

Rapid detection of multiple meat quality parameters based on near infrared spectroscopy

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Introduction: Near infrared spectroscopy (NIRS) has become the mainstream technology for quantitative analysis of meat quality with advances in hardware and chemometrics, furthermore, it has the potential for simultaneous detection of multiple meat quality parameters. The previous researches of NIRS for meat quality detection mainly focused on a single part of meat in a certain period after slaughter, which makes the prediction model less robust and narrow scope of application. The purpose of the present research is to build a meat quality prediction model of multiple quality parameters based on meat samples from different ages, parts and postmortem times.

Materials and methods: A total of 36 Tan sheep aged 3 months, 7 months, 11 months and 15 months were slaughtered in humane way, and then short loin, lamb shoulder, thick flank, topside of each sheep were cut and storage at 4°C, a total of 144 samples were obtained. The spectra of 200-1100 nm and 900-1700 nm of each sample were collected, further fat content, protein content, water content, cooking loss, color (L^* , a^* , b^*), pH value and shear force were all determined by reference method. Savitzky-Golay, first derivative, second derivative, multiplicative scatter correction and standard normalized variable were used to preprocess the original spectral data, and then the PLSR (partial least squares regression) prediction models of multiple meat quality parameters were build based on two wavelength range.

Result: (1) Results in 200-1100 nm wavelength: The prediction model of fat content based on original spectral was the best, the R_c and R_p of correction set and prediction set were 0.910 and 0.830. The prediction model of L^* value, a^* value, b^* value and shear force value after SNV treatment were the best, the R_c and R_p were 0.912, 0.948, 0.948, 0.929, 0.896 and 0.843, 0.922, 0.918, 0.805 respectively. The prediction model for pH value, cooking loss, protein content and water content based on MSC showed better, the R_c and R_p were 0.910, 0.955, 0.925, 0.924 and 0.834, 0.869, 0.882, 0.879, respectively. (2) Results in 900-1700 nm wavelength: The prediction model for b^* value, protein content and water content based on MSC achieved better results, which the R_c and R_p were 0.892, 0.901, 0.954 and 0.888, 0.895 and 0.941 respectively. The prediction model for L^* value, a^* value, pH value, cooking loss value and shear force value got better result via SNV treatment, which the R_c and R_p were 0.900, 0.933, 0.924, 0.907, 0.866 and 0.889, 0.922, 0.881, 0.862, 0.837 respectively. The fat content prediction model based on 2-der has better R_c (0.911) and R_p (0.8489).

Conclusion: The optimal PLSR model correlation coefficient of each meat quality parameter in two wavelength range is greater than 0.80, and the correlation coefficient of prediction set is up to 0.941, which means the performance of each prediction model is relatively good. The 370-1050 nm spectral data reflected the characteristic information of meat color, and got a more accurate prediction model. The results enrich and expand the application scope of NIRS non-destructive prediction model on meat quality, and provide reference and technical support for the quality control of meat.

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