. Today, fats are the most questioned when investigating the relationships between certain diseases and diets. In researches, especially the saturated or unsaturated structure of oils, cholesterol and essential fatty acid contents, and oxidative stability were emphasized (Karaca and Aytaç., 2007; Kayahan., 2009; Çakmakçı and Tahmas-Kahyaoğlu., 2012). The place and importance of animal products in a healthy and balanced diet is widely recognized. However, foods of animal origin, which are an important source of saturated fatty acids, are associated with the diseases of the modern lifestyle. The decrease in energy spent for physical activity in healthy living conditions makes it necessary to be more careful and selective in the diet. Today, especially in developed countries, people who want to maintain a healthy life take care of their nutrition for this reason.

A-linolenic acid ratios, which are known to reduce the risk of cardiovascular disease and benefit brain health, for the breeds of Artlı, Çepni, Karayaka and Of in tail fat were respectively; 0.035%, 0.148%, 0.056%, 0.080%. The autherogenic index in tail fat was determined as 1.068%, 1.325%, 1.268% and 1.568% in Artlı, Çepni, Karayaka and Of breeds, respectively. It was determined that there was no difference between the groups in terms of monounsaturated fatty acids found in tail fat and recommended to be consumed in terms of health. However, considering the levels of polyunsaturated fatty acids, it was determined that the percentage of fatty acids in the tail fat of the Çepni breed was higher than the others, followed by Of, Artlı and Karayaka breeds respectively. When evaluated in terms of desired fatty acids values in tail fat (Costa et al., 2009) It was observed that the Karayaka breed was in the first place, followed by the Çepni, Of and Artlı breeds. In addition, when the breeds were compared in terms of mono and polyunsaturated fatty acids found in tail fat, it was found that there was no presence of some fatty acids among the breeds or that the animals in the experimental groups had this difference between animals in the same group or animals in all groups. In terms of tail fat saturated fatty acids, it was determined that the Karayaka race showed significantly lower values than the others among the breeds, but there was no difference between them. However, some fatty acids were found to be absent in some groups.

Table 2. Fatty acid compositions and fatty acid ratios in tail fat of lambs of different breeds (%)

Fatty acids	Artlı	Çepni	Karayaka	Of	P
Saturated fatty acids	52.08±1.188^{a}	51.66±1.093^{a}	42.67±1.562^{b}	52.92±1.219^{a}	**
C6:0	0.024±0.003	0.020±0.001	0.020±0.001	0.025±0.003	ns
C8:0	0.040±0.010^{a}	0.020±0.001^{b}	0.019±0.001^{b}	0.025±0.002^{ab}	*
C10:0	0.298±0.024^{ab}	0.277±0.28^{b}	0.288±0.008^{b}	0.362±0.021^{a}	*
C11:0	0.052±0.006^{a}	0.016±0.003^{c}	0.025±0.004^{b}	0.015±0.002^{c}	**
C12:0	0.172±0.018^{c}	0.295±0.040^{b}	0.247±0.046^{bc}	0.498±0.050^{a}	**
C13:0	0.084±0.006^{a}	0.048±0.003^{b}	0.055±0.008^{b}	0.050±0.004^{b}	**
C14:0	3.306±0.229^{c}	4.496±0.319^{b}	3.965±0.376^{bc}	6.170±0.196^{a}	**
C15:0	1.733±0.118^{a}	1.102±0.030^{b}	1.227±0.120^{b}	1.052±0.013^{b}	**
C16:0	21.816±0.911^{a}	25.289±0.699^{b}	25.477±0.486^{b}	26.283±0.248^{b}	**
C17:0	3.790±0.168^{a}	3.109±0.569^{b}	3.143±0.225^{b}	2.497±0.147^{c}	*
C18:0	11.235±0.774^{b}	16.714±0.569^{a}	17.505±0.775^{a}	15.800±1.506^{a}	**
C20:0	0.088±0.008	0.096±0.007	0.099±0.003	0.110±0.010	ns
C21:0	0.0278±0.005	0.438±0.241	0.030±0.006	0.090±0.010	ns
C22:0	0.015±0.002	0.016±0.002	0.015±0.002	0.015±0.003	ns
Monounsaturated fatty acids	33.25±0.676	33.12±0.694	33.07±1.553	32.84±1.341	ns
C14:1	0.096±0.004^{b}	0.100±0.009^{b}	0.082±0.006^{b}	0.192±0.034^{a}	**
C16:1	1.1610.039^{b}	1.1390.051^{b}	1.0740.053^{b}	1.563±0.204^{a}	*
C18:1	3.532±0.929^{c}	4.790±0.259^{a}	4.320±0.296^{ab}	3.890±0.176^{bc}	*
C18:1n9c	30.173±0.567	27.014±0.505	27.696±0.828	27.133±1.212	ns
C20:1	0.130±0.019^{a}	0.072±0.005^{b}	0.077±0.007^{b}	0.057±0.006^{b}	**
Polyunsaturated fatty acids	0.76±0.240	1.20±0.428	0.64±0.074	0.87±0.102	ns
C18:2	0.725±0.007	1.051±0.347	0.595±0.066	0.793±0.083	ns
C18:3	0.035±0.002	0.148±0.079	0.056±0.007	0.080±0.019	ns
C20:3	nd	0.015±0.005	nd	nd	
C20:4	nd	0.035±0.004	nd	nd	
PUFA / SFA	0.0153±0.015	0.0245±0.093	0.0147±0.014	0.0165±0.019	ns
ΣUFA / SFA	0.8522±0.057^{a}	0.6705±0.035^{b}	0.6575±0.025^{b}	0.6413±0.039^{b}	*
Atherogenicity index[1]	1.0677±0.090^{c}	1.3247±0.087^{b}	1.2683±0.072^{bc}	1.5657±0.036^{a}	*
Desired fatty acids[2]	46.94±1.813^{b}	51.03±0.891^{a}	51.51±1.017^{a}	49.51±0.489a^{b}	*
(C18:0 + C18:1) / C16:0	1.9496±0.130	1.8531±0.067	1.8583±0.046	1.7135±0.024	ns
Thrombogenic index[3]	2.071±0.161^{b}	2.670±0.163^{a}	2.753±0.099^{a}	2.853±0.192^{a}	*

[1]: [(C12:0) +4 x (C14:0) + (C16:0) / ΣUA; [2]: [MUFA + PUFA + C18:0]; [3]: [(C14:0 + C16:0 + C18:0)] / [(0.5MUFA + 0.5 PUFAn-6 + 3PUFAn-3 + (n-3/ n/6)]; (Costa et al., 2009; Zhang et al., 2021).
[a.b.c]: The means indicated with different letters in the same row are significantly different; * P < 0.05; ** P < 0.01; ns: not significant; nd: not determined.

4. Conclusion

It has been determined that the fatty acid content has significant differences between breeds. As a result, it has been scientifically demonstrated that the fatty acid profile is an important source for the desired fatty acid content. However, more research is needed in this area. With the breeding and different fattening studies, more comprehensive information will be provided on the share of environmental and genotypic effects in the variations of both genotype differences and differences between genotypes in terms of tail fat fatty acids and body fat fatty acids.

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