2016 Reciprocal Meat Conference – Meat and Poultry Quality and Composition- Measurement and Prediction

Meat and Muscle Biology™

Prediction of Pork Fatty Acid Content Using Image Texture Features

X. Sun[1]*, D. Newman[1], J. Young[1], Y. Zhang[2], and E. Berg[1]

[1]Animal Science Department, North Dakota State University, Fargo, ND, USA;
[2]Engineering Department, Nanjing Agricultural University, Nanjing, China

Keywords: fatty acid, image processing, iodine value, texture feature
Meat and Muscle Biology 1(2):98–99 **doi:10.221751/rmc2016.096**

Objectives

The aim of this study was to investigate the analytical potential of computer image processing and texture analysis techniques to quantify fatty acids associated with soft pork (specifically oleic, linoleic, linolenic, and IV).

Materials and Methods

Texture features could be related to the softness of fat that would be related to level of unsaturation (Marshall, 1990). Plus, subtle changes in fatty acids profile could influence L*a*b* value or other color features not detectable by human eye. Fresh pork loins were obtained from 9 pork sides used in a separate research project that compared feeding obese swine a diet containing 16% corn oil (VEG) or 36% beef tallow (ANIM). The 3 mo feeding strategy resulted in significant differences in fatty acid profiles of the subcutaneous fat. The iodine value (IV) and concentration of oleic, linoleic, and linolenic acid expressed as percentage of total fat in a sample of subcutaneous fat collected adjacent the 10th thoracic vertebra were 85.8 (± 5.1), 36.2 (± 2.8), 26.9 (± 3.6), and 2.4 (± 0.4)% for VEG and were 60.2 (± 3.5), 44.5 (± 1.7), 9.8 (± 1.2), and 0.6 (± 0.2)% for ANIM, respectively. After a 24 h chill (2°C), each pork carcass was fully quartered at the 10th/11th rib interface and the blade and picnic shoulder were removed from the anterior section. The remaining rib section was placed against a black backdrop with the posterior (10th rib) facing the high-resolution camera (Fig. 1). After image acquisition, a 40-g sample of subcutaneous fat was collected from the 10thrib section, frozen, and sent to the University of Missouri Experiment Station Chemical Laboratories (Columbia, MO) for fatty acid profile (FAP) analysis. Pork loin images were acquired in the processing plant using a color digital camera (Model EOS 60D, Canon Corporation, Japan) with contrasting (black) background. Images were obtained in the plant to simulate the real-time industrial environment. Subsequent image analysis was conducted separately using image analyzing software (Matlab Version 7, The Math-works, Natick, MA). Five texture features (roughness, contrast, directionality, line-likeness, and heterogeneity) were extracted from the images based on previous work by Tamura, Mori, & Yamawaki (1978).

Results

The image texture features of contrast, roughness, heterogeneity, line-likeness, and directionality were successfully extracted from images. The image texture features were utilized in linear and stepwise regression models to predict percentages of total fat for oleic, linoleic, and linolenic fatty acids and IV.

For all predictions, linear regression models had a higher R^2 than stepwise regression models. For oleic acid, the linear regression model had an R^2 of 0.86 while the stepwise regression model had an R^2 of 0.65. For linoleic and linolenic, both linear regression models resulted in an R^2 value of 0.95 while the stepwise regression R^2 values for linoleic and linolenic were 0.80 and 0.81, respectively. For IV, the linear regression model reached an $R2$ of 0.95 while the stepwise regression only had an R^2 of 0.82. Due to the small sample size, no validation data was generated for the linear regression model.

Conclusion

This research shows the potential for the extraction of image texture features from pork loin images obtained in a processing plant environment as a means for quantifying fatty acids known to influence processing attributes of pork fat.

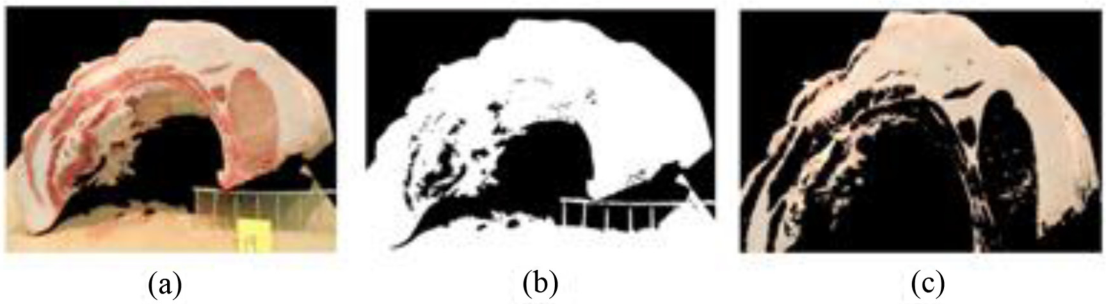

Figure 1. Segmentation of subcutaneous fat from a representative pork loin sample.