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Polyurethane-electrode Modified to Determine Histamine in Selected Samples Using Chemical Sensor

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Abstract. Food safety is an imperative part of public health that needs to be considered to ensure human health. *Histamine* is a compound that is easily found in food protein. Thus, analyzing histamine in food before distributing it to the market is essential. The present study discusses applying chemical sensors to evaluate histamine levels in fish samples. The screen-printed electrode (SPE) was applied in this study and modified using bio-polyurethane (PU). The PU was produced using an electropolymerized approach, and the PU was characterized using FTIR to investigate the functional group, the cyclic voltammetry (CV) to study the conductivity, and electrochemical impedance spectroscopy (EIS) to study the resistance of PU after combined with histamine. Furthermore, differential pulse voltammetry (DPV) was employed to validate the histamine detection. The chemical sensor recorded a linear range from $10^{-3} - 10^{-1}$ nmol・L^{-1} at the 0.002 nmol ・L^{-1} limit of detection (LOD). The sensor can analyze histamine in selected samples at room temperature and obtain satisfactory outcomes. Furthermore, the sensor can be categorized as a fast technique and suitable for on-site analysis.

Keywords: Chemical Sensor, Histamine, Screen Printed Electrode, Voltammetry

INTRODUCTION

The food industry development is rapid, and Indonesia's food security level is constantly improving. Nevertheless, many issues emerge, such as mishandling the packaging process, selling expired food products, abusing food additives and antibiotics, etc. The security and quality of foods involve everyone's safety and health. This issue has become a global issue. For example, histamine production in food has brought fatal consequences if consumed in high concentration (Dados et al. 2020; Silvia et al. 2022). Several sources of dangerous substances exist, such as endogenous, exogenous toxic, and microbial toxins. Endogenous toxins include toxic proteins, phenols, alkaloids in agricultural products, shellfish toxins, etc. Exogenous toxins come from food pollution, such as pesticide application, and microbial toxins occur due to bacterial and fungal toxins. Food toxicity caused by histamine presence occurs due to endogenous and microbial toxins (Ramona et al. 2023; Gallo et al. 2020).

Many bacteria are involved in histamine production such as *Proteus*, *Morganella morganii*, *Enterobacter*, *Clostriduium*, *Enterobacter aerogenes, Hafnia*, *Raoultella planticola*, *Klebsiella*, and *Lactobacillus*, where some of these microorganisms exist naturally in seawater (Oktariani et al. 2022). The histamine can be obtained easily in *the Scombrodiae* family, such as mackerel, bonito, and tuna. These fish are spreading widely in the Indonesian market. Fish processing is an imperative part of ensuring the quality and security of fish (Roobab et al. 2022; Chen et al. 2022). Fresh fish that are handled properly will not contain histamine. However, if fish are not appropriately handled, histamine will accumulate swiftly. Thus, the cooling, freezing, and heating process cannot be applied to destroy the compound (Abuhlega & Ali 2022). The histamine formation can also be affected by various factors, including pH and temperature.

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