

ENVIRONMENTAL AND GENETIC EFFECTS ON FATTY ACIDS PROFILE OF GOAT MEAT

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1. Background

Goats are the most widely dispersed meat animals and have been raised for centuries to provide meat, milk, fiber, and leather. Due to their small size, adaptability to harsh environments and availability, they have been more popular in tropical countries. The goat population in developing countries represents 94% of the world population, and large quantities of goat meat are consumed worldwide. Brazil is at number 10 in world's goat population with 9,5 million of goats (FAO, 2002). Consumers are interested in goat meat as a source of relatively lean meat since goat meat contains low percentages of fat and cholesterol and high levels of long-chain unsaturated fatty acids (UFA). The fatty acid composition of goat meat has received little research attention in comparison to other meat animals. The influence of environmental and genetic effects has been studied intensively on carcass production, however their influence on meat quality is not very clear, mainly in relation to fat components. An investigation was designed to analyze the effect of environment and genetic on fatty acids profile of goat meat.

2. Materials and methods

The fatty acids composition was determined using 18 male intact goats. These goats represented the following genotypes: six crossbreed of pure Boer and SRD (½ Boer + ½ SRD), six crossbreed of pure Anglo Nubian and SRD (½ Anglo Nubian + ½ SRD) and six SRD (not defined breed) with slaughter age of 7 months, 8 ½ months and 9 months, respectively. From each group, three kid goats were raised in confinement regime and three in field, making a total of nine animals in each creation system, with slaughter weight of 31,40kg, 30,57kg and 30,47kg, respectively. These animals were obtained from the Experimental Station of "Pendência" (physical base of EMEPA), located at the municipal district of "Soledade-PB", and slaughtered according to the effective norms of the Ministry of Agriculture (Brazil, 1997).

The extracted lipids obtained through methodology of Folch et al. (1957) were used to analyze the fatty acids profile. The method of Hartman and Lago (1973) was used in the preparation of fatty acid methyl esters (FAME). The FAME in the hexane fractions was quantified by gas chromatography (GC) with a reference of authentic standards. GC quantification of fatty acids were carried out on a Hewlett-Packard model 5890 series II instrument, fitted with a flame ionization detector (FID) and a fused silica capillary column HP INNOWAX (30m x 0,25m i.d. x 0,25µm film thickness). The final derivatised sample solution (1,0 µl) was introduced into a split/split less injector at 230°C, and chromatograms were recorded with Hewlett-Packard HP3365 ChemStation System. Column initial and final temperatures were 120 and 210°C, with temperature ramping program at 8°C/min. The detector temperature was maintained at 250°C.

All data were analyzed by analysis of variance, Tukey's multiple mean comparison among breeds and between creation systems using general linear model of SAS program (1996).

3. Results and discussions

Data on fatty acids composition are presented in Table 1. In fat extracts of goat meat were identified 14 fatty acids, being 7 saturated, 5 monounsaturated and 3 polyunsaturated. The predominant fatty acids found in decreasing order were: oleic (C18:1), palmitic (C16:0), stearic (C18:0), linoleic (C18:2), palmitoleic (C16:1), and myristic (C14:0), which represent 91 to 96% of the total fatty acids. The interaction effect of genotype x creation system was not significant on total fatty acids profile, however, creation system affected the total fatty acids composition of goat meat.

Through analysis of individual fatty acids it is observed that the factors creation system and genotype have influenced significantly percentages of myristic fatty acid (C14:0) in goat meat. The variable creation system just influenced stearic acid (C18:0). The largest (2,61%) and the smallest percentage (1,58%) of myristic acid were found respectively on genotypes ½ Anglo Nubian and ½ Boer. It was also observed that goats rose on field presented difference significantly ($P < 0,05$) larger percentage of myristic acid (2,41%) and stearic acid (20,71%) than goats rose on confinement regime. The variations (17,03 to 20,71%) of stearic acid found were superior of those presented by Rhee et al. (2000) on crossbreed of Boer (16,27%) raised in semi-confinement regime. Mahgoub et al. (2002) studying lipids compounds of Omani Jebel Akhdar goats in confinement regime found values of stearic acid varying from 15,21 to 18,72%.

Comparing the monounsaturated fatty acids profile, the C16:1 differed significantly ($P < 0,05$) in function of genotype and creation system. A larger percentage (2,96%) of C16:1 was observed on genotype ½ Boer, while the smallest (1,80%) was found on genotype ½ Anglo Nubian. Park and Washington (1993) reported on goat's percentage of 2,40% on goat meat of Nubian raised in semi-extensive regime. The largest percentage of C16:1 (2,60%) was found on goats raised in confinement regime. The variation from 1,87 to 2,60% was similar to those mentioned by Madruga et al. (2001) for crossbreed of Saanen (1,94 to 2,54%) rose in semi-confinement regime. Oleic acid (C18:1) was just influenced significantly by the factor creation system. Goats rose in confinement presented larger percentages (43,56%) of C18:1 in comparison with goats rose in field (36,23%). It was the most abundant fatty acid found in the lipid fraction of goat meat, and has also been reported as the main component in fatty acid compositions of goat meat by Kesava Rao et al. (2002), Souza (1999) and Park & Washington (1993). Madruga et al. (2001) studying lipids compounds of "Mestiço" goat meat from native Brazilian goat raised in semi-confinement regiment, found values of oleic acid varying from 38 to 44%. Of the polyunsaturated fatty acids, just the linolenic acid (C18:3) differed significantly ($P < 0,05$) by influence of both factors. In function of the factor genotype, ½ Anglo Nubian presented larger percentage of linolenic acid (4,11%), while the smallest (2,43 and 2,69%) were found on genotypes ½ Boer and SRD. The variation of linolenic acid was inferior to those mentioned by Souza (1999) for crossbreed of Anglo Nubian (7,93%) raised in confinement regime and slaughtered at age of 220 days, and superior to those reported by Rhee et al. (2000) for crossbreed of Boer (0,18 to 1,16%). In function of the creation system, the largest percentage of linolenic acid (3,62%) was found on goats raised in field.

Significant difference ($P < 0,05$) was just found in the factor creation system on SFA (saturated fatty acids), MUFA (monounsaturated fatty acids), and ratio MUFA/SFA and UFA/SFA. It was also observed (Table 2) that goats rose in field presented larger percentage of SFA (45,52%), while goats rose in confinement showed larger percentage of MUFA (49,04%). Rhee et al. (2000) found similar values (35,28% - 42,19% of SFA and 45,29 - 56,46% of MUFA) on crossbreed goats of Boer (½ Boer + ½ Spanish) raised in confinement regime. Similar values were found by Kesava Rao (2002), Souza (1999) and Park & Washington (1993).

The ratio of unsaturated:saturated fatty acids in function of the factor creation system showed that goats raised in confinement presented difference significantly ($P < 0,05$) larger ratio of MUFA/SFA and UFA/SFA than goats raised in field. Rhee et al. (2000) found similar values for the ratio MUFA/SFA (1,07) and for the ratio UFA/SFA (1,37) on crossbreed goats of Boer raised in confinement regime. Mahgoub et al. (2002) also observed similar ratio of UFA/SFA (0,74 to 1,59).

Table 1 - Profile of fatty acids found in goat meat, in function of the factors genotype and creation system.

Fatty Acids	Genotype			Creation System	
	½ Bôer	½ Anglo Nubian	Not defined breed (SRD)	Field	Confinement
Saturated					
C12:0	0.57 ± 0.18 ^a	0.12 ± 0.06 ^a	0.45 ± 0.23 ^a	0.46 ± 0.18 ^a	0.30 ± 0.11 ^a
C14:0	1.58 ± 0.20 ^b	2.61 ± 0.52 ^a	2.17 ± 0.27 ^{ab}	2.41 ± 0.35 ^a	1.83 ± 0.25 ^b
C15:0	1.39 ± 0.35 ^a	0.24 ± 0.12 ^a	0.16 ± 0.10 ^a	0.67 ± 0.31 ^a	0.53 ± 0.20 ^a
C16:0	21.24 ± 1.47 ^a	18.35 ± 0.64 ^a	20.06 ± 0.49 ^a	19.64 ± 1.15 ^a	20.12 ± 0.42 ^a
C17:0	1.83 ± 0.34 ^a	1.35 ± 0.12 ^a	1.72 ± 0.44 ^a	1.64 ± 0.29 ^a	1.63 ± 0.24 ^a
C18:0	17.63 ± 1.55 ^a	19.60 ± 1.25 ^a	19.38 ± 1.45 ^a	20.71 ± 0.84 ^a	17.03 ± 1.08 ^b
Monounsaturated					
C14:1	0.85 ± 0.24 ^a	0.11 ± 0.05 ^a	0.44 ± 0.35 ^a	0.44 ± 0.22 ^a	0.48 ± 0.22 ^a
C15:1	1.64 ± 0.42 ^a	0.60 ± 0.35 ^a	0.95 ± 0.43 ^a	1.17 ± 0.40 ^a	0.95 ± 0.30 ^a
C16:1	2.96 ± 0.57 ^a	1.80 ± 0.24 ^b	1.95 ± 0.13 ^b	1.87 ± 0.16 ^b	2.60 ± 0.42 ^a
C17:1	1.40 ± 0.10 ^a	2.36 ± 0.58 ^a	1.11 ± 0.30 ^a	1.80 ± 0.49 ^a	1.45 ± 0.09 ^a
C18:1	40.35 ± 2.23 ^a	39.00 ± 3.20 ^a	40.33 ± 2.37 ^a	36.23 ± 1.78 ^b	43.56 ± 1.50 ^a
Polyunsaturated					
C18:2	5.76 ± 0.94 ^a	9.55 ± 1.79 ^a	8.55 ± 0.86 ^a	9.06 ± 1.33 ^a	6.84 ± 0.76 ^a
C18:3	2.43 ± 0.37 ^b	4.11 ± 0.71 ^a	2.69 ± 0.31 ^b	3.62 ± 0.54 ^a	2.53 ± 0.28 ^b
C20:3	0.27 ± 0.18 ^a	0.02 ± 0.02 ^a	0.42 ± 0.19 ^a	0.25 ± 0.14 ^a	0.22 ± 0.12 ^a

Table 2 - Profile of saturated (SFA), monounsaturated (MUFA), polyunsaturated fatty acids (PUFA), ratio MUFA/SFA, PUFA/SFA and UFA/SFA found in goat meat, in function of the factors genotype and creation system.

Fatty Acids	Genotype			Creation System	
	½ Boer	½ Anglo Nubian	Not defined breed (SRD)	Field	Confinement
SFA	44.23 ± 2.43 ^a	42.26 ± 1.39 ^a	43.93 ± 2.04 ^a	45.52 ± 1.81 ^a	41.42 ± 0.93 ^b
MUFA	47.20 ± 2.02 ^a	43.86 ± 3.31 ^a	44.79 ± 3.12 ^a	41.52 ± 2.05 ^a	49.04 ± 1.75 ^b
PUFA	8.46 ± 1.36 ^a	13.68 ± 2.49 ^a	11.66 ± 1.05 ^a	12.94 ± 1.82 ^a	9.59 ± 0.98 ^a
MUFA/SFA	1.09 ± 0.09 ^a	1.05 ± 0.11 ^a	1.04 ± 0.11 ^a	0.93 ± 0.07 ^a	1.19 ± 0.06 ^b
PUFA/SFA	0.20 ± 0.04 ^a	0.32 ± 0.06 ^a	0.26 ± 0.01 ^a	0.29 ± 0.04 ^a	0.23 ± 0.02 ^a
UFA/SFA	1.29 ± 0.11 ^a	1.37 ± 0.07 ^a	1.31 ± 0.10 ^a	1.22 ± 0.08 ^a	1.42 ± 0.05 ^b

5. Conclusion

In conclusion, the interaction effect of genotype x creation system was not significant on fatty acids profile. Goats raised in confinement regime contained significantly greater MUFA, higher ratio of MUFA/SFA and UFA/SFA than goats raised in field.

6. References

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