CHEMICAL COMPOSITION OF SUBCUTANEOUS FAT OF IBERIAN PIGS FED ON WOODLAND (ACORNS)

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SUMMARY

The amounts of C16:0 and C18:0 fatty acids decreased significantly between 95 and 130 kg LW. C18:1 increased significantly between initial and final slaughter weights but had a higher difference between 95 and 115 kg. C18:2 decreased significantly only between 115 kg and 130 kg LW. Psychometric color attributes croma* and saturation* decreased, and hue* increased significantly between 95 and 115 kg.
The anatomical site did not influence the fatty acid composition but altered the gross chemical composition.
The outer layer of the subcutaneous backfat contained more C18:1 and less C16:0 than the inner one.
The third layer of backfat of the pigs slaughtered at 130 kg LW showed a significantly higher degree of saturation (less C18:1 and more C16:0).

Introduction

The Iberian pig deposits considerable amounts of fat in adipose tissue. The amount of subcutaneous fat deposited represents about 60% of carcass weight. Backfat thickness at the last rib level varies between 50 and 55 mm at 130 kg LW. Its peculiar body composition is closely related to feeding management, which includes a fattening period on acorns (an energetic feed) after a traditional long growing cycle. Therefore, pigs are traditionally slaughtered at high live weights and advanced age.

The Iberian pig fat plays an important role on the characteristics of dry cured products obtained from its meat. Fat chemical composition is also important on flavor development (Baldini et al., 1983) and on organoleptic characteristics (Girard, 1984). The aspects of fat quality are determined by the gross composition of fat tissue (water and lipids) and its fatty acid composition (Wood, 1989).

This study was carried out to investigate the evolution of chemical composition of fatty tissues of Iberian pigs during the fattening period on woodlands (acorns and grass).

Materials and methods

Animals and diets

Between 40 and 95 kg LW pigs were fed a commercial diet and then fattened at woodland on acorns and grass. Groups of 4 animals were slaughtered at 95, 115 and 130 kg LW.

Samples

Adipose subcutaneous backfat at 12th to 13th rib level and ham were sampled after slaughter. Outer and inner layers were analyzed for all groups. The third layer (innermost layer) of backfat at the heavier group was also sampled and fatty acid composition determined. Samples were vacuum packaged and stored at -20_ C until they were analyzed. Analyses were carried out 30 minutes after defrosting.

Analytical procedures

Analytical procedures

Analytical gross chemical composition included moisture (IN ISO - 1442), total protein (IN ISO - 937) and lipid = [100 - (protein (IN ISO - 937) and lipid = [100 - (protein + water)]. Lipids for fatty determination were extracted at 50*C. Color CIE L* a* b* (Minolta CR-200). Lipids from fat samples were latter prepared to obtain the methyl esters and analyzed by gas chromatography.

Data were subjected to analysis of variance using a package of the Stagraphics Statistical Graphics System 5.0. Means werer separated using the LSD test.

Results and discussion

Table 2 and 3 present the results for the evolution of chemical composition with slaughter weight and in outer and inner layers in two anatomical sites. The results in table 2 are averages of two layers at two sites. Table 4 present the results of fatty acid composition of three backfat layers of pigs slaughter at 130 kg LW. Table 1 shows the chemical composition of acorn (Almeida et al., 1991).

Table 1. Acorn chemical composition

DM	CP	EE	NFE	C16:0	C16:1	C18:0	C18:1	C18:2	C18.3
58,32	3,69	8,5	70,27	12,95	0,26	4,43	61,80	17,7	1,33

Evolution of chemical fat composition

At slaughter, the lighter group (95 kg LW) presented significant differences on gross constituent content (water, lipids and FFDM) when compared to the heavier ones (115 and 130 kg LW) (Table 2). Water content decreased ($P<0,05$), lipid concentration increased ($P<0,01$) and FFDM decreased ($P<0,01$). In growing pigs, the increase of adipose tissue mass involves an increase in fat content of adipose tissues from all body sites (Metz et al., 1980). Geri et al. (1990) found that, heavier animals presented larger adipocytes and fat tissue with more lipids and less water contents than lighter pigs, in both layers of backfat. Since there were no statistical differences between the two heavier groups (115 and 130 kg LW), differences registered between the lighter animals and these ones, can be attributed to an effect of the diet (energy intake) besides slaughtered weight. Wood et al., (1986) found that water and lipid content in backfat were greatly affected by feeding treatment.

Color values were significantly affected by the increase of weight during fattening on acorns (table 2). The most significative differences were observed between animals slaughtered at the beginning of this period and those slaughtered at 115 kg LW. Hue* increased from 68,81 to 85,28, a* , croma* and saturation* decreased from 2,3 to 0,34; 6,29 to 4,36 and 0,078 to 0,054 respectively. Between the group slaughtered at 115 kg LW and the heavier one, only a* and hue* presented significative differences. This results could be related with the increase of lipid content between 95 and 115 Kg (see Table 2) and with the intake of plant pigments which would have been deposited in subcutaneous fat.

Pigs from the two heavier groups presented lower ($P<0,001$) content of C16:0 and C18:0. As suggested by other authors, the maturity did not led to a selective deposition of total saturated fatty acids. The amount of C18:1, the major fatty acid in acorn (62%) increased significantly as slaughter weight increase, respectively from 46,14 to 50,05 and 52,05%. The amount of C18:2 content was significantly lower in pigs slaughtered at 130 kg LW. This reduction cannot be explained by C18:2 dietary level alone, where its content was relatively high (18%). Wood (1983) reported that a fairly constant dietary C18:2 amount (400 mg/g dietary C18:2) is incorporated into fat tissue whatever the dietary acid intake. Therefore the large content of dietary C18:1 intake and deposition results in a dilution of C18:2 content.

Chemical composition of layers

Gross chemical composition was different in outer and inner layers and differed with their anatomical location (Table 3). The outer layer of backfat had higher water content ($P<0,001$) and lower lipid concentration ($P<0,001$) than the inner one. However, at ham subcutaneous fat, the outer layer had lower water content and higher lipid concentration, although not significantly different. Geri et al. (1990) found that, as live weight increases, size fat cells increased faster in the inner than in the outer layer of backfat. This report agrees with ours previous measure observations during dissections at 95 kg (outer: 10,4 mm; inner: 28,5 mm), 115 kg (outer: 12,5; inner: 32,2) and 130 kg (outer: 16,5; inner: 41,5 inner).

Color attributes did not show significant differences between layers (Table 3). However, the outer layer presented in both sites higher values for a*, croma* and saturation*, and lower value of L*. Lo Fiego et al. (1987) found for L* value the same trend. Santoro (1983) reported a pink color in the outer layer of subcutaneous ham fat as a result of capillary network infiltration. In the present work the highest a* value in outer layer in both sites agrees with the latter report.

The fatty acid profile between layers was quite different (Table 3). However, at backfat (BF) these differences were more clear than at ham (H) subcutaneous fat. Therefore, considering the major fatty acids, the outer layer presents low amounts of C16:0 ($P<0,001$ BF; $P<0,05$ H) and C18:0 (although not significantly different in both); and higher content of C18:1 ($P<0,05$ BF; ns H) and C18:2 ($P<0,05$ BF; ns H). The results obtained at (BF) are similar to those found by many other authors, such as Marchello et al., (1983), Villegas et al., (1973).

Fatty acid composition of backfat three layers, was studied in pigs slaughtered at 130 kg LW and fed on acorns during the last 35 kg gained (Table 4). Since the third layer seems to present a latter growth during this research period, it is questionable to what extent the fatty acid composition of this layer reflects the fatty acid composition of the latter diet (acorns + grass). The results showed that outer layer was more unsaturated, monounsaturated and polyunsaturated than the inner one and this one more than the third and most inner layer. The C18:1, the major fatty acid in acorn fat is preferentially deposited in the outer layer, as C18:2. For C18:2, this results are in agreement with the report of Villegas et al., (1973).

Conclusions

Chemical composition and color attributes of subcutaneous fat were greatly affected by fattening on acorns. The amount of C18:1 (monounsaturation) increased and C18:2 decreased (polyunsaturation).

Outer and inner layers present different chemical composition and a trend to unsaturation from the most internal to the outer layer.

References

Almeida, A.A.; Marinho, A.A.; Batista, M.E. (1991). Bolota de azinho e sobro: I - Caracterização morfológica e química. Proc. Congresso Internacional de Zootecnia, Évora, 3-6 Abril.

Baldini, P.; Palmia, F.; Pezzani, G. e Lambertini, L. (1983). Indagine sulla composizione del grasso superficiale di prosciutti freschi destinati alla produzione del prosciutto di Parma. Industria Conserve, 58:219-222.

Girard, J.P. (1984). Les composantes de la qualité de la viande du tissu adipeux et des produits carnés. Bull. Tech. C.R.Z.V. Theix, 56:59-67

Geri, G.; Poli, M.; Zappa, A.; Campodoni, G. and Franci, O. (1990). Relationships between adipose tissue characteristics of newborn pigs and subsequent performance: III. Histological and chemical characteristics of backfat. Jour. Anim. Sci. 68:1936-1943.

Lo Fiego, D. P.; Santoro, P.; Costa, L.N. (1987). Caratteristiche del tessuto adiposo nel prosciutto fresco e stagionato. Rivista di suinicoltura, 11:45-48

Marchello, M.J.; Cook, N.K.; Slander, W.D.; Johnson, V.K.; Fischer, A.G. and Dinusson, W.E., (1983). Fatty acid composition of lean and fat tissue of swine fed various dietary levels of sunflower seed. Jour. of Food Scien. 48:1331-1334.

Metz, S. H.M.; Wijs, M. de and Dekker, R.A., (1980). The composition of adipose tissue and its usefulness as a parameter for carcass composition in growing pigs. Lives. Prod. Scien. 7:291-296.

Villegas, F.L.; Hedrick, H.B.; Veum, T.L.; Mcfate, K.L. and Bailey, M.E., (1973). Effect of diet and breed on fatty acid composition of porcine adipose tissue. Jour. Anim. Scien. 36:663-668.

Wood, J.D.; Enser, M.; Whittington, F. M.; Moncrieff, C.B. and Kempster, A.J. (1989). Backfat composition in pigs: differences between fat thickness groups and sexes. Livestock Prod. Sci. 22:351-362.

Wood, J. D.; Buxton, P. J.; Whittington, F. M. and Enser, M., (1986). The chemical composition of fat tissues in the pig: effects of castration and feeding treatment. Lives. Prod. Scien. 15:73-82.

Wood, J.D., (1983). Fat quality in pigmeat-U.K. Meat Research Institute Special Report N_2. 'Fat Quality in Lean Pigs'. Ed. J.D.Wood, AFRC Meat Research Institute, Langford, Bristol, UK.