Title Development and optimisation of amperiometric biosensors for improved postharvest quality control

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Abstract

Until now the main impact of biosensors has been in the medical diagnostics field for monitoring glucose levels in blood. However, the demand for reliable and inexpensive methods for the assessment of fresh produce quality is set to expand; biosensors offer a viable opportunity to fulfil this niche. This study reports on two biosensor systems for the rapid determination of pungency in onion bulbs, and glucose in both onions and strawberry fruit. Accordingly, disposable prototype biosensors were constructed and optimised using pyruvate oxidase (PyOx) and Pyruvate dehydrogenase (PDH) or glucose oxidase (GOx) immobilised onto Meldolas Blue screen printed electrodes. The mediated biosensors operated at low operating potentials (+0.0; +0.150 and 0.30V (versus Ag/AgCI)) which is favourable for minimising positive bias encountered from potential interferents with fresh produce matrices (viz. ascorbic acid and phenylpropanoids). The response of the pyruvate-based biosensors showed a strong correlation with untreated onion juice of known pyruvate concentration ranging from 2-12 μmol/g fresh weight (FW) and thus enabled rapid discrimination between low and high pungency onions. Similarly, GOx-based biosensors were able to measure glucose in real strawberry and onion juices. Unlike total soluble solids (TSS), and as hypothesised, the GOx biosensors, under different operating conditions, were able to discriminate and rank different strawberry and onion cultivars based on their glucose content when compared to known concentrations measured by HPLC ($R2 > 0.73$; $P < 0.001$). The results from this study demonstrated the possibility of replacing standard techniques that are either time consuming (viz. colorimetric assay for determining pyruvate concentration in onions) or poorly correlated with the real composition of the samples (viz. total soluble solids determination in onions and strawberry fruits) with a more rapid method using a screen-printed mediated amperometric biosensors. The introduction of biosensors for specific target analytes in fresh produce will empower growers to undertake their own QC rather than outsourcing analysis.