NIRS TECHNOLOGY FOR PORK MEAT CLASSIFICATION. EFFECT OF SPACE ENRICHMENT

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I. INTRODUCTION

Near-infrared spectroscopy (NIRS) is a rapid, non-destructive, and efficient analytical technique widely used in the meat industry to enhance product traceability and authenticity. While its application in differentiating pig breeds is well established, there is limited research on its use in production systems with environmental enrichment, which can influence animal welfare and meat quality.

OBJECTIVE

To evaluate the feasibility of the MicroNIR 1700 handheld spectrometer for discriminating intact pork loin samples based on available space and the introduction of toys and other environmental enrichment items.

III. RESULTS AND DISCUSSION

The best classification performance was obtained using the SNV 2,4,4,1 pretreatment, achieving 91.25% accuracy in calibration (80% of samples). The best results were obtained for E1 group (Table 1).

Table 1. Classification model for the samples

	Members	Correct	C1	E1	C2	E2
C1	20	80%	16	2	1	1
E1	20	100%	0	20	0	0
C2	20	95%	0	0	19	1
E2	20	90%	0	0	2	18
No class	0		0	0	0	0
Total	80	91,25%	16	22	22	20

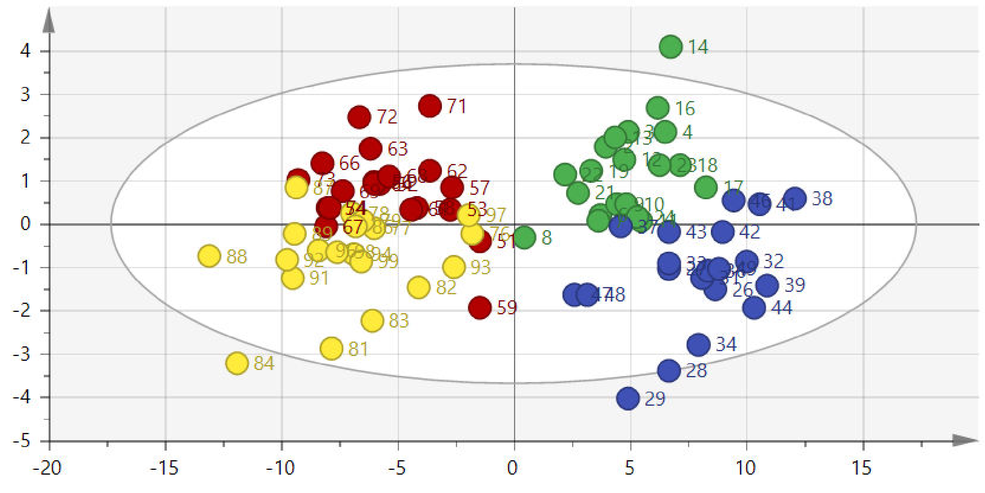


Figure 1. OPLS-DA score plot for the four groups analyzed C1 (green), E1 (blue), C2 (red) and E2 (yellow)

Group G1 (100% Iberian, fed outdoors) is located on the right side of the graph. The control group (C1) in the upper area and the experimental group (E1) in the lower area, displaying a clear separation between them. Group G2 (50% Iberian, intensive) appears on the left side of the graph, with less differentiation between control and experimental groups. In both cases, the experimental groups (E1 and E2) tend to cluster in the lower part of the graph, suggesting they share structural or compositional traits.

Table 2. Validation model for a set of 20 samples

	Members	Correct	C1	E1	C2	E2
C1	5	60%	3	2	0	0
E1	5	60%	1	3	1	0
C2	5	40%	0	0	2	3
E2	5	80%	0	0	1	4
No class	0		0	0	0	0
Total	20	60%	4	5	4	7

The model achieved 60% overall accuracy when validated with a set of 20 different samples. The control group of 50% Iberian genetics showed the lowest classification rate (40%), indicating they were harder to distinguish, while other groups showing better model performance.

II. MATERIALS AND METHODS

100% Iberian fed with feed outdoors

25 pigs C1

E1 25 pigs

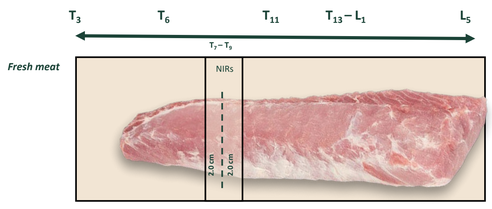
Chewing toys, cotton ropes, chains, pond

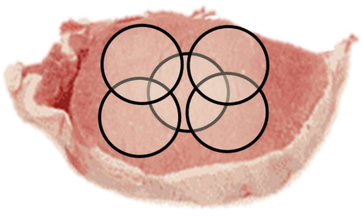
25 pigs C2

50% Iberian fed with feed indoors

E2 25 pigs

Chewing toys, cotton ropes, balls





- MicroNIR 1700, in reflectance mode with measurement in the spectral range of 908-1676 nm (measures each 6.195 nm).
- The spectrum was recorded by direct application of the probe in five points of the slice taken from the *Longissimus dorsi* muscle (T7-T9).
- Data treatment was performed using the OPLS-DA discriminant method (SIMCA software) applied to both raw spectra and those treated with scatter treatments (SNV, Detrend) combined with the first and second derivatives and smoothing.

IV. CONCLUSIONS

NIRS combined with OPLS-DA successfully classified pork samples by space enrichment system, with better discrimination in outdoor-reared animals. The method offers a rapid, non-destructive tool for evaluating production practices and supports the use of enrichment to enhance animal welfare.

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