Title: Post-harvest Prediction of Pork Tenderness – NPB #09-218

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Abstract:

Recent pork consumer research has shown that tenderness is an important pork quality attribute. Automated grading technologies to assess tenderness on-line in pork processing plants could provide a tool for tenderness assessment and segmentation. With the development of automated grading technologies, the pork industry could either sort their product for pork tenderness or develop branded programs to assure tenderness. This study consisted of 1208 pork loins randomly selected to test the efficacy of six automated grading techniques. Visible and near-infrared spectroscopy using 350 to 1830 nm wavelength (Visible-NIR), electrical impedance (EI) (resistance, reactance, phase angle, and partial capacitance), pH, and CIE L*, a* and b* color space values from a Minolta colorimeter, High Resolution Imaging and Stress-Strain Imaging (SSI) were the technologies used to predict chemical moisture and lipid, pH, Warner-Bratzler shear force (WBSF), and Slice shear force (SSF) on 13 d aged pork loins. The means and standard deviations for WBSF were (22.95 and 5.16) and SSF were (165.49 and 58.15). Prediction was based on stepwise linear regression and partial least squares regression. Visible-NIR, pH, and color, when in combination, had the highest R² (0.19 and 0.21) for the prediction of WBSF and SSF, respectively. Partial least squares regression (PLSR) was used to remove autocorrelation between Visible-NIR values. By using PLSR, with an R² value of 0.49, 97% of the “tender” chops were correctly classified, 93% of the “intermediate” chops were correctly classified, and 92% of the “tough” chops were correctly classified into its category for WBSF. However, for SSF was much lower (R² = 0.24) with only correctly placing 62% of the “tender” chops and 48 % of the “intermediate” and “tough” chops. Electrical impedance, alone or in combination with other technologies, either did not improve predictability of linear regression equations (increase R²) or of PLSR models (increase R²). Equations and models that included EI values had low R². When adding EI to the regression equation involving all variables, R² increased slightly from 0.19 to 0.21 in predicting WBSF, and from 0.21 to 0.25 for SSF. When pH or CIE L* color space values were included in linear regression or PLSR models to predict WBSF and SSF, R² values increased from 0.14 to 0.19 for WBSF, and 0.14 to 0.21 for SSF. pH played a large role in predicting WBSF and SSF, along with CIE L* color space value. Thus, for an on-line situation, use of Visible-NIR, pH, and color could be used to predict tenderness. Utilization of Visible-NIR could alone be effective in predicting pork tenderness (WBSF). Using EI alone or in combination with Visible-NIR would not provide acceptable prediction of WBSF or SSF. Use of
Visible-NIR with pH and color would improve the ability to predict tender and intermediate pork WBSF and SSF, but the additional improvement in accuracy may not be warranted based on the cost and additional time needed when using more than one technology. The SSI system utilized the toughest and most tender samples within a processing day. Results indicate some structural differences between samples. With the advent of commercialization of ultrasound systems for pork carcass assessment, integration of these results with commercial ultrasound systems is viable.

The Tenera Technology High Resolution Imaging System was a relatively new system that had never been evaluated and imaging problems/deficiencies using the bench-top design occurred. Only 376 pork chop images were analyzed. Mechanical design flaws including the amount of illumination, the amount of “noise” that was captured in the photographs (due to vibrations, etc.), and the speed at which the machine operated. In an attempt to capture the greatest number of analyzable images per chop, the machine operated at an extremely slow speed. Thus, it is our conclusion that the technology does not exist at this time to use digital imaging within a commercial setting to measure all necessary traits to optimize tenderness prediction. Nonetheless, small additive gains were demonstrated by the Tenera Technology High Resolution Imaging system that need to be fully explored using alternative methods that would more efficiently and successfully capture the features on an ultra-structural level that are essential for enhanced predictions of pork tenderness.