

Comparison of the Fatty Acid Composition of the Longissimus Dorsi Muscle of Kids, Lambs and Calves Produced under Iranian Transhumant Production System

Research Article

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ABSTRACT

Transhumant production system (TPS) is a type of extensive livestock production practiced by transhumant pastoralists in which indigenous livestock breeds are mainly fed a pasture-based diet. The hypothesis tested in this work was whether differences existed between fat samples from the different species in respect to ratios of n-6/n-3, and polyunsaturated fatty acids to saturated fatty acids. To test our hypothesis, fatty acids (FAs) composition of the longissimus dorsi muscle of kids (n=10), fat-tailed lambs (n=10), and calves (n=10) produced in a pasture-based system were determined. All animals were indigenous intact male and randomly selected from nomads in the Zagros mountains (Noorabad, Lorestan province). The live body weight of kids, lambs and calves were 21 ± 6 , 27 ± 4 , and 158 ± 35 kg respectively. Meat samples were analyzed either without (lean meat) or mixed with 30% of sirloin subcutaneous fat (fat meat). Results showed that saturated FAs (as percentage) in kids meat was lower than those in lambs and calves (41.4 vs. 46.2 and 47.4% $P=0.02$). Kid meat had higher α -linolenic (C18:3 n-3), eicosapentaenoic acid (C20:5 n-3), docosapentaenoic acid (C22:5 n-3), but lower undesirable FAs (C16:0+C14:0) and n-6/n-3 ratio in comparison with lambs and calves. In conclusion, goat meat produced under TPS conditions, compared with lambs and calves, showed more promising healthy source of FAs for human nutrition.

KEY WORDS omega-3, red meat, ruminants, transhumant pastoralists.

INTRODUCTION

Transhumant production system (TPS) is practiced in Iran predominantly in the Zagros mountains where livestock are mainly raised in a pasture-based feeding (Badripour, 2004). The annual migration of nomads' takes place from mountainous cold rangelands towards the warmer plains at the beginning of autumn, with the reverse movement in the spring. In transhumant system animal husbandry, the stock comprise on average 48% sheep, 47% goats, 3% cattle and 2% draught animals (Badripour, 2004). Nomadic and trans-

humant pastoralists own 13.6, 8.3 and 0.25 million heads sheep, goats and cattle, respectively and they produce about 20% of red meat production (e.g. 800 thousand metric ton) in the country (Organization for Nomadic People of Iran, 2008). Red meat production under extensive systems (such as TPS) is different from that of intensive production systems in many aspects including management, breeds, feeding regimes, animal activity, and environmental condition (Zervas and Tsipoulakou, 2011). In TPS, ruminants are usually finished on diets containing high proportions of green forages which might produce meat with more desir-

able fatty acids compositions than that of intensive production systems (Fincham *et al.* 2009; Daley *et al.* 2010; Howes *et al.* 2015).

Red meat is a good dietary source of essential amino acids, minerals, vitamins, and fatty acids (FAs) (Williams, 2007), however, its consumption is under question mainly due to unbalanced ratio of n-6 to n-3 FA, and ratio of polyunsaturated FA (PUFA) to saturated FA (SFA) (Binnie *et al.* 2014). These unhealthy nutritional facts of red meat could be to some extent improved by dietary inclusion of green grass in animal daily ration (French *et al.* 2000; Nuernberg *et al.* 2005; Fincham *et al.* 2009). There are opportunities in extensive production systems in which ruminants are fed green forage in which enhancement of desirable FAs compositions might occur (Nuernberg *et al.* 2005; Talpur *et al.* 2008; Fincham *et al.* 2009; Ponnampalam *et al.* 2014; Howes *et al.* 2015; Kiani and Fallah, 2016). In TPS, ruminants are finished on diets containing high proportions of green forages, thus they might produce meat with more desirable FAs compositions. To our knowledge, information on fatty acid composition of red meat produced in Iranian transhumant production system practicing by nomads is lacking. The hypothesis tested in this work was whether differences existed between fat samples, with respect to n-6/n-3, and PUFA/SFA ratios, from the goats, sheep and cattle reared under TPS. To test our hypothesis, we chose the longissimus dorsi (LD) muscle to compare FAs composition and ratios of n-6/n-3 and PUFA/SFA in kids, lambs, and calves produced under TPS.

MATERIALS AND METHODS

Animals and meat samples

In total, 30 intact indigenous male animals including 10 Lori goat kids, 10 fat-tailed lambs, and 10 Lori calves; all reared in a pasture-based feeding system by nomads were randomly selected. All animals had free access to their dams' milk even when they were able to graze. The animals had grazed on the same natural ranges at least for two months prior to slaughter day. The ranges were located at Zagros Mountains, near Noorabad, Lorestan province, Iran (34 °02'34.8"N, 48 °17'53.0"E). Predominant plant species of the grazed ranges were ryegrass (*Lolium perenne*), clover (*Trifolium* spp.), and other legumes (such as *Astragalus* spp.). Kids had free access to green leaves of oak trees (*Quercus brantii*). Slaughter age for lambs and kids were 5.5 ± 1 and for calves were 8 ± 2 months. Live body weight (Mean±SD) of the animals averaged 21 ± 6, 27 ± 4, and 158 ± 35 kg for kids, lambs and calves, respectively. All animals were slaughtered in a commercial processing plant (Gholshan Abattoir, Khoramabad, Lorestan) according to the Halal procedure. Slaughter procedure was approved by

the Animal Ethics Committee of Lorestan University. Meat samples (about 30-50 g) were taken from the loin portion of *longissimus dorsi* (between ribs 12th and 13th) muscles on the left side of the carcasses. Samples were cut off within 2 h after slaughter and were chilled to +4 °C for 24 h. Meat samples were divided into two sub-samples; either without subcutaneous fat (lean meat) or mixed with 30% sirloin subcutaneous fat of each animal (fat meat). Samples were ground by means of a food processor (3×5 s), and stored at -80 °C pending analysis.

Lipid extraction and methylation

Fatty acid methyl esters (FAME) were determined using the procedures described by (Sukhija and Palmquist, 1988) with some modification. Briefly, 0.1 g of meat sample was weighed (0.0001 g, KERN, Germany) and then was freeze dried. Sample was then placed into screw cap Pyrex culture tube (16×125 mL, Scott glass tube). One mL of heptane was added and mixed. After that, 0.2 mL of sodium methylate (25%) was added, and the tube was put in a 50 °C water bath for 10 min. Sample was then cooled for about 5 °C and 3 mL of freshly made methanolic HCl 10% (prepared by adding 20 mL of acetyl chloride to 100 mL of anhydrous methanol) was added to the sample and the tube was shaken vigorously. The tube was put in steam bath (90 °C) for 30 min and then the tube sample was cooled with ice. Finally, one mL of heptane and three mL of potassium carbonate 10% was added and mixed for one minute using a shaker. The sample was centrifuged (Centrifuge 5415 R; Rotofix 32A, Germany) at 300 g for 5 min. Heptane phase (upper phase) was transferred to the GC vial (1.5 mL) using Pasteur pipette.

Determination of fatty acid composition

Fatty acid methyl esters were analyzed using a GC (GC-FID; HP 6890 chromatograph, Hewlett-Packard, Avondale, PA, USA) fitted with a flame ionization detector. The GC was equipped with a Chrompack CP-Sil 88 TM fused silica capillary column (100 m×0.25 mm i.d., 0.2 mm film thickness; Varian Inc., Walnut Creek, CA, USA). The injector and detector temperatures were maintained at 280 °C and 300 °C, respectively. Initially, the column temperature was held at 150 °C for 5 min and then increased at 5 °C min⁻¹ to 180 °C (held for 30 min), then increased at 1 °C min⁻¹ to 190 °C (held for 5 min) and finally increased at 1 °C min⁻¹ to 200 °C (held for 35 min). Hydrogen was used as the carrier gas at a flow rate of 1.0 mL min⁻¹. Identification of common FAs was accomplished by comparison of sample peak retention times with those of FAME standard mixtures (SupelcoTM37 component FAME Mix, Supelco-47885-U, Sigma-Aldrich Chemie GmbH, Germany) and by using published chromatograms obtained under similar analytical