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Characterization of moisture content in dehydrated scallops using spectral images

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Abstract

Herein, a hyperspectral imaging system in the 380–1030 nm range was used to rapidly determine the moisture content of scallops in different dehydration periods. Mean spectral values of scallops were extracted from hyperspectral images. Only eight optimal wavelengths were selected using the regression coefficient method. Spectra of full wavebands and selected wavelengths were used as independent variables for modeling. Partial least squares regression (PLSR) and least-squares support vector machines (LSSVM) were employed to establish multispectral calibration models to correlate spectral features with moisture content. The best results, with correlation coefficients of prediction (R_P), root mean square error of prediction (RMSEP), and residual predictive deviation (RPD) of 0.9673, 3.5584%, and 3.7150, respectively, were achieved using the optimal wavelength-based PLSR model. To visualize moisture content in scallops, a visualization map was generated using the selected wavelength-based PLSR model. These results highlight the potential of hyperspectral imaging for non-destructive prediction of moisture content in scallops.

Keywords: Hyperspectral imaging, Scallop, Moisture content, Wavelength selection, Visualization map

1 Introduction

Scallops are popular seafood products in the international market owing to their high nutritional value and delicious taste (Wang et al., 2011). Since the 1980s, the cultivation of scallops has rapidly developed, with production in excess of 100,000 tons (Bai et al., 2009). Aquaculture factories often dehydrate scallops to meet consumer's demands, as this prolongs shelf-life and result in high quality products (Tsironi and Taoukis, 2014). The distribution of moisture content in dried scallops is heterogeneous among individual scallops and within the same scallop, as it is affected by the condition of the scallop and dehydration. This variability may decrease the quality of dehydrated scallops, which necessitates the measurement of the moisture content of dried scallops.

Conventional methods used to determine moisture content in seafood include oven-drying, freeze-drying, and use of electronic moisture analyzers. The oven-drying method has been widely used for the determination of moisture content. This method is based on the loss in the weight of scallops after drying, regardless of the shape, color and tenderness of the scallop (Li et al., 2011). However, this method is time consuming and destructive, as the utilized samples cannot be used for further analysis.