ABSTRACTS BOOK

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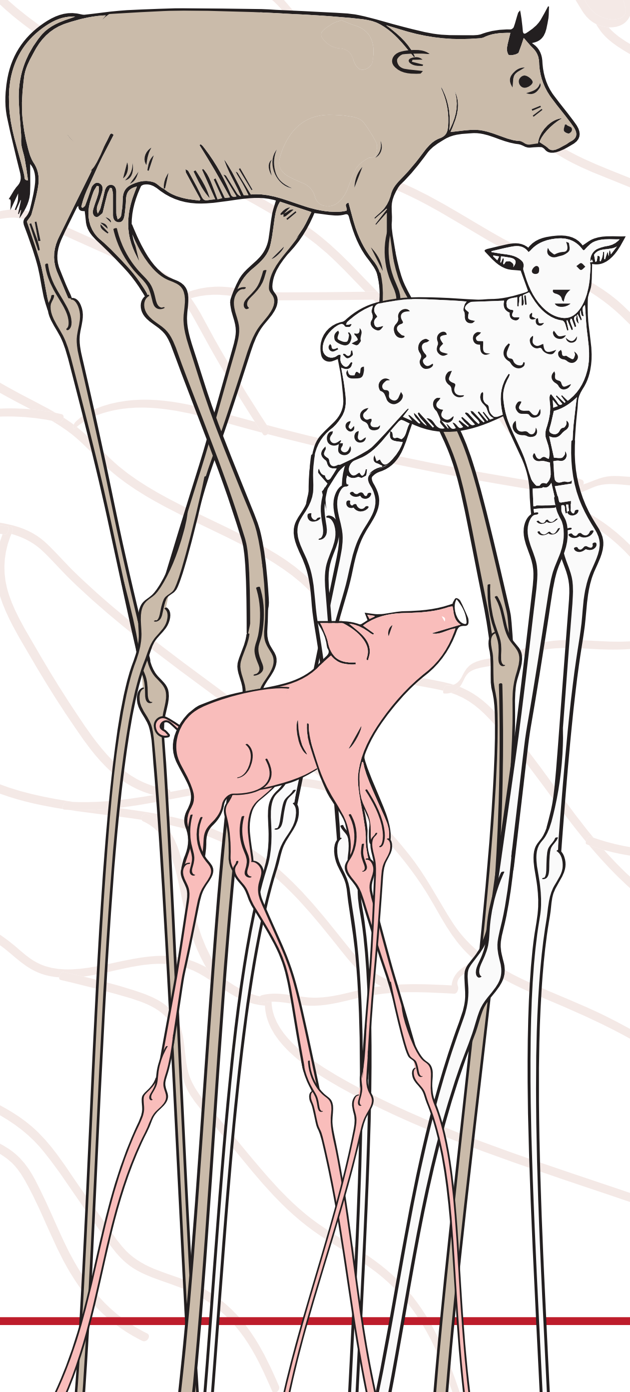

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NIRS TECHNOLOGY FOR PORK MEAT CLASSIFICATION. EFFECT OF SPACE ENRICHMENT

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I. INTRODUCTION

Near Infrared Spectroscopy (NIRS) has established as an efficient analytical tool in the meat industry due to its speed, ease of use and non-destructive nature. Its application makes it possible to optimize the production chain and reinforce the authenticity and traceability of meat and meat products. In addition, advances in portable devices have opened up the possibility of its on-line implementation, although its accuracy can be influenced by the spectral range and measurement conditions. Although NIRS has been widely used to differentiate Iberian pork from Duroc crosses [1], studies on its application in systems with environmental enrichment are still limited. These systems, which incorporate elements to stimulate movement and muscle infiltration, have been shown to influence pig welfare and reduce aggressive behaviors, capable of indirectly influencing meat quality [2,3]. The present study evaluates the feasibility of the MicroNIR 1700 portable spectrometer to discriminate intact pork loin samples depending on the available space and the introduction of toys and other environmental enrichment elements.

II. MATERIALS AND METHODS

A total of 100 pork loin samples were used, coming from two groups according to the production system: 50 samples of 100% Iberian pigs fattened with feed outdoors (G1) and 50 samples of 50% Iberian × Duroc pigs in intensive system (G2) and in each group all were raised with the same feeding regime. The first group was subdivided into two pens: a conventional pen with a compacted earth floor (C1, n=25) and an experimental pen with the same structural characteristics, but equipped with metal chains, cotton ropes, chew toys and a pond (E1, n=25). The second group was distributed in a conventional pen with access to outdoor park (C2, n=25) and an identical experimental pen, but including balls, chew toys and cotton ropes (E2, n=25). The animals were kept in these conditions until they reached commercial slaughter weight, at which time they were transported to the slaughterhouse. After slaughter, the left loin of each animal was removed and transferred to the laboratory for analysis. At 48 hours post mortem, spectroscopic analysis was performed on 2 cm thick loin fillets taken between vertebrae T7-T9, and spectral recording was done by direct application of the probe at five different points of each slice, using a MicroNIR 1700 (Viavi solutions, USA) in reflectance mode with measurement in the spectral range of 908-1676 nm. 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. To study the classification capability, the data were divided into a calibration and a validation set containing 80% and 20% of the samples in each category. The goodness of fit of the model was determined as a function of the % of classification success in both calibration and validation according to the factors analyzed.

III. RESULTS AND DISCUSSION

The results showed that, of the different spectral pretreatments tested, the one that best discriminated the four groups studied was the SNV treatment. From there, the most correct mathematical pretreatment was determined to improve the quality of the classification. The model that showed the best results was SNV 2,4,4,1 (the first digit being the no. of the derivative, the second the gap over which the derivative is calculated, the third the number of data points in the smoothing, and the fourth digit the second smoothing) with 91.25% of the samples correctly classified for the calibration group. Figure 1 shows that group G1 (100% Iberian, fed outdoors) appears on the right side of the graph, i.e., with positive values on the abscissa axis. For this group, the differences between the control group on the upper right (C1) and the experimental group on the lower right (E1) are clearly observed. On the other hand, for group G2 (50% Iberian, intensive) represented on the abscissa axis with negative values, the differences observed between the control and the experimental group are not as evident as in group G1, with most of the samples in the middle part of the graph and with a lower dispersion on the ordinate axis. However, there is a tendency for the samples from the space-enriched experiments (E1 and E2) to be at the bottom of the graph. This results points to the chemical composition and physical structure being similar for these two groups of samples and different from the controls.

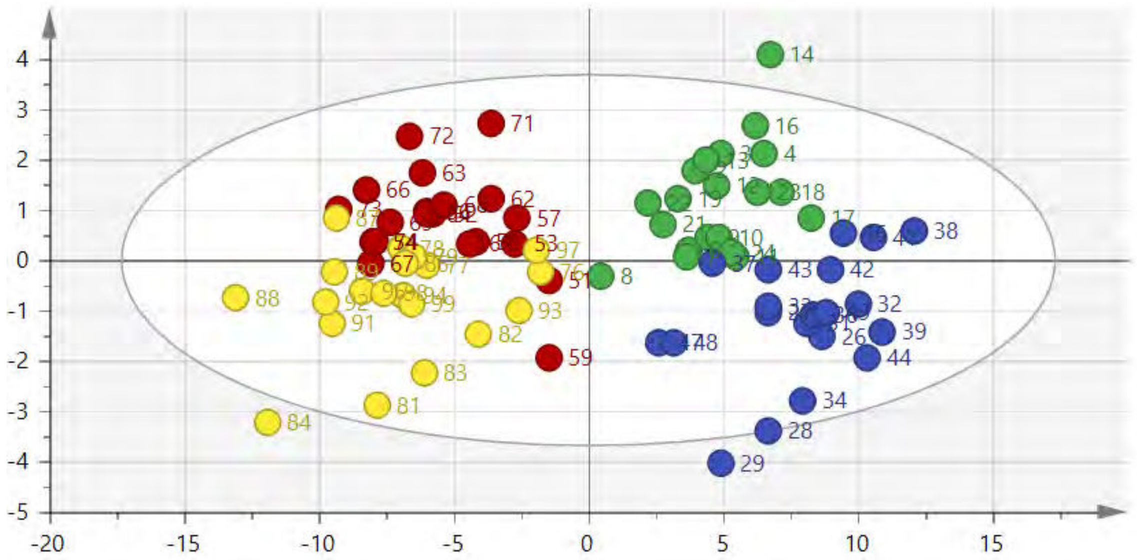

Figure 1. OPLS-DA score plot for the four groups analyzed C1 (green), E1 (blue), C2 (red) and E2 (yellow)

The model was validated using a set of 20 samples, obtaining an overall correct percentage of 60%. It was observed that the group of pigs with 50% Iberian genetics within the control group presented the lowest correct classification rate (40%), indicating greater difficulty in its discrimination. In contrast, the other groups reached accuracy values above 80%, which shows a better capacity of the model to differentiate these cases.

IV. CONCLUSION

The Near Infrared Spectroscopy in combination with the OPLS-DA classification method showed a high ability to discriminate the four groups of samples according to the different space enrichment systems. The results indicated that animals reared in outdoor spaces, such as the field fattening system, presented better discrimination compared to those in intensive systems with access to outdoor pens, where the differences were less marked and only a tendency was observed. From an applied point of view, the implementation of NIRS in the evaluation of these production systems could be integrated at key points in the fresh meat supply chain—such as processing plant, packaging lines, storage and retail or receiving points, providing a rapid and non-destructive tool for grading meat according to animal management. In addition, the data support the adoption of space enrichment practices as a strategy to improve animal welfare and meet consumer demand for products from systems with greater freedom and welfare.

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REFERENCES

1. Horcada, A., Valera, M., Juárez, M., & Fernández-Cabanás, V.M., 2020. Authentication of Iberian pork official quality categories using a portable near infrared spectroscopy (NIRS) instrument. Food Chemistry 318, 126–133. https://doi.org/10.1016/j.foodchem.2020.126471
2. Lebret, B., & Čandek-Potokar, M. (2022). Pork quality attributes from farm to fork. Part I. Carcass and fresh meat. *Animal*, *16*, 100402. https://doi.org/10.1016/j.animal.2021.100402
3. Ludwiczak, A., Kasprowicz-Potocka, M., Zaworska-Zakrzewska, A., Składanowska-Baryza, J., Rodriguez-Estevez, V., Sanz-Fernandez, S., Diaz-Gaona, C., Ferrari, P.; Juul-Pedersen, L., Couto, M.Y.R.; Revilla, I., & Sell-Kubiak, E. (2023). Husbandry practices associated with extensification in European pig production and their effects on pork quality. *Meat Science*, 206, 109339. https://doi.org/10.1016/j.meatsci.2023.109339