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

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I. INTRODUCTION

The composition of fat is an important indicator of meat quality; particularly the relative concentration of saturated and unsaturated and mono- and poly-unsaturated fatty acids (FAs). A number of strategies have been designed to improve the FA composition of meat, however current methods of measuring FAs to verify anticipated improvements on-line are impractical. The main disadvantages of gold standard chromatographic methods for the measurement of FAs are that they are time consuming, multi-step processes, require highly skilled personnel, and expensive. In contrast, the novel biosensor approach based on screen-printing technology is rapid, reagent-less, user-friendly, convenient and inexpensive with potential for mass production. Developing biosensor technology for rapid measurement of FAs in meat could streamline abattoir processing, as well as having potential applications in other fields. A recent review by the research team highlights advances in this technology for various applications [1]. The aim of the current project is to develop novel screen-printed biosensors for the direct measurement of FAs in meat.

II. MATERIALS AND METHODS

Screen-printed carbon electrodes were drop-coated with a selected enzyme to measure FAs. Applied voltage was optimised for measurement of a selected fatty acid (linolenic acid) using hydrodynamic voltammetry, and a calibration study and precision study were performed using amperometry in stirred solution, at 37°C and in pH7 PBS buffer.

III. RESULTS AND DISCUSSION

A hydrodynamic voltammetry study was performed to optimise the applied voltage for the operation of the biosensor, as shown in figure 1. From the position of the plateau, +0.5V vs. Ag/AgCl, was selected, which provides maximum sensitivity without excessive voltage. Using lower voltages minimises the possibility of interferences from electrochemically active naturally occurring compounds in meat.

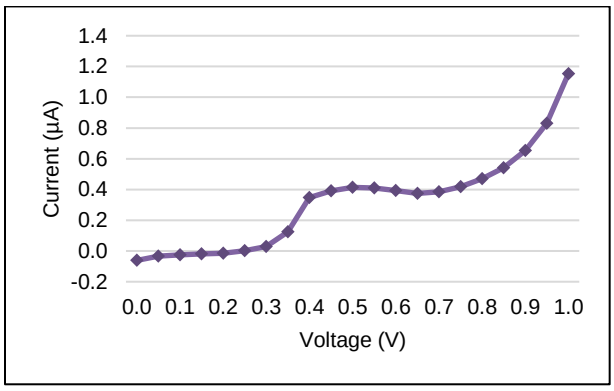

Figure 1 Optimisation of applied voltage: Hydrodynamic voltammogram obtained with the amperometric biosensor in 0.1mM linolenic acid

A calibration study was carried out at the optimised voltage (0.5V vs. Ag/AgCl). As shown in figure 2, the steady state current was proportional to concentration up to 200 µM linolenic acid. This indicates that the biosensor holds promise for the measurement of the selected FA.

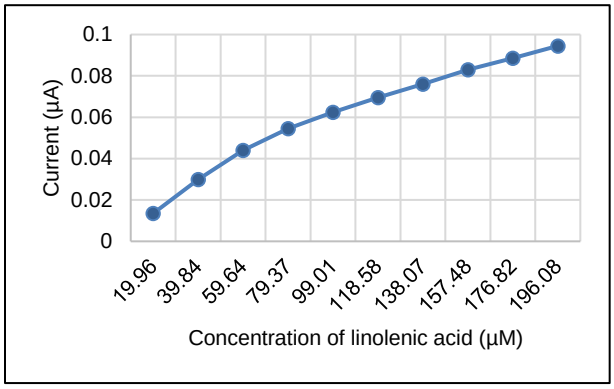

Figure 2 Calibration study: amperometry in stirred solution at +0.5V vs. Ag/AgCl showing the effect of linolenic acid concentration on the biosensor response.

The reproducibility of the biosensor was assessed by examining the response of three individual biosensors to additions of linolenic acid, using amperometry in stirred solution (figure 3). The coefficient of variation was found to be 2.77% (calculated by taking the mean and SD of calibration plots, shown in figure 3), which demonstrates good precision.

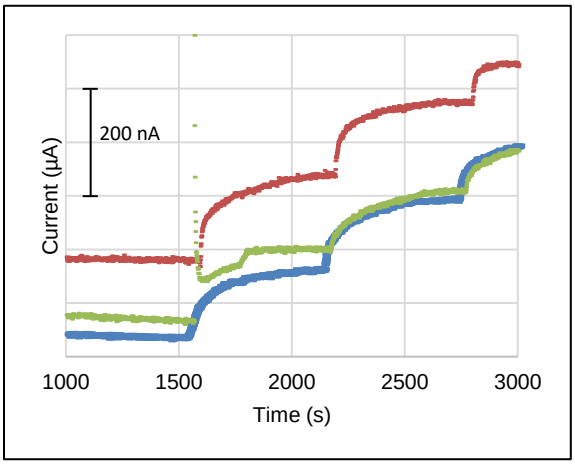

Figure 3 Reproducibility study: amperometry in stirred solution at +0.5V vs. Ag/AgCl showing the response of three individual biosensors to additions of linolenic acid

IV. CONCLUSION

This investigation demonstrates that the novel amperometric screen-printed biosensor can successfully measure linolenic acid. This technology holds promise for the measurement of other fatty acids present in meat. Future work will involve developing biosensors for other FAs based on this platform technology.

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