Title Artificial olfactory sensing systems for safety assessment of packaged beef

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Abstract

A gas-phase Fourier transform infrared (FTIR) spectroscopy was evaluated for its ability to discriminate between *Salmonella* -contaminated packaged beef samples from uncontaminated ones. Gas-phase FTIR spectra of the headspace volatiles of packaged beef were acquired and divided into several regions. The selected regions were further reduced by extracting their principal components (PC). Statistical models (linear and quadratic discriminant analysis) and neural network models were validated using bootstrapping and 0.632 bootstrap crossvalidation methods, respectively. Samples with *Salmonella* less than 0.7 $\log_{10}$ cfu/g were treated as control, and greater than or equal to 0.7 $\log_{10}$ cfu/g were treated as spiked samples. The quadratic discriminant model developed on the entire spectrum provided a mean average total classification accuracy of 86%. Statistical techniques such as sequential forward selection using statistical feature selection methods provided a mean average total classification accuracy of 95%. Multilayer perceptron neural network validated with 0.632 bootstrap method produced a mean average total classification accuracy of 90% when the entire spectrum was used as input to the neural network. FTIR shows potential for implementation of optical electronic nose technology as an intelligent sensing system for identifying meat contamination. Besides FTIR, investigations were conducted to use metalloporphyrin-based optical sensing technologies for sensing selected compounds of interest associated with packaged meat contamination (Salmonella).

A prototype configuration of an opto-electronic nose system in reflectance mode was designed and integrated to evaluate the responses of metalloporphyrin sensing films for sensing acetic acid vapor (in the range of 50-1000 ppm). The films were also characterized using atomic force microscopy, stylus profiler and optical profiler to investigate the surface characteristics of sensing films. The optical responses of metalloporphyrin films were also used for simultaneous prediction of acetic acid and ethanol concentrations in their binary mixtures using partial least square regression and artificial neural networks. It was found that metalloporphyrins (2,3,7,8,12,13,17,18-Octaethyl-21 *H* ; 23*H* -porphine ruthenium(II) carbonyl and 5,10,15,20-Tetraphenyl-21 *H* ; 23*H* -porphine manganese(III) chloride) provided the lowest

prediction errors using multilayer perceptron neural network models validated using independent test set method. These methods show promises and need to be further validated on larger samples.