

Advancing Food Safety from Bench to Field: A Compact Electrochemical Instrument with In-Situ Sample Extraction for Sulfite Quantitation

Kanchana Uraisin^{1,2*}, Nanthatchaphon Jantawong^{1,2}, Paithoon Prasertying^{1,2},
Thinnapong Wongpakdee^{1,2}, Nutnaree Fukana^{1,2}, Arinrada Rattanadechawan^{1,2},
Tananya Setjanthuek^{1,2}, Prapin Wilairat^{1,2}, Phoonthawee Saetear^{1,2}, Chanpen Karuwan³,
Wichayaporn Kamsong³, Wattanasit Pimpao⁴, Duangjai Nacapricha^{1,2}

¹*Department of Chemistry, Faculty of Science, Mahidol University,
Rama 6 Road, Bangkok 10400, Thailand*

²*Flow Innovation-Research for Science and Technology Laboratories (FIRST Labs),
Bangkok, Thailand.*

³*National Nanotechnology Center (NANOTEC), National Science and Technology
Development Agency, Thailand Science Park, Phahonyothin Road, Pathum Thani, 12120,
Thailand.*

⁴*Diamond Pi Co., Ltd. National Science and Technology Development Agency,
Thailand Science Park, Phahonyothin Road, Pathum Thani, 12120, Thailand.*

**e-mail: kanchana.ura@mahidol.ac.th*

Abstract

Ensuring food safety remains a critical global challenge, particularly in products prone to chemical preservative abuse, such as frozen shrimp. Although sulfite preservatives are effective in preventing spoilage, their use must be strictly controlled due to potential health hazards. We will present the translational journey from laboratory-based chemical analysis to the development of a compact, user-friendly bench-top instrument that incorporates a unique electrochemical sensor for quantifying sulfite residue in frozen shrimp and other types of seafood. The electrochemical sensor operates in the gas phase above the closed vessel containing the sample. The sensor measures the sulfur dioxide gas generated from the sulfite in an aqueous suspension within a sealed extraction chamber. This modular device integrates an extraction unit with a reusable electrochemical sensor mounted in the lid, capable of providing consistent readings for at least 50 consecutive measurements. The system is electronically controlled and integrated with a software platform that enables fine-tuning of electrochemical parameters, signal monitoring, and real-time reporting sulfite concentration on a graphical display. Our instrument not only delivers a useful quality control tool for the frozen food industry but also serves as a product for a local start-up entrepreneur to explore the commercialization of this sensor innovation.

Keywords: sulfite, electrochemistry, sensor, gas phase detection, innovation, food safety