

¹H NMR AND CHEMOMETRICS TO ANALYSE THE LIPID PROFILE OF MEAT FROM IBERIAN AND CELTIC PIGS

Trinidad Pérez-Palacios^{1*} Jose Luis Ramiro^{1,2}, Ana G. Neo², Carlos F. Marcos², Abraham Pajuelo¹ and Teresa Antequera¹

¹Institute of Meat and Meat Products, Universidad de Extremadura, Cáceres, Spain

²Laboratory of Bioorganic Chemistry & Membrane Biophysics, Universidad de Extremadura, Cáceres, Spain

*Corresponding author email: triny@unex.es

I. INTRODUCTION

Spain is the second largest producer of pork in Europe. As in other Mediterranean countries, traditional livestock farming is making a strong comeback in coexistence with an intensive production model. These traditional mode of production is sustained on the rearing of autochthonous breeds [1] well adapted to the environment, prioritizing animal welfare [1] and a feeding system based on natural resources [2]. This results in high-quality products. The Iberian pig is a highly recognized and consolidated autochthonous breed [1] of the southwest of the Iberian Peninsula, while the Celta pig, autochthonous to the northwest, is the subject of a major recovery plan [3]. A comparative study of the meat products of these two traditional pig breeds has never been carried out and would provide valuable information for both producers and consumers. Recently benchtop NMR spectroscopy has become an affordable methodology that provides qualitative and quantitative information in food samples [4]. The aim of the present work is to combine ¹H NMR spectroscopy and chemometry to analyze the lipidic profile of two pieces of Iberian and Celta pigs, as a way of quality control and classification.

II. MATERIALS AND METHODS

Iberian and Celta pork cheek (n=5) and loin (n=5) were analysed in triplicate, resulting in a total of 60 individual samples. Firstly, total lipids were extracted following the method of Folch [5] modified by Pérez-Palacios [6]. Next, ¹H NMR spectra of lipid extract (25 mg) were recorded in a Magritek Spinsolve 80MHz Carbon Ultra spectrometer. The spectra were binned into 0.04 ppm segments and subjected to Partial Least Squares Discriminant Analysis (PLS-DA) using the Caret package [7] in R v.4.2.3 [8].

III. RESULTS AND DISCUSSION

Peaks were assigned according to previous reports [9] and tagged with an alphanumeric nomenclature (Figure 1). The peaks corresponding to saturated, monounsaturated and polyunsaturated fatty acids (SFA, MUFA and PUFA, respectively) from both triglycerides and phospholipids were identified in the ¹H NMR spectra.

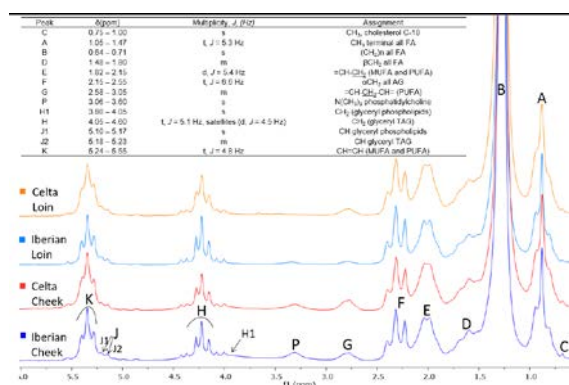


Figure 1. ¹H NMR spectra and peak assignments of the lipidic fraction of Iberian and Celta meat pieces.

A PLS-DA chemometric approach was used for the classification of meat pieces from Iberian and Celta pigs. The resulting two dimensional plots (Figure 2) corresponding to cheeks and loins show a clear clustering of the samples according their breed origin.

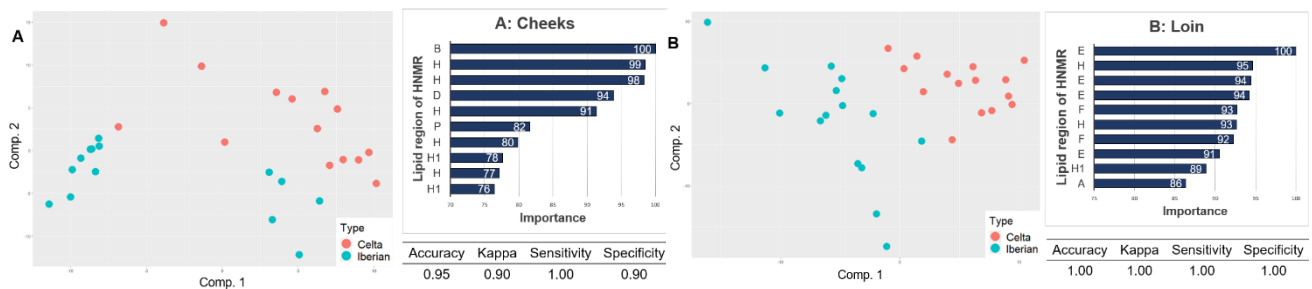


Figure 2. PLS-DA model and metrics prediction of the meat pieces (A: Cheeks and B: Loin).

Most important variables for discrimination of breeds (Figure 2) have been identified, corresponding to ¹H NMR regions related to the phospholipids/triacylglycerides ratio in cheek pieces and to the presence of unsaturated bonds (MUFA and PUFA) in loin.

IV. CONCLUSION

The lipid extract of commercially valuable pork pieces from traditional breeds has been analyzed for the first time using benchtop ¹H NMR spectroscopy, identifying the principal peaks of the lipidomic profile. A chemometric study of the spectra has found differences between pieces corresponding to each of the breeds, allowing their correct classification.

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