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Discrimination analysis of milk types based on mid-infrared spectroscopy

Abstract:

There are various types of milk available in the market. This study compared the composition differences of three processing types of milk and three quality types of milk. Classification models were established using mid-infrared spectroscopy and machine learning. Significant differences were found in the lactulose, furosine, casein, and the ratio of lactulose and furosine among the three processing types of milk, with pasteurized milk (PM) < ultra-high temperature sterilized milk (UHTM) < powdered reconstituted milk (PRM) ($P < 0.05$). PM and UHTM had higher β -lactoglobulin content ($P < 0.05$). There were no significant differences in the fatty acid and α -lactalbumin content ($P > 0.05$). Significant differences were observed in the content of fat, protein, lactose, solids-nonfat (SNF), and total solids (TS) among different quality types of milk ($P < 0.05$, regular milk < high-end milk < organic milk), and regular milk had the lowest total fatty acid content, while organic milk had the highest total casein content. The best discriminant model for milk processing types was the differential wavelength (925.92-1481.472 cm^{-1} 1720.668-2314.8 cm^{-1} 2418.966-2966.802 cm^{-1}) + no preprocessing + support vector machine (SVM), while the best discriminant model for milk quality was the differential wavelength (925.92-1539.342 cm^{-1} 1720.668-2523.132 cm^{-1} 2538.564-2966.802 cm^{-1}) + standard normal variate (SNV) + SVM. The accuracy and kappa coefficient of both best models on the test set were 1, and the external validation results were also correctly classified. Therefore, mid-infrared spectroscopy can be used as a rapid, convenient, and accurate detection method to discriminate milk processing types and quality, providing new references for milk identification.

Biography

Shujun Zhang is a Professor at the College of Animal Science and Technology and the College of Veterinary Medicine of Huazhong Agricultural University and received her PhD in agriculture from Sichuan Agricultural University in 2001. Her research interests include MIR fingerprints, biomarkers and batch detection technology of milk, and the regulatory mechanisms and techniques of animal gender. She has obtained 16 invention patents, formulated 2 national standards, and published over 130 papers in domestic and foreign journals such as "JEM, Journal of Experimental Medicine," "PNAS," "J Bone Miner Res," and "Journal of Genetics and Genomics."