Artificial intelligence in the context of sensory quality assurance of PDO products as iberian ham

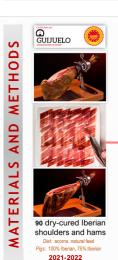Martínez B[1], Rubio B[1], Curto B[2], Vieira C[1], García-Esteban J[2], Rodríguez M[3], Moreno V[2]

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CONTEXT

Industry 4.0 applications to the food industry has as one of its pillars the application of Artificial Intelligence in those aspects of food manufacturing that are related to consumers' perception of the products, thus obtaining valuable information to be able to act accordingly. Here, the sensory characteristics of food play a transcendental role for consumer acceptance, particularly for PDO products. To date, the only possible way to verify the sensory quality of the products guarantee by a quality label is to perform a evaluation with a trained sensory panel. To solve this problem, Artificial Intelligence into the field of Food Sensing is enable to reproduce the human perception, even improve the results of a trained sensory panel in terms of objectivity and regularity.

The aim of this work is to use networks to estimate the true numerical values of sensory attributes in samples of iberian ham.

MATERIALS AND METHODS

90 dry-cured Iberian shoulders and hams
Diet: acorns. natural feed
Pigs: 100% Iberian, 75% Iberian
2021-2022

Physicochemical analysis

- pH, water activity
- Moisture, fat, protein
- Fatty acids profile
- NaCl

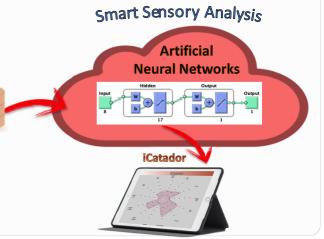### Sensory analysis

Selected hams and shoulders were assessed by a trained panel of 9 members, using a quantitative-descriptive analysis with 13 different attributes selected to evaluate the characteristics included in the Guijuelo PDO specifications.
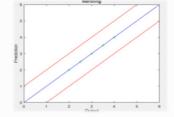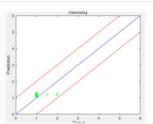
- Lean and Fat colour
- Lean and Fat brightness
- Fat greasines
- Infiltrated fat (marbling)
- Characteristic odour
- Crumbliness and Fibrousness
- Sweet and Salty taste
- Characteristic flavour
- Rancidity

Smart Sensory Analysis

Artificial Neural Networks

iCatador

RESULTS AND DISCUSSION

As one of the most known Artificial Intelligence utilities, Artificial Neural Networks (ANN) allow finding functional relationships, such as a fit to induce values of certain properties from simple measurable variables. They are particularly useful in cases where this dependence contains processes with evident behavioral non-linearities. The relationship of sensory attributes with physicochemical properties is a clear example as it is evident that the relationship is far beyond a simple causal relationship.
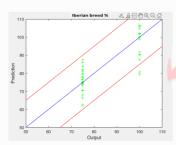
The use of fatty acids profile improves the ANN performance. When the marbling is considered, the precision changes from MSE=0.382 to 0. Rancidity maintains a good behavior.

TEST I

An ANN is proposed that takes as input, for each sample, the physicochemical test including fatty acid profiles and output to predict each of the 13 sensory parameters (13 ANNs in total). The tasting values made by each of the panel members (730 tastes) are used. Matlab 2022b with the Neural Networks toolbox is used. ANN architecture with 52 inputs in the input layer (7 parameters of physicochemical nature plus 35 fatty acids profile), 74 in the hidden layer and one neuron in the output layer, i.e. sensory attribute, is considered. A Bayesian relaxation algorithm is considered as a learning strategy. Two (2) sensory attributes behavior is shown.

TEST II

In this case it is considered that the ANN takes as input the physicochemical tests for the prediction of the breed profile 75 % or 100 %. Input in this case is also the instrumental measurement and as output the breed profile. In this case, the best performance is obtained with 85+ neurons in the hidden layer and one neuron in the output layer.

DISCUSSION

Concerning sensory attributes and their dependence on physicochemical properties, prior work had already been done with a reduced set of properties, with good results. In this proposal it has been demonstrated that the addition of fatty acid profiles is a positive and viable option, which enables to improve the capabilities and quality of the predictions.

Moreover, there is a consensus that among the elements that define the quality of the product, the percentage of Iberian profile is a crucial element. Again, AI provides a tool that predicts the racial aspect of the product, which is already controlled by the quality systems. It can prove, for the consumer, that the sensory attributes or physicochemical information can serve to characterize the quality of the different racial profiles.

CONCLUSION

The machine-learning methods can provide a reliable methodology for sensory quality control in a product such as Iberian ham