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Predicting Aged Pork Quality Using a Portable Raman Device

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Objectives

A need exists for a better on-line evaluation method for pork quality. Raman spectroscopy evaluates structure and composition of food samples, with advantage of being portable, non-invasive and insensitive to water. The objectives of this study were to evaluate the correlation between Raman spectral (RS) data measured from fresh and aged pork with sensory characteristics and slice shear force (SSF), to develop classification models for prediction of fresh pork sensory.

Materials and Methods

Eight hundred pork loins, from 4 plants, were removed from the carcass at 24 h postmortem and selected based on color and marbling. Six hundred loins from 3 plants were subjected to onsite RS measurements in which the ventral side of each loin was scanned with RS for 6 s. All loins were then transported to USMARC and held for 14 d at 0°C. The aged loins were cut into 2.54 cm chops for RS, SSF and sensory analysis. For the sensory analysis only 75 loins from each plant were chosen. One chop for RS measurements and 2 for sensory were vacuum packed and transported to ISU Labs. At 14 d, the chops (cross-section) were scanned under same conditions. SSF on 800 samples was determined following Wheeler et al. (2005). Sensory tenderness was evaluated by a trained sensory panel (n = 10). All spectral data were analyzed using R and Matlab. Support Vector Machine was used to develop the classification model, where 300 pork loin samples were divided into groups according to the percentile (25%) of values of sensory tenderness or SSF.

Results

A weak correlation (R^2 = 0.20) between SSF and sensory tenderness was obtained using a least square regression model. The prediction accuracies for d15 postmortem samples are significantly higher than that for d1 postmortem samples, both for tenderness scores and SSF values (Table 1). These observations strongly suggest that aging of the meat samples from d 1 to 15 has significantly affected their chemical properties that are directly correlated to their tenderness. For d15 postmortem samples however, a substantial improvement in classification accuracies for the 4 quality grade groups was observed. In general, pork samples that belong to the medium quality category are more difficult to predict based on their Raman spectroscopic characteristics.

Table 1. The average accuracies for classifying pork Raman spectra into 4 groups based on percentiles

Grouping	1st 25% percentile	2nd 25% percentile	3rd 25% percentile	4th 25% percentile
D1 postmortem tenderness	76.3%	62.4%	67.7%	98.6%
D15 postmortem tenderness	93.5%	90.1%	92.2%	95.5%
D1 postmortem SSF	76.1%	73.5%	72.6%	69.9%
D15 postmortem SSF	92.8%	93.1%	96.7%	100%

Conclusion

It was demonstrated that sensory attributes of pork loins are moderately correlated to their Raman spectroscopic characteristics. The classification model developed yielded moderate performance in identifying pork loins that belong to extreme categories of sensory quality (i.e., superior and inferior) in freshly cut loins. The spectra obtained from aged samples showed a more accurate classification. Raman spectroscopy, in combination with performance-enhancing data processing and multivariate statistical discriminant modeling, has the potential to become a rapid on-line screening tool for the pork producers to quickly select meats with superior quality and/or poor quality to better serve customers. This project was funded in parts by a grant from the National Pork Board. The scholarship for the first author was granted by CNPq-Brazil.

