

# EVOLUTION OF FATTY ACID PROFILE IN FREE-RANGE IBERIAN PIGS DURING FATTENING: THE EFFECT OF FAT-ENRICHED DIETS DURING THE GROWING PERIOD

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**Abstract** – This study aimed to evaluate the effect of dietary fat (sunflower oil, high-oleic acid sunflower oil and hydrogenated fat) given to Iberian pigs during their growing period (from 50 to 105 kg) on the evolution of the main groups of fatty acids in subcutaneous fat during the fattening period in free-range conditions. Fat biopsy samples were taken at days 0, 22, 43 and 93 during the fattening in free-range conditions. The proportion of PUFA changed slightly over time in pigs receiving saturated fat. However, groups that received a sunflower oil-enriched or high oleic-enriched diet that had a higher proportion of PUFA at the beginning of fattening showed a marked decrease of these fatty acids during the first 20 days, reaching a minimum level of 12%. The modification of SFA during fattening was less affected than the other fatty acid groups. MUFA evolution during fattening was also affected by dietary fat given during the growing phase. This group of fatty acids increased markedly over time, especially in high oleic-enriched and sunflower oil-enriched groups that had lower proportions at the beginning of the period. After six weeks of feeding on acorns and grass, the proportion of MUFA reached similar proportions in all groups.

**Key Words** – Iberian Pig, fatty acids evolution, dietary fat

## I. INTRODUCTION

Traditional Iberian pig production, consisting of a diet of acorns and grass in extensive conditions during the fattening period, produces meat that is high in enriched-oleic acid [1], which is highly interesting from a consumer health perspective. This fatty acid profile also plays an important role in the quality of products from pigs fed in extensive conditions because the replacement of polyunsaturated fatty acids by monounsaturated fatty acids has been related to low rancidity and high stability during processing [2]. The particular fatty acid profile of Iberian pig meats is attributable to the fact that pigs are monogastric animals and most of the fatty acids are accumulated without undergoing any change [2], plus Iberian pigs also have a metabolism with high lipogenesis and high desaturase activity [2,3]. In addition, the tissue lipolysis level depends on the nutrient supply; hence during periods in which Iberian pigs are feed restricted (before free-range conditions in order to increase feed intake during fattening) the mobilization of fatty acids may increase. A selective mobilization of fatty acids has been described in different species [4] and also in heavy pigs [5]. It is thus hypothesized that since the Iberian pig is feed-restricted during growing, the fat-enriched diet given to pigs before the fattening period affects the initial fatty acid profile and its evolution during fattening. The objective of the present research was to study how the dietary fat given to pigs before fattening affected changes in the main groups of fatty acids in subcutaneous fat during the fattening period.

## II. MATERIALS AND METHODS

The study was carried out at the facilities of the CIA Dehesón del Encinar (Toledo, Spain). Thirty barrow Iberian pigs (Iberian Torbiscal strain) were divided into three experimental groups according to the fat (30 g/kg) added to their diet (sunflower oil: L, high-oleic acid sunflower oil: O and hydrogenated fat: S). Diets were isocaloric and isoenergetic and were administered as the pigs grew from 50 kg (210 days) to 105 kg, just previous to the 201-day fattening phase. Feed was administered twice a day and the amount was restricted to 60-65 kg/kg pv<sup>0.75</sup>. From day 421, pigs were fattened in free-range conditions with acorns and grass for

93 days. Fat biopsy samples were taken at days 0, 22, 43 and 93 of the fattening period in free-range conditions. Lipids from fat biopsy samples were extracted by the method proposed by Bligh and Dyer [6], Fat extracts were methylated and analysed by gas chromatography as described by Carmona et al. [7]. Data were analysed using the GLM procedure available in SAS (v. 9.3). A polynomial repeated measures analysis was used to compare differences in the evolution of the main groups of fatty acids during the fattening period.

### III. RESULTS AND DISCUSSION

The evolution of the main groups of fatty acids (saturated: SFA, monounsaturated: MUFA and polyunsaturated: PUFA) during fattening in free-range conditions, in relation to the dietary fat given during the growing period, is presented in Figure 1 (A, B and C, respectively).

PUFA evolution was affected by diet and time, and a fat x time interaction was found (Fig 1C) ( $P=0.0001$ ). Hence, PUFA changed slightly in relation to time of fattening in pigs receiving S during growing, and this group had the lowest proportion of PUFA at the beginning of the fattening phase. However, the L group, which had the highest initial proportion of PUFA, showed a marked decrease, mainly at the beginning, of these fatty acids over time until a minimum level of 12% was reached at approximately day 40. The O group, which had a proportion of PUFA somewhere between the levels in the L and S groups ( $P<0.0001$ ) at the beginning of the fattening period also showed a decrease in PUFA content during free-range feeding until they reached minimum levels similar to the L group. There is a lack of information on the evolution of fatty acids in Iberian pigs depending on the enriched-fat diets they receive. However, these results suggest that there is a physiological limit, below which PUFA oxidation seems to be inhibited, to assure that PUFA levels do not drop below a certain level. However, when available, PUFA are used immediately to obtain energy, as reported before [5], and this results in the increase of other fatty acid groups.

MUFA evolution during fattening was also affected by dietary fat given during the growing phase (Fig 1B) ( $P=0.0001$ ). The highest proportion at the beginning of fattening was found in the S group, followed by the O and L groups. This higher proportion of MUFA at the beginning of fattening in the S group can be explained by the fact that MUFA not only can be directly deposited from feed but also synthesized by desaturation or elongation of the *novo* synthesized fatty acids and this is regulated by the activity of desaturase enzymes [8]. Moreover, these fatty acids increased markedly with time ( $P=0.0001$ ), especially in the O and L groups that had started with lower proportions at the beginning of fattening. The increase in MUFA was expected, as acorns (the main fruit available to the pigs in the forest) are very rich in MUFA [1]. However, it is very interesting to observe how the MUFA accumulation varied depending on the previous diet received during growing. The increase is faster in those pigs that received a PUFA-enriched diet before fattening. Since PUFA are preferentially utilized to obtain energy [5], they are rapidly catalysed and after six weeks of fattening on acorns and grass the proportion of MUFA reached similar proportions in all groups. This information is important for the Iberian pig production sector.

Finally, the SFA profile was also modified during fattening depending on the dietary fat received during the growing period ( $P=0.0001$ ), and the highest initial proportion was found in groups supplemented with S followed by L and O. These fatty acids also decreased with time (1A). However, the changes in relation to different dietary treatments were not as pronounced as in the other fatty acid groups, which is likely due to fatty acid dilution. Higher changes were reported for MUFA and PUFA than for SFA, which can be explained by a possible mechanism to maintain a relatively constant unsaturated to SFA ratio in the cellular membranes [9]. Since SFA levels only change slightly, it would be important to control their initial levels.

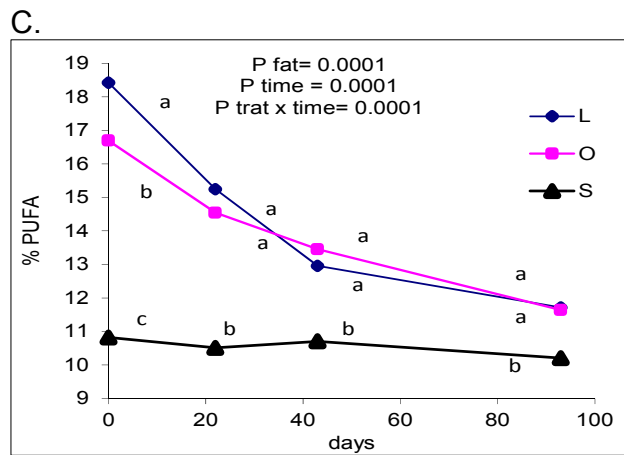
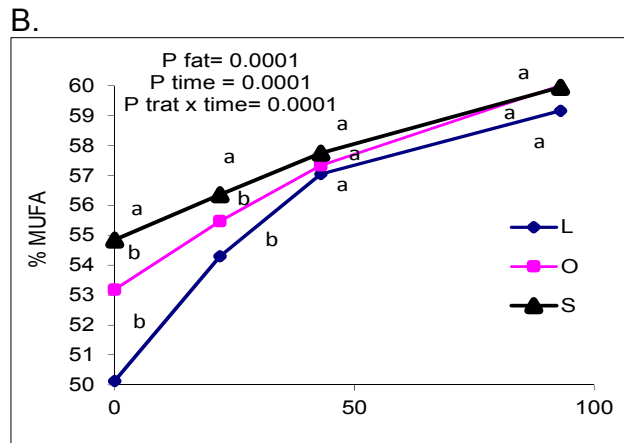
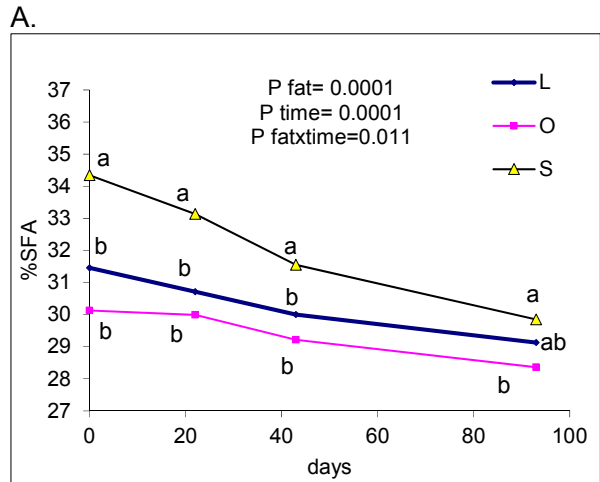


Figure 1. Evolution of the main fatty acid groups during the fattening phase (A. saturated, B. monounsaturated and C. polyunsaturated) depending on the dietary fat provided during the growing phase. Different letters indicated statistical differences ( $P < 0.05$ ) in dietary treatment.

#### IV. CONCLUSION

SAT, MUFA or PUFA-enriched diets given to pigs in the growing phase do not modify the evolution of MUFA and PUFA in subcutaneous fat after 6 weeks of fattening with acorns and grass. However, the SAT proportion of fat tissue during fattening depends on the SAT given to pigs during the growing phase.

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