Review

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PII: S1350-4495(16)30623-5
DOI: http://dx.doi.org/10.1016/j.infrared.2017.05.005
Reference: INFPHY 2293

To appear in: *Infrared Physics & Technology*

Received Date: 10 November 2016
Revised Date: 4 May 2017
Accepted Date: 7 May 2017

Please cite this article as: D. Yang, D. He, A. Lu, D. Ren, JihuaWang, Combination of spectral and textural information of hyperspectral imaging for the prediction of the moisture content and storage time of cooked beef, *Infrared Physics & Technology* (2017), doi: http://dx.doi.org/10.1016/j.infrared.2017.05.005

Combination of spectral and textural information of hyperspectral imaging for the prediction of the moisture content and storage time of cooked beef

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Abstract

The feasibility of combining spectral and textural information from hyperspectral imaging to predict the moisture content and storage time of cooked beef was explored. A total of 10 optimal wavelengths were selected for the moisture content and storage time by conducting variable combination population analysis (VCPA). Principal component analysis was employed to reduce the number of dimensions of hyperspectral images, while a discrete cosine transform was applied to the first three principal component images to extract 30 textural features. A back-propagation artificial neural network (BP-ANN) model and partial least-squares regression model were developed to predict the moisture content and storage time from spectra, textural data, and their combination. The fused BP-ANN model provided satisfactory results with $R^2{}_p$ of 0.977, and RMSEP of 0.9151for the prediction of moisture content; these results were superior to those obtained with spectral or textual information alone. Combined with the storage time, the distribution map of the moisture content of cooked beef was visualized using the best fused BP-ANN model with imaging process method. The results reveal that the combination of spectral and textural information of hyperspectral imaging coupled with the BP-ANN algorithm has strong potential for the prediction and visualization of the moisture content of cooked beef at different storage times.

Keywords: hyperspectral imaging, cooked beef, VCPA, BP-ANN, moisture content, storage time

1. Introduction

Cooked beef is one of the most consumed meat products in the world and is favored by consumers because of its taste, convenience of preparation, and long shelf life[1, 2]. At the same time, cooked beef is a rich source of proteins, minerals, and vitamins. Recently, attention has been increasingly paid to issues of quality safety, such as adulteration for beef and lamb, fake shelf lives, and spoiled and toxic meat production[3].Thus, relevant meat industry departments need to address the early stages of quality detection for meat products.