Abstract

Food remains the fundamental source of nourishment, making the assurance of its safety and quality paramount. To address this, establishing efficient and reliable methods for food quality evaluation is essential. This thesis concentrates on the development of novel molecularly imprinted polymer (MIP) based sensors for the rapid and selective detection of key food nutrients: Inositol, Syringic Acid (SGA or SA), Folic Acid (FA), and Quercetin (QCN or QT). Furthermore, the work explores a portable, on-site detection system for Salicylic Acid (ScA).

The research details the fabrication, characterization, and analytical performance of various electrochemical and capacitive sensors. Using techniques such as Cyclic Voltammetry (CV) and Differential Pulse Voltammetry (DPV), the sensors' electrocatalytic properties were optimized by investigating critical factors like pH, buffer composition, and scan rate. These platforms were rigorously characterized for their size, structure, and morphology using diverse analytical tools.

The core findings include two distinct platforms for Inositol detection: a platinum-based electrochemical system and a sensitive MIP-based capacitive sensor, both successfully applied to orange juice samples. It also details a selective acrylonitrile MIP-on-graphite sensor for Syringic acid, validated against HPLC. For Folic acid, a polyacrylonitrile-imbued graphite electrode (MAN@G) demonstrated a remarkably low limit of detection in diverse food extracts. For Quercetin, an rGO-decorated MIP graphite electrode and a dual-polymer capacitive sensor were developed. Finally, an integrated pen-like tri-electrode system for on-site Salicylic acid detection is introduced, offering improved portability.

In conclusion, this thesis demonstrates the strategic use of MIPs and advanced materials to overcome the limitations of conventional techniques. The developed technologies offer a promising pathway toward cost-effective, portable, and reliable devices for real-time food quality assessment.