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Identification of important image features for pork and turkey ham classification using colour and wavelet texture features and genetic selection

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ABSTRACT

A method to discriminate between various grades of pork and turkey ham was developed using colour and wavelet texture features. Image analysis methods originally developed for predicting the palatability of beef were applied to rapidly identify the ham grade. With high quality digital images of 50–94 slices per ham it was possible to identify the greyscale that best expressed the differences between the various ham grades. The best 10 discriminating image features were then found with a genetic algorithm. Using the best 10 image features, simple linear discriminant analysis models produced 100% correct classifications for both pork and turkey on both calibration and validation sets.

1. Introduction

Computer vision systems have a long and successful record of tackling food classification problems (Aguilera & Briones, 2005; Brosnan & Sun, 2003; Du & Sun, 2004; Sun, 2008; Tan, 2004). Analysis of hams is no exception to this with numerous successful applications in recent years (Cernadas, Duran, & Antequera, 2002; Du & Sun, 2006a; Du & Sun, 2006b; Mendoza et al., 2009; Valous, Mendoza, Sun, & Allen, 2009a).

Hams differ in quality primarily due to the number of muscle pieces forming the ham. The highest quality hams are cut from a single muscle with minimal or no brine injection to increase yield. The more muscles that are required to make up the ham the more brine is needed to form the ham and produce an acceptable yield. Hams requiring a lot of brine are thus of low quality. However, low quality hams are cheaper to produce so they are economically viable. Various qualities of ham can look quite similar, which makes the job of expert graders or factory managers difficult. By introducing a computer vision system to observe the ham, finer details can be examined under consistent and objective conditions, allowing effective discrimination between various classes or qualities of ham.

In seeking a novel approach to identifying ham image features with strong discriminant capacity to allow accurate ham classification, research which used beef image features to classify beef carcasses according to meat quality traits was drawn upon (Jackman, Sun, Du, Allen, & Downey, 2008; Jackman, Sun, & Allen, 2009a, 2009b, 2009c, 2009d, Jackman, Sun, Allen, Brandon, & White, 2009e; Jackman, Sun, Du, & Allen, 2009f). These authors used meat colour, marbling and surface texture features to predict the meat quality. These methods can be applied to pork and turkey hams as surface texture and colour are known to be important quality indicators (Mendoza et al., 2009; Valous et al., 2009a). Colour is important for a different reason in pork and turkey hams than in beef cuts or salmon cuts (Quevedo, Aguilera, & Pedreschi, 2008) as a pale colour indicates pale soft exudative meat which is of poor quality (Mendoza et al., 2009; Molette, Remignon, & Babile, 2003). Marbling fat is a lot harder to measure in hams as not all whitish objects will be fat. Ham colour can be expressed with histograms of red, green and blue, while the ham texture can be expressed with the wavelet transform detailed by Jackman et al. (2008, 2009f).

The results of Jackman et al. (2009b) showed that the wavelet transform was more effective than the classical algorithms for expressing surface texture in beef images; in particular the symmetric modified Daubechie wavelet (Symlet) transform emerged as the most useful wavelet. The wavelet transform processes images by conceiving them as two-dimensional waves with peaks being brighter pixels and troughs being darker pixels. The wave is then decomposed into horizontal, vertical, diagonal and approximation details according to the type of wavelet and the decomposition level.

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