

Profile study contribution of the odd chain fatty acids for qualifying of the final products of Alentejo local pig breed fattened on diets of *montanheira*

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Fat composition.
Fresh ham.

SUMMARY

Within our studies of the profile of fatty acids of emerging row of the Portuguese autochthonous Alentejo local pig breed, we decided to emphasize the importance of odd chain fatty acids in the qualification and distinction of their final products. Therefore, we used samples of dorsal subcutaneous fat of 36 carcasses of Alentejo local pig breed (18♂♂castrated and 18♀♀females) spread over two (2) lots with different food management in the fattening stage (Lote1, n = 24, regime feed *montanheira* and the final third with herb spontaneous pasture and corn grain and Lote2, n = 12, feeding of *montanheira* and the final third with herb spontaneous pasture and triticale grain). From the analysis of the results, on average, in sums of odd chain fatty acids (Lote1 = 0.66 ± 0.13 and Lote2 = 1.02 ± 0.33), we've found that the Lote2 showed a highly significant difference ($P \leq 0.001$) in relation to Lote1, which enabled us to distinguish the final products derived from the carcasses of pigs consumed grass and triticale in the final third of *montanheira* in maize. Thus, we conclude that by using the % of the sum of the profile of the odd-chain fatty acids it is possible to disentangle (fresh and / or processed end products) from the Alentejo local pig breed, according to the diet of grazing in the *montanheira* and, simultaneously, the substitution of corn in grain by triticale grains in animal husbandry will facilitate the mitigation of scarcity and food shortages caused by the degradation of the Mediterranean ecosystem.

Contributo para o estudo da cadeia de ácidos gordos ímpares com vista à classificação do produto final da raça suína local do Alentejo engordada em diferentes dietas de *montanheira*

RESUMO

Dentro dos nossos estudos do perfil dos ácidos gordos da fileira emergente da raça autóctone Portuguesa, porco alentejano, decidimos salientar a importância dos ácidos gordos ímpares na qualificação e destrição dos seus produtos finais. Assim sendo, utilizámos amostras de gordura subcutânea dorsal de 36 carcaças de porcos alentejanos (18♂♂castrados e 18♀♀fêmeas), distribuídos por 2 (dois) lotes com manejo alimentar distinto na fase de engorda (Lote1, n=24, regime alimentar de *montanheira* e no terço final com erva da pastagem espontânea e milho em grão e Lote2, n=12, regime alimentar de *montanheira* e no terço final com erva da pastagem espontânea e triticale em grão). Pela análise dos resultados obtidos, em média, nos somatórios dos ácidos gordos ímpares (Lote1 = $0,66 \pm 0,13$ e Lote2 = $1,02 \pm 0,33$, verificamos que o Lote2 manifestou uma diferença altamente significativa ($P \leq 0,001$), em relação ao Lote1, o que nos permitiu distinguir os produtos finais provenientes de carcaças de porcos que consumiram erva e triticale no terço final da *montanheira* em relação ao milho. Assim, concluímos que através da % do somatório do perfil dos ácidos gordos de cadeia ímpar é possível destriçar produtos finais (frescos e/ou transformados) do porco alentejano, conforme o regime alimentar de pastoreio em *montanheira* e, simultaneamente, a substituição do milho em grão pelo triticale em grão no manejo alimentar dos animais facilitará a mitigação da escassez e ou penúria alimentar provocado pelo fenómeno da degradação do ecossistema mediterrâneo de montado.

PALAVRAS CHAVE ADICIONAIS

Porco Alentejano.
Composição da gordura.
Presunto fresco.

INFORMATION

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INTRODUCTION

Before addressing the concrete subject of our work, it is worth emphasizing the importance of the conclusions of the Budapest Congress (1984), cited by Nunes (1985), in which the European Economic Community

(EEC) highlights, the reasons for the defense and conservation of their local breeds, since it is a cultural, scientific, zootechnical and economic right and duty and, of course, a social policy strategy to defend the establishment of rural populations in each Member State.

Of course, we cannot ignore the resolutions of activities and recommendations in the context of the International Year of Family Agriculture by the AIAF-FAO (2014), taking into account that the world has changed since 1999 (Ferreira 1999, p. 28). The importance of the biosystem Alentejano pig breed/*montado* is fundamental to the equilibrium of the Mediterranean agro-silvo-pastoral system (Oliveira 2008, Belo et al. 2009), which is an anthropogenic and multifunctional system and, according to Pinto-Correia et al. (2014), currently occupies more than one million hectares in the South of Portugal, a territory with a strategic importance that needs to be enhanced. Within the multifunctional aspects of cattle production, we emphasize the importance of the production of the Alentejo local pig breed farmed in an extensive pastoral feeding system.

As it is known, there are three strains of Alentejo local pig breeds, and currently there are two lines of these autochthonous, non-nipped and nipped breeds (Oliveira, 2012). They are the livestock species that use better the local food grazing in *montanhaeira* (fattening period when pigs eat acorns and gras) (Carvalho, 2006; Belo et al. 2009, Santos Silva & Tirapicos Nunes, 2013).

By the analysis of the profiles of the 12 standard fatty acids (C12: 0, C14: 0, C16: 0, C16: 1, C17: 0, C17: 1, C18: 0, C18: C20: 0 and C20: 1) selected by the Spanish quality standard for the certification of Iberian pigs final products (Carmen et al. 2013), we decided, in this work, to emphasize the importance of the sum of the odd chain fatty acid profile (heptadecanoic C17: 0 + C17: 1 heptadecenoic) for conducting and the accreditation in order to qualify and differentiation of end products alentejo local pig breed, taking into account the effect of the addition of triticale grain in the final third of the grazing diet regime of *montanhaeira*, seeking to mitigate the effect of the degradation of the *montado* in the food shortage during the fattening stage of the Alentejo local pig breed in pasture in the diet regime of *montanhaeira*.

It should be noted that the production area of triticale in Portugal is 30 198 ha, with a high and moderate capacity in the Alqueva irrigation perimeter, 33 000 ha of about 70 000 ha available (EDIA, 2015, p.24). In fact, there is a lack of in-depth studies on cereal triticale, since it is a raw material that will certainly contribute to improve the formulation of rations aiming a good food management in the final third of the fattening of the Alentejano pig breed in the regime of *montanhaeira* with competitive advantages in the feeding of the Alentejo

local pig breed (Oliveira 2000, Santos et al. 2008 and Oliveira 2016),

Thus, we alert the competent and interested entities, taking into account that in the last 25 years (1990-2015) when we carried out a bibliographical review of the main research carried out on the laboratory analyzes of food products most used in the herding stage experimental studies are still scarce and related to the Alentejo local pig breed line (Oliveira 1990, Nunes 1993, Freitas 1998, Neves 1998, Oliveira 2000).

Finally, we find that there is still a deficit of scientific production duly systematized in this area of the intercalibration and accreditation of laboratory parameters defining the quality of the meat products of these native breeds, which belong to the same Iberian trunk.

The aim of this paper is to present the importance of the profile of the fatty acid sums with particular incidence in the odd chain for the certification and qualification of the end products of Alentejo pork (fresh ham) fattened in different grazing food management regime under *montanhaeira* system.

MATERIALS AND METHODS

In order to elaborate this work, we used samples of dorsal subcutaneous fat collected in 36 carcasses of Alentejo local pig breeds (18♂♂ castrated males and 18♀♀ females), distributed in two (2) lots with different dietary management in the fattening phase (Lote1, n=24, feeding of diet food regime of *montanhaeira* and in the final third with grass of spontaneous grazing and corn in grain and Lote2, n=12, diet food regime of *montanhaeira* and in the final third with grass of spontaneous and triticale grass grazing). This was executed in the county of Ourique in the pig farms, properties of the Entrepreneur Snr. José Cândido Matos Félix Nobre, former President of the Alentejo Pig Breeders Association (ACPA). Considering the experimental design that we implemented (Lots 1 and 2), to determine the profile of the fatty acids, particularly those of the odd chain, we collected dorsal subcutaneous fat from the carcasses under study for laboratory analysis using Gas Chromatography (GC), technique described by Oliveira (2000), which we adopted (Commission Regulation (EEC) No 2568/91 of 11 July 1991). Statistical Analysis: data and results were analyzed using the program Microsoft Office Excel (2010), using ANOVA (one factor) and Turkey test, to statistically differences

Table I. Diet of food regime of *montanhaeira* composition and sums profile of fatty acids acorn not shelled and the herb of pastures spontaneous (Regime alimentar de *montanhaeira* e composição dos somatórios do perfil dos ácidos gordos da bolota sem casca e da erva da pastagem espontânea).

| Fatty acid composition (n=36) | NSA (n=24) | GSG (n=12) |
|-------------------------------|------------|------------|
| 1 – Σ Odd chain | 0.18±0.10 | 2.06±1.10 |
| 2 – Σ Saturated | 42.25±2.28 | 37.36±1.78 |
| 3 – Σ Unsaturated | 54.15±2.42 | 59.49±1.65 |
| 4 – Σ Monounsaturated | 50.61±1.61 | 51.24±1.43 |
| 5 – Σ Polyunsaturated | 3.54±1.41 | 8.25±0.88 |

N= number of animal samples studied; Σ = sum of fatty acids; NSA = Not shelled acorn; GSG = Grass of spontaneous grazing

RESULTS AND DISCUSSION

In the analysis of our results, which we present in **Tables I, II, III** and **IV**, we verified that the best diet to mitigate food scarcity and / or scarcity of the acorn and grass of the spontaneous pasture in the final third of the fattening of Alentejo local pig breeds, in diet of food regime of *montanheira* areas, is to use triticale in grain, as pointed out by Oliveira (2000) and Santos et al. (2008). Thus, in **Table I**, we present the results of the fatty acid profile of the pasture composition in diet of food regime of *montanheira* pasture with acorn and spontaneous grass, which revealed the phenomenon of unsaturation (acorn, 81.89% and herb 77.46%), reported by several authors (Nunes 1993, Freitas 1998, Neves 1998, Oliveira 2000, 2007 and 2016).

In **Table II**, we present the composition of the diet, which also shows the phenomenon of unsaturation, but with the addition of grain corn in the final third of the food regime of *montanheira*, which reduced the metabolic profile, particularly in the Σ = sum of the odd-chain fatty acids (0,10%).

In **Table III** we present the composition of the diet with the addition in the final third of food regime the triticale in grain, which manifests the positive effect on the metabolic profile of fatty acids, particularly on the Σ of the odd chain fatty acids (0.40%), mitigating the phenomenon of scarcity or food shortages caused by the degradation of the diet of food regime of *montanheira*, as demonstrated by Oliveira (2000) and Santos et al. (2008).

In the subcutaneous fat of the fresh ham (**Table IV**), the unsaturation in the metabolic profile is evi-

dent, showing significant differences ($P < .001$), in the metabolic profile of the monounsaturated fatty acids ($P < 0.05$), between the groups of animals under study and, particularly Σ of the unsaturated and polyunsaturated fatty acids, which show highly significant differences ($P < 0.001$), mainly in the Σ of the highly significant ($P < 0.001$) odd-numbered fatty acids (1.02%), which is registered in tests (Oliveira 1990, 2000, 2007 and 2016), allowing us now to consider it is another reference element for the qualification and perhaps differentiation of the final products (fresh or processed) from the raw material of the Alentejo local pig breeds.

In the last 25 years (1990-2015) we have taken into account our research which has deepened the studies of the results of the laboratory analyzes of the parameters of food products derived from the end products of the Alentejo local pig breeds and also the local food resources most used in the fattening stage in the diet of food regime of *montanheira* and carried out on the Alentejo pig breed (Oliveira 1990, Nunes 1993 and 2014, Freitas 1998, Neves 1998, Oliveira 2000, Carvalho 2006 and Oliveira 2016) do not explicitly state whether the laboratories participated in intercalibration and accreditation work, as did ASICI in 2000 (www.ibérico.com). Interestingly, in relation to the Iberian pig, there is only reference to the data and results of intercalibration and accreditation of laboratory parameters defining the quality of the final products of the Iberian pig, only in the year 2000, made by ASICI, according to information published on the website (www.ibérico.com), accessed 30/10/2016, referring to the percentages of fresh ham and acorn fat analyzed.

Table II. Diet of food regime of *montanheira* composition and profile sums of fatty acid fattening in final third with corn grain (Regime alimentar de *montanheira* e composição dos somatórios do perfil dos ácidos gordos com engorda no terço final com milho em grão).

| Fatty acid composition (n=36) | NSA | GSG | CGR |
|-------------------------------|------------|------------|------------|
| 1 – Σ Odd chain | 0.20±0.17 | 1.54±0.45 | 0.10±0.00 |
| 2 – Σ Saturated | 16.11±1.13 | 19.64±0.35 | 11.86±0.45 |
| 3 – Σ Unsaturated | 82.44±0.35 | 79.78±2.61 | 87.30±1.55 |
| 4 – Σ Monounsaturated | 64.63±1.14 | 43.98±2.15 | 28.20±1.45 |
| 5 – Σ Polyunsaturated | 17.81±1.39 | 35.80±5.88 | 59.10±1.50 |

N= number of animal samples studied; Σ = sum of fatty acids; NSA = Not shelled acorn; GSG = Grass of spontaneous grazing; CGR: Corn in grain.

Table III. Diet of food regime of *montanheira* composition and profile sums o fatty acid with fattening in final third with triticale grain (Regime alimentar de *montanheira* e composição dos somatórios do perfil dos ácidos gordos com engorda no terço final com triticale em grão).

| Fatty acid composition (n=36) | NSA | GSG | TGR |
|-------------------------------|------------|------------|------------|
| 1 – Σ Odd chain | 0.20±0.17 | 1.54±0.45 | 0.40±0.03 |
| 2 – Σ Saturated | 16.11±1.13 | 19.64±0.35 | 17.20±0.36 |
| 3 – Σ Unsaturated | 82.44±0.35 | 79.78±2.61 | 81.80±1.49 |
| 4 – Σ Monounsaturated | 64.63±1.14 | 43.98±2.15 | 17.30±0.35 |
| 5 – Σ Polyunsaturated | 17.81±1.39 | 35.80±5.88 | 64.50±1.69 |

N= number of animal samples studied; Σ = sum of fatty acids; NSA = Not shelled acorn; GSG = Grass of spontaneous grazing; TGR: Triticale in grain.

Table IV. Diet of food regime of *montanheira* and comparison of the composition of the fatty acid profile sums of the final products, fresh ham (Regime alimentar de montanheira e composição dos somatórios do perfil dos ácidos gordos dos produtos finais, presunto fresco).

| Fatty acid composition (n=36) | Lote1 (n=24) | Lote2 (n=12) | P |
|-------------------------------|--------------|--------------|-----|
| 1 – Σ Odd chain | 0.66±0.13 | 1.02±0.33 | *** |
| 2 – Σ Saturated | 42.25±2.28 | 37.36±1.78 | *** |
| 3 – Σ Unsaturated | 54.15±2.42 | 59.49±1.65 | *** |
| 4 – Σ Monounsaturated | 50.61±1.61 | 51.24±1.43 | * |
| 5 – Σ Polyunsaturated | 3.54±1.41 | 8.25±0.88 | *** |

N= number of animal samples studied; Σ = sum of fatty acids; Lote1 = Group 1 corn in grain; Lote2 = Group 2 Triticum in grain; * P ≤ 0.05; *** P ≤ 0.001.

When comparing the data of our trial with those of the intercalibration and laboratory accreditation of ASICI (2000), we verified that of the total amount of the odd-chain fatty acids in the bark acorn (ASICI 0.19% ≈ 0.18% Oliveira), and in the fat of the fresh ham (ASICI 0.17% # 1.00% Oliveira, 2000), there is no data to compare with those of the herb of the spontaneous pasture (2000), these values are very different, taking into account the profile of the odd-chain fatty acids (*Norma de Calidad* - Quality Standard, 2014, 2015 and 2016).

CONCLUSIONS

While acknowledging the absence of intercalibration and laboratory accreditation of parameters defining the quality of fat in indigenous breeds, particularly in the Alentejo local pig breeds, except for the work of the Interprofessional Association, ASICI-Spain, for the year 2000 to the Iberian pig, anyway, we conclude and recommend the following in defense of indigenous breed in the study, which is part of the Iberian trunk naturally.

By studying the percent of the sums of the profile of the odd chain fatty acids (0,10%, 0,40% and 1,02%) it is possible to have the perception of the greater or lesser amount of pasture grass ingested by the animal during the fattening phase in grazing diet in the supplemented or not, diet food regime of *montanheira*. However, our results are obtained without laboratory contrast completed (it's a proposal) and advocate that the profile of the sum of odd chain fatty acids (C17: 0 + C17: 1), can be considered as a further differentiating and complementary element distinction to end products (fresh ham) from Alentejo local pig breed herds fattened on grazing diet regime under *montanheira*, applying the sample analysis methodology and technique of subcutaneous fat by Gas Chromatography (GC) when there are doubts or suspicions about the quality of end products of the breed in the study, while the practical application is not possible, in Portugal, other methods and resourceful and innovative analysis techniques such as NIRS (De Pedro et al. 2007) and MEMS-NIRS (De Pedro et al. 2007 and Zamoras-Rojas 2013), developed by the Department Animal Production, ETSIAM School of the University of Cordoba and applied in the row of food industry of the Iberian pig.

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