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Fatty acid profile of Turkish Bandirma Crossbreed, Karacabey Merino Multiplier and Karacabey Merino Nucleus lambs raised in the same intensive production system

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ABSTRACT

Fatty acid composition of *Longissimus dorsi* intramuscular fat in Bandirma Crossbreed (BC), Karacabey Merino Multiplier (KMM) and Karacabey Merino Nucleus (KMN) lambs were compared. Twelve of BC, twelve of KMM and twelve of KMN lamb genotypes were evaluated as test materials and each genotype was grouped as male and female composed of six lambs. There was no effect of sex on fatty acid composition in three different meats of lamb. According to the analysis results, saturated fatty acids (SFAs) were found to be 45.05 ± 2.12, 43.32 ± 3.51, and $44.95 \pm 3.13\%$, monounsaturated fatty acids (MUFAs) were found to be 46.66 ± 1.90, 46.34 ± 3.48, and $46.66 \pm 2.39\%$, and polyunsaturated fatty acids (PUFAs) were found to be 5.20 ± 0.83, 6.52 ± 1.39, and $6.03 \pm 1.35\%$ in BC, KMM, and KMN lamb breeds, respectively. The content of C18:1*t*-11 (vaccenic acid), C18:2, conjugated linoleic acid (CLA), which is known to have beneficial properties such as antidiabetic and anticarcinogenic, antiatherogenic for human health and PUFAs were higher for KMM lambs than for BC and KMN lambs ($p < 0.05$).

1. Introduction

The breeding condition of animals has a considerable effect on the meat quality and fatty acid composition in tissues (Landim et al., 2011). The Marmara region, which is the most crowded region in Turkey, sheep breeding have decreased owing mainly to decreasing pasture areas and grasslands. Recently, semi-intensive sheep farming systems have begun to increase in the Marmara region (Gokdal et al., 2012). In this area, Kivircik is the most widespread breed and thus consumers are accustomed to the meat of this breed (Ekiz et al., 2009). However, researches on the fatty acid composition of this lamb meat are fairly limited.

The characteristics of the fat from lamb carcasses primarily depend upon the type of fatty acids (Cieslak et al., 2013). Meat quality and fatty acid composition of muscle lipid tissue of lamb may be influenced by different factors such as slaughter weight (Yakan and Unal, 2010; Landim et al., 2011) and sex (Tejeda et al., 2008).

Nowadays, particularly in developed countries, there is an increasing tendency for consumers to prefer lean meat with less fat and high quality meat (Mushi et al., 2008). Consumption of saturated fatty acids (SFAs) has been related to increases in plasma cholesterol and low density lipoprotein

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(LDL) levels, connected to a higher risk of coronary heart disease (Grundy, 1987). A decrease in SFAs level and/or a concomitant increase in the monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs) content of ruminant meat may confer benefits for human health (Villalobos-Villalobos et al., 2014). For these reasons, there is an increased interest in the fatty acid composition of lamb meat by consumers from day by day. Thus, the objective of this study was comparison of the fatty acid profile, omega fatty acids and *trans* fatty acid contents of Bandirma Crossbreed (BC), Karacabey Merino Multiplier (KMM) and Karacabey Merino Nucleus (KMN) lambs. The results of the study could be useful for healthy nutrition of the fatty acid composition of lamb meat.

2. Material and methods

2.1. Location of study

The experiment was carried out at the Sheep Research Station – Bandirma District in Balikesir province, located in the Marmara region of the country at a longitude of 40°21 E, the latitude of 27°52 N, and at an altitude of 65 m. The mean relative humidity ranged from 20% to 88%, and the maximum ambient temperatures from −14 to 42.4 °C. The annual rainfall in this area varies from 500 to 900 mm, with an erratic distribution throughout the year.

2.2. Animals

2.2.1. The Bandirma Crossbreed lamb

Initially, German Black Headed Mutton (GBM) rams and Kivircik (K) ewes were mated in order to obtain the F1 genotype. Then, F1 ewes were divided into two groups. The ewes in the first group were mated with GBM rams to obtain the Backcross-1 (GBMB1) called the Bandirma-I genotype. The ewes in the second group were mated with GBMB1 rams to obtain the Backcross-1 × F1 crossbred genotype called the Bandirma-II genotype. Then, in the mating season of 2008, all the ewes and rams in the Bandirma-I and Bandirma-II genotypes were put together in the same flock, and the flock was closed. The closed flock is known as the "Bandirma Crossbreed" sheep flock.

2.2.2. The Karacabey Merino lamb

To improve the body performance and fleece quality of the indigenous sheep breeds, German Mutton Merino sheep were imported to Turkey in the 1930s. It was developed by crossing German Mutton Merino, and Kivircik breeds, so it carries a Merino genotype of over 90%. KMM is a herd that is created afterwards and bought from commercial breeders. The aim of creating such a herd is to enhance the number of animals. Males obtained from this herd are not used for breeding. The females are however, used to renew the same herd.

KMN is an improved version of the herd that the Bandırma Sheep Breeding Research Station has had since 1940. This herd is an elite one, and its breeding features are evident. Thus, breeding males obtained from this herd are used both in the herds of KMN and KMM.

2.2.3. Management conditions

A total of 36 lambs (12 Bandirma Crossbreed lambs, 12 Karacabey Merino Multiplier lambs, and 12 Karacabey Merino Nucleus lamb genotypes) were used as test subjects, and each genotype was divided into male and female groups, with each group composed of 6 lambs. The lambs were kept together with their mothers from birth for 40 days. They were also made to get used to concentrate feed and dry clover fodder from 15 days onwards. Then, the chosen lambs were separated from their mothers and taken in nutrition sections after being weighed. The period of adapting lasted 8 days, and with their weight of 18 kg at the beginning and at the age of 48 days, when they were put into an intense nutrition of 56 days. After the lively detection of weight, 6 male and 6 female lambs were taken to slaughter, and they were slaughtered in the business slaughterhouse.

2.2.4. Fat extraction and fatty acid methyl esters (FAME) analyses

Lipid extraction was from a 5.0 ± 0.1 g of the *Longissimus dorsi* according to Folch et al. (1957). Lamb meat samples were homogenized by blender with 5 mL of chloroform:methanol (2:1, v/v) and later analyzed to determine fat content. Lipid extracts were converted to fatty acid methyl esters (FAME) as described by AOAC (1990). FAME was prepared after alkaline hydrolysis, followed by methylation in methanol plus BF3 (14% boron trifluoride). The final concentration of the FAME was approximately 7 mg/mL in heptane.

2.3. GC condition

Gas chromatography (GC) analysis was carried out using Hewlett-Packard 6890 model gas chromatograph equipped with a flame ionization detector (FID), a split injector (Chrompack, Middleburg, The Netherlands). A fused-silica capillary column was used, CP™-Sil 88 (Chrompack), 100 m in length, 0.25 mm in internal diameter, 0.2 μm in film thickness. The oven temperature programming consisted of an initial temperature of 120 °C held for 1 min, an increase in temperature of 3 °C/min to 230 °C and a hold time of 20 min at 230 °C. The injector and detector were kept at 250 °C with gas flows of 40 mL/min for hydrogen and 450 mL/min for air. Helium was used as the carrier gas at a flow rate of 1 mL/min. The GC was equipped with a split injector; a single injection volume of 1 μL was made per sample duplicate, using a split ratio of 1:100. The peaks were identified by comparing the retention times and area percentages with those of authentic standards of FAMEs obtained from Nu-Chek-Prep Inc. and on the basis of literature data (Pawlowicz and Drozdowski, 1998). Three replicate GC analyses were carried out and the results were denoted in GC area % as mean values.

2.4. Statistical analysis

The data obtained on various parameters were subjected to statistical analysis by using 3 × 2 factorial design. Duncan's multiple range test was applied to compare the difference between the means. The statistical analyses were done with the SPSS statistical package program (SPSS, 2001).

3. Results and discussion

Fatty acid composition has an important role to describe meat quality and is usually linked to meat aroma and nutritive value (Yarali et al., 2014). As it is shown in Table 1, the proportion of SFAs was higher in BC lambs than the other lamb breeds and differences in the total percentage of SFAs were insignificant ($p > 0.05$). SFAs content in all genotypes was relatively high and similar to those notified by Villalobos-Villalobos et al. (2014).

The main SFAs type was palmitic acid (C16:0), followed by stearic acid (C18:0) and myristic acid (C14:0), which represented about 90% of the total SFAs in the *Longissimus dorsi* of lambs (Table 1). According to the results of fatty acid profile, C14:0 were higher in BC lambs than in KMM and KMN lambs ($p < 0.05$). C16:0 contents were the highest in KMN lambs ($p < 0.05$), while C18:0 contents were highest KMM lambs ($p > 0.05$). These results were compatible with those reported by some researchers (Yakan and Unal, 2010; Yarali et al., 2014).

C18:1 is the major fatty acid in intramuscular lipids of lambs (Tejeda et al., 2008). As expected, C18:1 was the most represented fatty acids in all the lamb breeds. According to the results, C18:1 contents account for approximately 87% of the MUFAs in all genotypes (Table 2). The highest proportion of C18:1 was observed in KMN lambs (41.26 ± 2.17%), but there were no differences in proportions of C18:1 among the lamb breeds ($p > 0.05$). The results were similar to those found in Bafra (Yakan and Unal, 2010), Chall