CHANGES IN CARCASS COMPOSITION AND IN LIPID COMPOSITION OF LONGISSIMUS DORSI AND BACKFAT DURING FATTENING OF CORSICAN PIGS IN CHESTNUT PLANTATION

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SUMMARY

The aim of the present study was to compare the carcass composition and the lipid composition of muscle and adipose tissue before and after fattening in chestnut plantation. Six pigs were slaughtered at both stages. Carcasses were cut in order to estimate the relative proportions of bone, muscle skin and fat. Lipid analyses were performed on samples of *Longissimus dorsi* and backfat. During fattening in chestnut plantation, the pigs displayed a compensatory growth (daily weight gain = 620 g/day). The weight gain was mainly related to fat deposition but animals deposited a small amount of muscle. Lipid content of adipose tissue increased from 6g / 100g to 79g / 100g. However the fatty acid composition remained unchanged. The lipid content of *Longissimus dorsi* increased from 1.9 to 5.8 g /100 g due to triglyceride accumulation in muscle. The proportion of unsaturated fatty acids in total lipid extract and in triglycerides decreased (16.6 to 5.3 % and 11.4 to 2.6% respectively). Conversely, the proportion of these fatty acids increased in phospholipids from 36.4 to 47.5 %.

Introduction

Pig production in Corsica is extensive and is closed to the sylvo - pastoral system of southern Mediterranean countries. The successive phases of rearing (reproduction, slaughter) are closely related to the cycle of natural food resources. After a period of drastic food restriction during summer, pigs of local population were slaughtered between 18 and 24 months of age at the end of a fattening period in chestnut plantation (from November to February). This fattening period is regarded as an essential condition to obtain the specific sensory quality of Corsican dry cured products. However this assumption is not supported by objective data. The aim of this study was to compare the carcass composition and the lipid composition of muscle and adipose tissue at the beginning and at the end of the traditional fattening period of Corsican pigs in chestnut plantation.

Materials and Methods.

Animals : Eighteen Corsican pigs were used. One group of twelve pigs were used for the determination of carcass composition. Six animals of 18 months of age were slaughtered just before the fattening period in chestnut plantation and six ones two months later at the end of this period (2 females and 4 castrated males at each time). The left half carcass were dissected into skin, bones, muscles and dissectable adipose tissue. The inter muscular fat was not removed for muscles. A second group of six pigs (2 females and 4 castrated males) were used for the study of the changes in lipid composition of muscle and adipose tissue during the fattening period. A sample of *Longissimus dorsi* and backfat were taken by biopsy at the beginning of the fattening period according to the procedure described by Talmant *et al.* (1989). At the end of the period , the pigs were slaughtered and a sample of muscle and adipose tissue was taken at the same location (1st lumbar vertebra). Muscles were carefully trimmed and minced in a blender just before lipid analysis.

Lipid extraction : Lipids were extracted from muscle and adipose tissue according to the method of Folch *et al.* (1957). The extracts were dryed under vacuum on a rotary evaporator and were weighted. The total lipid content was expressed in g / 100 g of meat.

Lipid extract fractionation : The total lipid extracts were fractionated into triglycerides and phospholipids on silica cartridges (sep-pack, Waters) following the procedure described by Juaneda and Rocquelin (1985). The triglyceride and phospholipid contents were estimated by gas liquid chromatography (GLC) of the methyl esters using heptadecanoic acid as internal standard. The factor used to convert methyl esters into triglycerides and phospholipids were 0.995 and 1.340 respectively (Christie, 1982). Results were expressed in g / 100 g of muscle.

Fatty acid composition : Fatty acid composition of total lipid extracts triglycerides and phospholipids was determined by GLC. Methyl esters were prepared as described by Morrison and Smith (1964). The gas chromatograph was DANI 6500HR apparatus equipped with a split injector and a flame ionisation detector. It was paired with a CR3A integrator (Shimadzu). We used a capillary column (30 m long, 0.32 mm internal diameter, 0.1 mm film thickness) containing a polar stationary phase (Superox II Alltech).The split flow rate was set at 40 ml / min. The head pressure of the hydrogen carrier gas was 0.5 bar. The oven temperature was increased from 160 to 200°C at 2°C/min, and then maintained at 200°C until the end of the analysis. The injector and detector temperature was 250°C. The results were expressed in percent of the amount of methyl esters present.

Statistical analysis : The carcass composition and lipid composition of *longissimus dorsi* and backfat before and after the fattening period were compared by a t test.

Results and discussion.

Carcass composition : During the fattening period in chestnut plantation, the live weight of the pigs increased from 53 to 90 kg (+ 70 %). The daily weight gain is high (620 g/ day), indicating a compensatory growth of the pigs. Significant changes in carcass composition of pigs occurred during this period. The most important one was a large increase of the weight (from 2.16 kg to 11.20 kg) and the thickness of the backfat (i.e. from 10 mm to 45 mm on the neck) (Table 1). This results were expected because the pigs ate chestnuts *ad libitum* (a high energy diet) in plantation at late stage of development (16-18 months) and also because this period came after a drastic feed restriction during summer. The increase in muscle weight is more surprising (9.6 kg versus 15.00 kg). This result seems to support the hypothesis of a compensatory growth. However, our results should be considered with caution because the inter muscular adipose tissue was not separated from lean muscles during the dissection. So, the increase in muscle weight in this study should be related both to inter muscular adipose tissue development and protein deposition in lean tissue. Further investigations were required to determine the relative proportions of inter muscular fat and lean tissue in muscles and to quantify the lipid and protein contents of lean tissue.

Lipid composition of *Longissimus dorsi* and backfat : During the fattening period, the lipid content of the backfat rose from 6 to 79 g/100 g. In the same way, the intramuscular lipid content of *longissimus dorsi* increased sharply (1.9g to 5.8 g / 100 g) This result was a consequence of the triglyceride accumulation in muscle, whereas the phospholipids content remained unchanged. Our results were consistent with the results previously published on lipid content of the muscle in pigs which indicated that the difference in lipid content between muscles are mainly related to differences in triglyceride content (Leseigneur-Meynier and Gandemer, 1991 ; Gandemer *et al.*, 1992). The changes in lipid composition of the muscle and backfat observed in this study are in good agreement with the results previously obtained in Corsican pigs (Molenat *et al.*, 1983; Casabianca et Luciani, 1992). Two causes should be proposed to explain this propensity of Corsican pigs to accumulate lipids both in muscles and adipose tissues. The first one is related to the rearing conditions, as reported earlier the pigs received ad libitum a high energy diet consisting essentially of chestnuts at an old age (16-18 months). The second one is a particularity of the Corsican pigs which exhibit a clear propensity to accumulate more lipids in muscles and adipose tissues than industrial European genotypes whatever the rearing conditions (traditional or industrial fattening method) (Molenat *et al.*, 1983).

Fatty acid composition of *Longissimus dorsi* and backfat : In relation with the lipid deposition in muscle during the fattening period, we have observed a clear decrease in polyunsaturated fatty acid (PUFA) amount in intramuscular lipids (from 16.0% to 5.3%). It is generally admitted to explain such a result by the accumulation of triglycerides in muscles. This leads to a correlative decrease in PUFA amount in total intramuscular lipids because triglycerides contain far less PUFA than phospholipids. In Corsican pigs, the result is more marked because the PUFA amount in triglycerides dropped from 11.4% to 2.5% during the same time. Conversely the

PUFA proportion in phospholipids increased from 36.4 to 46.7% during the fattening period. No significant change was observed in fatty acid composition of backfat between the beginning and the end of the study. The changes in fatty acid composition of muscle and adipose tissue suggest some hypothesis on the mechanisms involved in lipid deposition in the tissues of Corsican pigs during fattening in chestnut plantation. In muscle, the decrease in PUFA amount of triglycerides is related to their accumulation. This marked drop of PUFA proportion in triglycerides indicated that most of the fatty acids deposit in the Longissimus dorsi as triglycerides were *de novo* synthesised from the glucides provided by the chestnuts. It is well known that the *de novo* fatty acid synthesis from glucides in animal tissues provide mainly oleic and palmitic acid what explain the high proportion of these fatty acids observed in triglycerides of both muscle and adipose tissue at the end of the fattening period in chestnut plantation. In phospholipids, the PUFA proportion is low at the beginning of the fattening period as compared to the data previously published in industrial European pigs (36.4 versus 45-50%) (Leseigneur-Meynier and Gandemer, 1991). This result should be a consequence of the undernutrition of the pigs during the summer because the natural food availability was weak and no additional feed was provided to the animals during this season. This undernutrition is corroborated by the weight loss of the pigs generally observed during summer. It seems that the essential fatty acid requirement is not covered by the feed in summer. During the fattening period in chestnut plantation, the PUFA amount reached the value generally observed in pork phospholipids. These fatty acids were supplied by the lipids of chestnuts which contain a high proportion of linoleic acid (45% - Beaubatie, 1979). However the chestnuts contain a small amount of lipids and the quantity of PUFA provided is too small to induce a significant PUFA deposition in triglycerides of adipose tissue or muscles.

Conclusion : The traditional fattening of Corsican pigs in chestnut plantation induce drastic changes both in carcass composition and in lipid content and composition of muscles. The increase of carcass adiposity during the fattening should be considered as excessive. Further investigations are required in order to reduce carcass adiposity without impairing meat quality. On the other hand, it is generally accepted to consider that the high lipid content of muscles and the low PUFA proportion of muscle and backfat lipids improve some quality traits of dry meat products. So Touraille (1990) demonstrated that muscle with a high lipid content gave more tender and more fondant ham. Moreover, it is well known that muscles and adipose tissues containing a low proportion of PUFA are appropriate raw matters for the production of dry cured ham because they oxidize very slowly. This study give objective results which demonstrate that muscles get the composition traits required for the production of dry cured ham during the traditional fattening of Corsican pigs in chestnut plantation.

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References

Beaubatie, L. (1979). Etude des lipides, en particulier des acides gras du fruit de Castanea sativa (Miller). Bull. Soc. Pharm. Bordeaux, 118, 109-114.

Casabianca, F. and Luciani, A. (1989). Relation entre lipides intramusculaires et âge à l'abattage dans une race porcine méditerranéenne (Corse). 40 th meeting of European Federation of Zootechny, Fez, Dublin, Eire : 4 p.

Christie, W.W. (1982). Lipids analysis (2nd edition). Pergamon press, Oxford, England.

Folch, J., Lees, M. and Sloane-Stanley, G.R. (1957). A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem., 226 : 497-509.

Gandemer, G., Viau, M., Caritez, J. C. and Legault, C. (1992). Lipid composition of adipose tissue and muscle in pigs with an increasing proportion of Meishan genes. Meat Sci, 32, 105-121.

Juaneda, P. and Rocquelin, G. (1985). Rapid and convenient separation of phospholipids and non phosphorus lipids from heart using silica cartridges. Lipids, 20:40-41.

Leseigneur - Meynier, A. and Gandemer, G. (1991).Lipid composition of pork muscle in relation to the metabolic type of the fibres. Meat Sci., 29, 229-241.

Morrison, W.R and Smith, L.M. (1964). Preparation of fatty acids methyl esters and dimethyl acetals with boron-fluoride methanol. J. lipids res., 5, 600-608.

Talmant, A., Fernandez, X., Sellier, P. and Monin, G. (1989).Glycolytic potential in *longissimus dorsi* muscle of Large White pigs, as measured after *in vivo* sampling. Proceeding 35 th Int. Congress Meat Res. Workers, Copenhagen, Denmark : 1129-1132.

Touraille, C. (1990). Qualités organoleptiques de viandes de porcs issus de croisements avec des races chinoises. Proceeding of the Chinese pig Symposium" (ed.) Molenat M. and Legault C. INRA Press, Paris, France. 243-254.