The Rapid Detection of Food Spoilage Using Vibrational Spectroscopy and Chemometrics

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INTRODUCTION

Muscle foods, which include meat, poultry and seafood, are described as spoiled if organoleptic changes make them unacceptable to the consumer. These organoleptic characteristics may include changes in appearance (discoloration), the development of off-odours, slime formation or indeed any other characteristic which makes the food undesirable for consumption (Jay, 1996; Jackson *et al*., 1997). It is generally accepted that detectable spoilage is a result of decomposition and the formation of metabolites caused by the growth of microorganisms. This information can be exploited through spectroscopic analysis and rather than detecting the presence of bacteria *per se* on the meat surface, vibrational spectroscopy will be used to measure biochemical change within the meat substrate, enhancing and accelerating the detection of microbial spoilage.

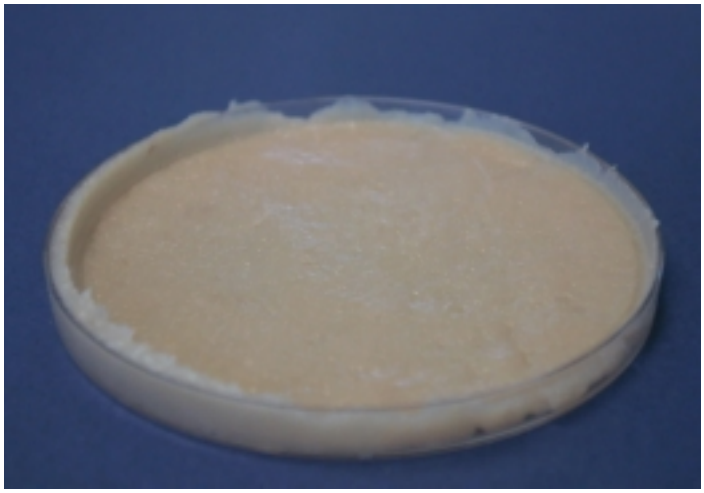
METHODS

Preliminary experiments have concentrated on standardisation of sample preparation and measurement and observation of chicken breast muscle at both room and refrigeration temperatures over time. All IR spectra were recorded between 4000-600 cm^{-1} using the microscope of a Bruker IFS28 FT-IR spectrometer in reflectance mode with a resolution of 16 cm^{-1} and 128 co-adds. Data from the experiments were analysed using the unsupervised multivariate statistical methods of PCA and DFA and the supervised method of partial least squares regression (PLSR).

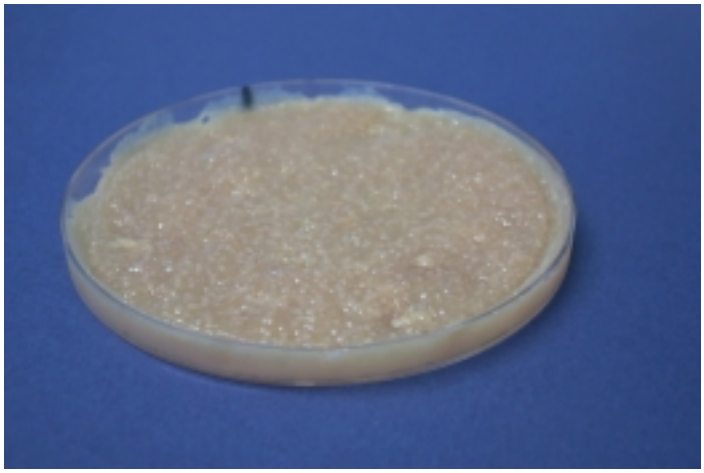
RESULTS AND DISCUSSION

Results from preliminary experiments demonstrate that FT-IR spectroscopy in combination with chemometric methods can be used to detect biochemical change within meat during the spoilage process. Therefore, proof of principle has been established and with improvements, in experimental technique and application, the methods applied here could subsequently be used to manipulate the spectral data collected from a meat sample to predict microbial load, spoilage status and remaining shelf-life of the product under investigation. However, due to focussing-related problems leading to the collection of a number of low quality spectra, future experiments will concentrate on the application of HATR spectroscopy, which should elicit more representative and reproducible spectra. Further investigations into the bacterial diversity of meat at both the fresh and spoiled stages will also be undertaken through spectroscopic analysis.

Fresh sample



Spoilt sample after 10 d at 4±1°C



REFERENCES

Jackson, T.C., Acuff, G.R. and Dickson J.S. 1997. Meat, Poultry, and Seafood. In *Food Microbiology: Fundamentals and Frontiers*, ed. Doyle, M.P., Beuchat, L.R. and Montville, T.J. pp. 83-100. Washington D.C.: ASM Press.

Jay, J.M. 1996. *Modern Food Microbiology*, 5th Edition. London: Chapman & Hall.