Available online at www.sciencedirect.com
SCIENCE DIRECT®
Meat Science 71 (2005) 490–497
MEAT SCIENCE
www.elsevier.com/locate/meatsci

Meat mixture detection in Iberian pork sausages

V. Ortiz-Somovilla [a,*], F. España-España [a], E.J. De Pedro-Sanz [b], A.J. Gaitán-Jurado [a]

[a] IFAPA, CIFA Alameda del Obispo, Avda. Menéndez Pidal, s/n, PO Box 3092, 14080 Córdoba, Spain
[b] Departmento de Producción Animal, E.T.S.I.A.M., Universidad de Córdoba, Avda. Menéndez Pidal s/n, 14004 Córdoba, Spain

Received 17 March 2004; received in revised form 4 April 2005; accepted 18 April 2005

Abstract

Five homogenized meat mixture treatments of Iberian (I) and/or Standard (S) pork were set up. Each treatment was analyzed by NIRS as a fresh product ($N = 75$) and as dry-cured sausage ($N = 75$). Spectra acquisition was carried out using DA 7000 equipment (Perten Instruments), obtaining a total of 750 spectra. Several absorption peaks and bands were selected as the most representative for homogenized dry-cured and fresh sausages. Discriminant analysis and mixture prediction equations were carried out based on the spectral data gathered. The best results using discriminant models were for fresh products, with 98.3% (calibration) and 60% (validation) correct classification. For dry-cured sausages 91.7% (calibration) and 80% (validation) of the samples were correctly classified. Models developed using mixture prediction equations showed SECV = 4.7, $r^2 = 0.98$ (calibration) and 73.3% of validation set were correctly classified for the fresh product. These values for dry-cured sausages were SECV = 5.9, $r^2 = 0.99$ (calibration) and 93.3% correctly classified for validation.

Keywords: NIRS; Qualitative analyses; Iberian pork; Meat mixture; Sausages

1. Introduction

In Spain, sausage made from Iberian pork is considered a very high quality food product, mostly due to the intrinsic characteristics of the raw material used. Final quality standards will depend on: the suitability of the sausage formula; the technological conditions of the manufacturing process; the chemical/physical modifications of the mixtures; and the characteristics and quality of the raw material utilised. This raw material comes directly from Iberian pigs as well as from F_1 hybrids from crosses between specimens of this breed with Duroc pigs. These animals are slaughtered at a late age, with high weights and after having exercised their musculature for some time on the rangeland where they are raised. Some months before slaughtering, these pigs feed either freely on the fallen acorns and natural grass of the oak forests of the West and South West of Spain (''montanera'' pigs) or on a combination of acorns and commercial feed formulas (''recebo'' pigs) or solely on the latter (Cava et al., 1997). Before slaughter the animals are tracked via a recording and identification system. After slaughter, the traceability of the manufactured products is of great importance, and is based mainly on chemical, physical, microbiological and technological characterisation.

Recently, a need has arisen for a technique that is able to carry out quick determinations to trace the end product by identifying the presence and amount of different lower-priced meats in allegedly Iberian pork dry-cured sausages. This could eventually become an authentication technique, which could be very helpful for the economic development of the pork industry, based mainly on the promotion of 100% Iberian pork

* Corresponding author. Tel.: +34 957 016 001; fax: +34 957 016 043.
E-mail address: victor.ortiz@juntadeandalucia.es (V. Ortiz-Somovilla).

0309-1740/$ - see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.meatsci.2005.04.028

products. At the same time, this technique will enable sausage producers to display different sets of certified products, containing different quantities of both Iberian and Standard pork meat, which could be aimed at consumers with different standards of living. Manufacturers who submit their products to an authentication technique will undoubtedly have a clear advantage over those who do not wish to undergo this procedure.

In recent years, a series of methods have been developed in order to determine the composition of meat mixtures: electrophoresis, immunochemical systems, nuclear magnetic resonance, gas and liquid chromatography, mass spectrometry, DNA fingerprinting and near infrared reflectance spectroscopy (NIRS). During the 90 s, this technique was utilised to measure different parameters on manufactured meat products (Thyholt, Indahl, Hildrum, & Ellekjaer, 1997).

Perten developed a system (Perten DA 7000), which allows NIRS/NIT determinations on a wide array of products: from liquid samples to non-ground raw materials, using a non-contact technique and without the need for specific sample preparation. Samples are merely presented on a Petri dish or in a plastic bag. This hardware has been successfully used to discriminate different chicken meats of standard and slow growth chickens (Fumière, Sinnaeve, & Dardenne, 2000) and different types of fresh forages (Dardenne & Féménias, 1999).

The main goal of this study was to develop and validate multivariate models based on NIRS technology able to differentiate Iberian pork meat from standard pork meat and to detect any mixture levels of them in homogeneous fresh sausage meat used to manufacture dry-cured sausages, and in homogeneous dry-cured sausages.

2. Material and methods

2.1. Meat

The meat used in this study consisted of lean Standard pork (S) meat and Iberian pork (I). Standard pork meat was obtained from known herds of Landrace pigs, slaughtered at a similar age and weight (approximately 6 months and 95 kg). The Iberian pork meat was obtained from a set of individuals registered in the Iberian breed genealogical catalogue and which came from the same farm. When these animals were slaughtered, they were older and heavier than the standard pigs used (approximately 13 months and 145 kg).

2.2. Additives

The additives used in this study (salt, pepper, red pepper, dextrose, nitrite, wine and ascorbic acid) were those routinely employed in the Spanish dry-cured sausage industry. These additives improve the maturation process and are characterised by having very specific organoleptic effects (smell, taste, etc.). They were added to the meat mixture in accordance with the Martin Bejarano formula (Martín, 1992).

2.3. Experimental design

Five treatment groups were set up, consisting of different percentages of Iberian pork meat and/or Standard pork meat. Samples with only Iberian and Standard pork meat were labelled treatments A and E, respectively. The mixed treatments were B, C and D, with 75%, 50% and 25% of Iberian pork meat and 25%, 50% and 75% of Standard pork meat, respectively.

2.4. Processing the meat mixtures

Meat of both origins was thawed at room temperature. Ground meat was then mixed according with the treatment designs. Later, meat mixture was kneaded manually for 15 min and then mechanically for 20 min. At this time, additives were added, and then the meat mixture was left to rest for 24 h. All the equipment was carefully cleaned and dried after the handling of each treatment. The whole meat mixture of each treatment was split into two parts: one (300 g) to be analyzed as a fresh product and the second which was stuffed into artificial tubes to produce traditional sausages (300–350 g). All of them were left to age for 21 days, then analyzed by NIRS. This process was repeated five different times (periods) over a 6-month cycle.

2.5. Analyses

All NIRS measurements were performed on all treatments of the fresh product as well as on the dry-cured sausages, for the complete five periods of production.

2.5.1. NIRS measurements

2.5.1.1. NIRS instrument. Spectra acquisition was carried out with a DA 7000 (Perten Instruments, Huddinge, Sweden), which produces simultaneous measurements from 400 to 1700 nm (NIR/VIS). The design of this equipment produces spectra from two different spectrometer sample positions (upper and lower view). The lower one was used in this study by placing samples in a circular capsule of 127 mm diameter. This allows spectra measurements to be taken at different points of the sample as the capsule rotates for a 6-s analysis, during which, 1800 separate observations with different orientations are made. Capsule spinning provides a means of improving sample homogenisation and reducing the effect of sample surface variability.