AN INVESTIGATION INTO THE DEVELOPMENT OF ELECTROCHEMICAL SCREEN-PRINTED BIOSENSORS FOR FATTY ACID ANALYSIS IN MEAT

A. Smart[1*], J. P. Hart[1], A. Crew[1], and O. Doran[1],

[1]*Health and Applied Sciences, University of the West of England, Bristol, United Kingdom*,

*amy.smart@uwe.ac.uk

I. OBJECTIVES

The composition of fatty acids (FA) in meat is an important indicator of quality, particularly relative amounts of saturated and unsaturated FAs. Current chromatographic methods of measuring FA on-line are impractical. The novel screen-printed biosensor approach is rapid and simple to use, and producible at low cost on a large scale. Developing biosensor technology for measurement of FA in meat could streamline abattoir processing. The objective of this project is to develop novel screen-printed biosensors for the direct measurement of FA in meat.

II. MATERIALS AND METHODS

Mediated screen-printed carbon electrodes were drop-coated with a selected enzyme to measure polyunsaturated FA. Enzyme was immobilized on the electrode surface using a cross-linking agent. Applied voltage was optimized using hydrodynamic voltammetry, and amperometry in stirred solution was used to optimize measurement conditions and perform calibration and precision studies for α-linolenic and linoleic acid.

III. RESULTS

The applied voltage for the operation of the biosensor was optimized. From the position of the plateaus, +0.5 V versus Ag/AgCl was selected for both FA, which provides maximum sensitivity without excessive voltage (low voltages minimizes potential interferences, improving selectivity). Enzyme loading and concentration of the cross-linking agent was optimized with reference to potential commercial manufacture. The reproducibility of the optimized biosensor was assessed by examining responses of 3 individual biosensors to additions of α-linolenic acid. The coefficient of variation was 2.77%, which demonstrates good precision. pH and temperature were optimized; neutral pH 8 was optimal for both FA, and a linear response was seen at 37°C (suitable for abattoir carcasses). Calibration studies at the optimized conditions show a steady state current proportional to concentration of FA over an extended linear concentration range (R^2 values of 0.98 were achieved). This indicates that the biosensor holds promise for the measurement of the selected FA in meat.

IV. CONCLUSION

This investigation demonstrates that novel amperometric screen-printed biosensors can successfully measure α-linolenic and linoleic acid. This technology holds promise for the measurement of polyunsaturated FA present in meat. Future work will evaluate the application of the biosensors to meat samples.

Keywords: biosensor, fat composition, fatty acid, meat quality