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Assessing the impact of extensive husbandry conditions on broiler meat quality using machine learning

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The effects of extensive farming on the quality of broiler meat are not straightforward because measuring the quality of meat and the extensiveness husbandry conditions is complex.

We aimed to assess the impact of extensive husbandry conditions on broiler meat quality using machine learning. The data was collected from seven farms across three European countries. Husbandry conditions included space allowance, diet, genetics, and quality of space. These conditions were binarized to extensiveness versus conventional husbandry.

The broilers (N = 885) were analyzed in terms of their sensory properties (N =175) and their chemical properties (N = 710) forming two datasets. We predicted the extensiveness of each husbandry condition using the meat quality attributes with multiple machine learning models (XGBoost, AdaBoost, Support Vector Machine, RandomForrest, Logistic Regression, Decision Tree). We trained separate models for chemical attributes and sensory attributes.

The performance of each model was evaluated using the area under the receiving operator characteristics curve (AUC-ROC) on the test set. Important meat quality attributes were identified using SHapley Additive exPlanations (SHAP).

Our preliminary analysis of the sensory attribute data showed that the best predicted condition was diet extensiveness (XGBoost AUC-ROC = 0.71). The flavor and crispiness of the skin and the juiciness of the breast were the most important meat quality attributes.

The most important variables for predicting the space allowance (logistic regression AUC-ROC = 0.68) were juiciness breast, fried chicken flavor, and sweetness of the breast.

Genetics was the best predicted condition for the chemical attribute data (XGBoost AUC-ROC = 0.82). Lightness of color and sheer energy were the most important characteristic for predicting genetics.

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