

Utilization of NIR to predict the fat percentage on commercial sliced “salchichón”

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Introduction

The fat content is an important parameter to determine the meat products quality. NIR spectroscopy has been widely used in the meat industry for proximate analysis¹. A special interactance fiber-optic probe has been designed to spear carcasses and determine their fat content. G. Tøgersen and T. Isaksson² determined fat, water and protein contents on-line in industrial scale meat batches by near infrared (NIR) reflectance spectroscopy.

In this work, near infrared spectroscopy has been used to predict the fat percentage of vacuum packed and unpacked sliced “salchichón” (a typical Spanish sausage). The sausages elaboration was made in a meat industry from Fuenteovejuna in Córdoba (“Embutidos Camilo Ríos S.L.”). In this industry, two different types of sausages were made: “salchichones” elaborated using only Iberian breed swine lean and “salchichones” elaborated using only white breed swine lean.

Methods

Sampling scheme per swine breed

All the sausages were elaborated and ripened by the industry workers utilising the traditional process. This is shown in Figure 1.

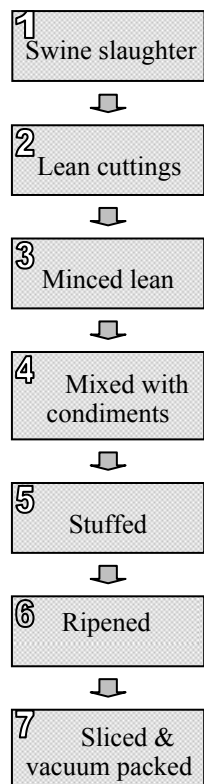


Figure 1. The sausages elaboration process in the meat industry

Three repetitions of the total process were made for each type of “salchichón” (Iberian type and White swine type). In each repetition three elaborations were made: the first elaboration was made following the traditional recipe used by the industry; the second and the third one were elaborated like the first one but adding a 2,5% (1 kg) and a 10% (4 kg) respectively of swine fat.

The ripened “salchichones” were sliced and vacuum packed. Fifteen packs were prepared for each elaboration. This is shown diagrammatically in Figure 2.

Calibration scheme

The near infrared spectra were obtained in a Perten DA 7000 spectrometer from vacuum packs using the spectrometer UP position mode and without the packs in the DOWN position mode. The pictures of the different positions and the samples are given in Figure 3.

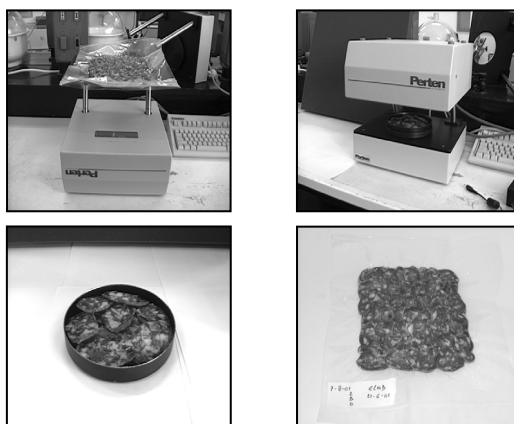


Figure 3. Different position modes and sample presentations

Five spectra were obtained per sample and before averaging them, we eliminated each sample outlier spectra with RMS tool (WINISI software).

After averaging the spectra, the select tool (WINISI software) was applied to select 98 samples. The fat content was analysed by reference method in “Laboratorio Agroalimentario de Córdoba”. The data set was studied with a Matlab script programmed with PLS-Toolbox 1.3 program³ and the Fastmcd,⁴ Rapca,⁵ and Savitsky-Golay algorithms. The spectra pretreatment was carried out with Multiplicative Scatter Correction and Savitsky-Golay (15,4,0) smoothing without derivation. Before PLS regression, calibration set and test set were centered and so laboratorial data.

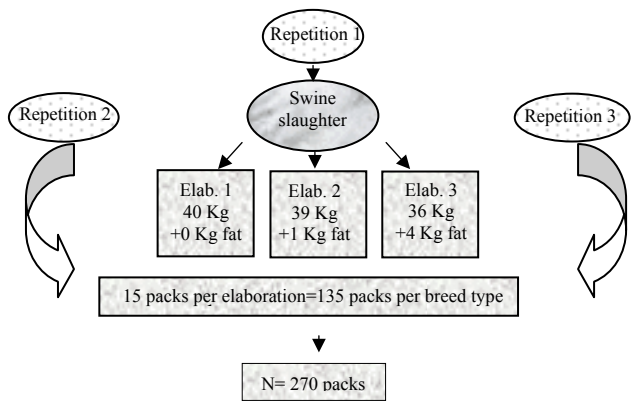


Figure 2. Sampling diagram. Three repetitions of the process were made per swine breed.

The calibration steps are shown in Figure 4.

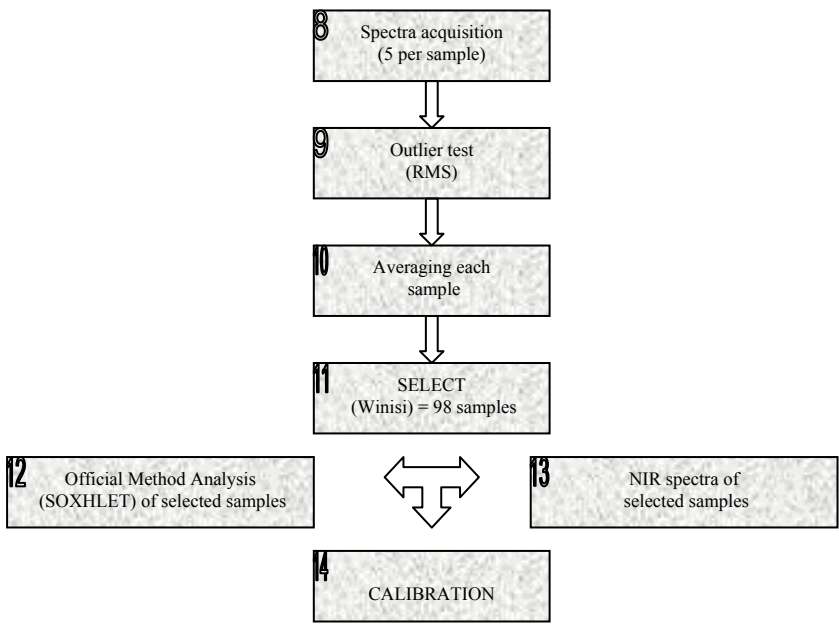


Figure 4. Steps for the calibration process

Results

The obtained results are given in Table 1 and Figure 5.

Table 1. The results for the UP and DOWN position mode

P	N	Select	AX	AY	AT	P1	M1	Sd1	nPLS	RMSECV	R ²	P2	M2	Sd2	RMSEP	R ²
Up	268	97 *	9	3	1	49	37,8	4,5	3	1,61	0,93	35	35,5	5,9	2,1	0,94
Down	270	98	5	4	0	52	38	4,9	3	1,68	0,94	37	35,8	6	1,96	0,94

P=position sample; N=spectra number; Select=Winisi algorithm for selecting samples; AX= spectra outliers; AY= laboratorial outliers; AT= T outliers; P1= calibration set; M1=% fat mean in P1; Sd1= standard deviation in P1; nPLS = latent pls components; RMSECV= root mean squared error of cross validation; P2

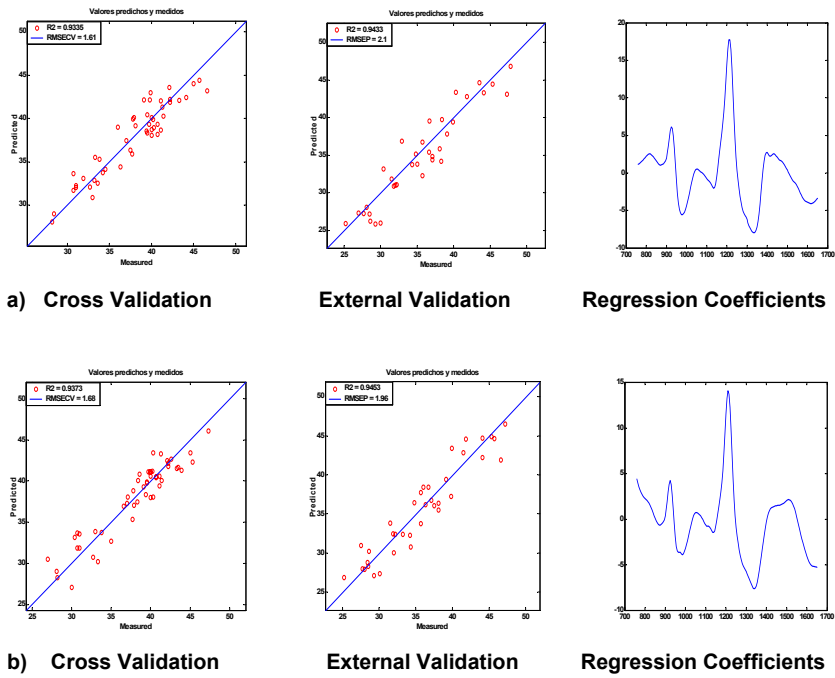


Figure 5. Graphics for the different positions. a) Packed product (UP position). b) Unpacked product (DOWN position)

Discussion

The results show that Near Infrared Spectroscopy predicts with the same equation for both swine breeds the fat content of packed and unpacked samples of "salchichón". This conclusion has important applications for the meat industry in "on line" quality control or nutritional labelling of vacuum packed sausages.

Acknowledgement

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