Development of a caffeine sensor for use with in-line monitoring of PAT in the food and beverage industry

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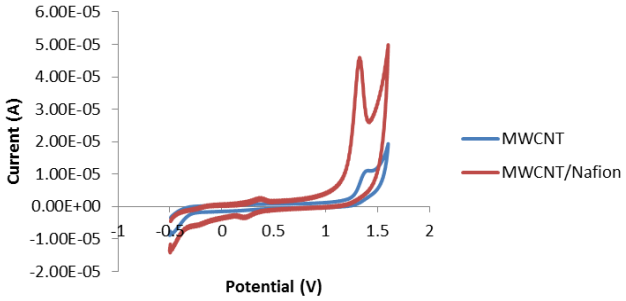

Fig.1. Electrochemical detection of caffeine: comparison of MWCNT-modified (blue) and Nafion/MWCNT-modified (red) GCE.

Abstract:

Food and beverage quality and safety have become of significant importance over the past decade and assuring the highest standards of process control is a key priority. The FDA's Process Analytical Technology initiative emphasises that "quality cannot be tested into products; it should be built in or should be by design" [1]. This has generated a large amount of interest in new technologies for the analysis of pharmaceuticals, food, petroleum and many more. As with the pharmaceutical industry, the food industry faces high regulatory standards regarding the quality control; safety and traceability of their production processes. Advances in modern electronics and data acquisition technology have made it possible to potentially place a wide range of instrumentation at a number of sampling points in many industrial processes. In this work, chemical sensors for the on-line detection of caffeine in real samples have been developed and tested. Two electrode types, a Glassy Carbon Electrode (GCE) and a Screen Printed Carbon Electrode (SPE), were compared for performance. The assay conditions for caffeine detection were then optimised, using Nafion, Multi-walled Carbon Nanotubes (MWCNTs) and a Nafion/MWCNT mixture as electrode surface modifications to explore the possibility of increased electrode sensitivity. The effect of pre-treatment procedures on the performance of the SPE was also investigated. As expected, the MWCNT/Nafion modification showed the greatest improvement in electrode response, when compared to the other modifications. Caffeine was successfully detected in real soft drink samples using both electrodes. The results indicate the potential of electrochemical sensors to compare and compete with the current off-line methods of caffeine analysis, such as HPLC, allowing for both a reduction in time and cost of product quality analysis.

References:

1 United States Food and Drug Administration (FDA), *Guidance for Industry PAT-A Framework for Innovative Pharmaceutical Development, Manufacturing and Quality Assurance*, FDA, September 2004

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