IOP Conference Series: Earth and Environmental Science

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Preface

To cite this article: 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **880** 011001

Preface

Following the success of 2014, 2016 and 2018 International Conference on Science & Technology Applications in Climate Change (STACLIM), the Institute of Climate Change (IPI), Universiti Kebangsaan Malaysia (UKM) is proud to extend our promotion of research and education for the advancement of climate change studies. The 2021 International Conference on Science & Technology Applications in Climate Change (STACLIM 2021) with the theme "Empowering Breakthroughs for Climate Change" is the fourth in the series of conferences organized by IPI. This year the conference was carried out in virtual form through the Webex platform (1 – 2 July 2021) due to the COVID-19 travel restriction. Through the virtual form, the science community is able to share their research findings in time.

The aim of this conference is to bring together researchers in fields of Environmental Science, Health Sustainability, Mathematics, Sustainable Energy, Economic Sustainability, Socio-Cultural Studies, Social Science, Atmospheric Science, and related fields, to present their research findings as well as create new opportunities for future research collaborations. This event is envisaged to witness active participation from various eminent environmental and earth scientists, engineers and students from academia, industry and government sectors for addressing complications associated with climate change and to draw forth novel and ground-breaking initiatives and solutions for climate resilience.

The plenary sessions in the main room was opened by three keynote speeches from leading experts including Prof. Dr. Joshua S. Fu from The University of Tennessee Knoxville, USA on "Integrated Engineering and Earth Systems Science as Solution to Climate Change: Lessons and Opportunities", Prof. Dr. Agamuthu Pariatamby from Jeffrey Cheah Institute on Southeast Asia, Malaysia on "Waste Management and Climate Change in Asia: Will it Mitigate or Aggravate?" and Distinguished Professor Dr. Biswajeet Pradhan from University of Technology Sydney, Australian "Geospatial Intelligence in Climate-Induced Hazard Modelling". As the keynote session were open for public registration, we had 119 participants joining the event. It was then followed by the oral presentation of 72 papers in 3 parallel breakout rooms. Each presenter was given up to 15 mins for presentation and Q&A sessions. There were additional of 13 non-presenters who joined in during the presentation session. Presenters and participants have attended the conference from their respective countries including Malaysia, Indonesia, Philippines, USA, China, Saudi Arabia, Iraq, Algeria, India, and Ukraine.

The conference went well with great support and synergy of the staff and personnel from Institute of Climate Change, UKM. To document and promulgate the research findings and ideas shared, we are very pleased to published the accepted abstracts and research papers of STACLIM 2021 in IOP Conference Series: Earth and Environmental Science (EES) (Online ISSN: 1755-1315).

IOP Conf. Series: Earth and Environmental Science **880** (2021) 011001 doi:10.1088/1755-1315/880/1/011001

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Polyurethane modified screen – printed electrode for the electrochemical detection of histamine in fish

To cite this article: M A Munir *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **880** 012032

Polyurethane modified screen – printed electrode for the electrochemical detection of histamine in fish

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Abstract. Histamine needs to be determined because of its toxicity. Histamine is commonly determined using chromatography, where not only that the instrument is expensive, the process is very tedious and require an expert. A sensor was developed using palm-based polyurethane as an electro-sensor substrate. Palm-based polyurethane (PU) was produced via condensation polymerization between palm kernel oil-based monoester polyol (PKOp) and 4,4'-diphenylmethane diisocyanate (MDI). PU offers high porosity and capability to attach onto screen–printed electrode (SPE) sturdily without being disintegrated. PU–SPE adsorbed histamine onto its pores, before being oxidized. The oxidation process was detected using cyclic voltammetry (CV) and differential pulse voltammetry (DPV). Histamine was oxidized electrochemically at +0.31 V (vs. Ag/AgCl, 1 mol·L^{-1}, pH 7.5). Differential pulse voltemmetric approach were used in order to get a satisfactory response, thus the histamine concentration was made in the range from 1×10^{-4} to 1 mmol·L^{-1}. A good sensitivity of 0.1 mmol·L^{-1} was attained with 3.07 % during intraday and 9.55 % during interday. The detection and quantification limits of histamine acquired at 0.17 mmol·L^{-1} and 0.53 mmol·L^{-1}, respectively. A wide variety of interfering compounds were also examined in order to establish their effect, if any, on the determination of histamine at the PU modified electrode. The sensor showed an excellent anti – interference property towards the other amines. The developed chemical sensor using PU – SPE has a good potential to determine histamine level in mackerel *(Rastrelliger Brachysoma)* owing to its simplicity and reproducibility.

Keywords: Histamine, polyurethane, electrode, conducting, mackerel

Track Name: Chemistry

IOP Conf. Series: Earth and Environmental Science **880** (2021) 012032 doi:10.1088/1755-1315/880/1/012032

1. Introduction

The production of food protein increases significantly owing to the high demand. Protein has an important role in human growth. Nevertheless, it will give impact to food security due to foods protein have been thoroughly investigated due to the possibility of biogenic amines accumulation, particularly histamine. The common biogenic amines obtained in foods are cadaverine, tyramine, putrescine, spermine, spermidine and histamine. However, histamine has been receiving great attention by several organization such as Food and Drug Administration (FDA) and European Food Safety Authority (EFSA) due to its toxicity [1]. Histamine is produced by the decarboxylation process of histidine, it is caused by many factors such as microbial or enzymatic process. In order to stop this microbial process, cooking or heating becomes an alternative to destroy the bacteria, nevertheless, histaminolytic bacteria found in foods, which acts as oxidizing agent, has the ability to survive inside the foods during the cooking or heating process [2,3]. Thus, the detection of histamine is imperative, in order to ensure the safety of human consumption.

Several approaches such as chromatography and electrochemical techniques have been applied and studied to detect histamine in foods. Liquid and gas chromatography are techniques that have been applied in decades. These methods are well developed, sensitive and very selective [4-9]. However, many conflicts occur during the application of these methods such as very expensive, require many chemical materials, time–consuming and only people who have background in analytical chemistry can use it. Moreover, both HPLC and GC methods need derivatization step using specific derivatizing reagent in order to increase the sensitivity of HPLC and GC. Derivatization step is needed since biogenic amines have low volatility and lack of chromophores [10].

Thus, in order to tackle these issues, electrochemical sensors are applied. Electrochemical sensors are cost-effective and have the capability to detect histamine either using biological receptors such as enzyme–modified and antibodies or using chemical receptors such as conducting polymers. They are still using chromatography methods [11,12]. Histamine biosensors coupled with a specific enzyme have attracted significant attention such as methylamine dehydrogenase, diamine oxidase and amine oxidase [13]. Nevertheless, the application of these enzymes to the sensor has some drawbacks such as life cycle and price of enzymes. Several studies have reported that immobilization enzymes causes instability. The instability of enzymes can be influenced by several factors such as pH and temperature. Some foods also containing metal that inhibit the enzyme activity [14,15].

Furthermore, biological receptors such as enzymes and antibodies are costly, complicated to produce and the selectivity is questionable. The receptors also cannot survive in high concentration of organic solvents, can be destroyed in high temperature and unstable in a specific pH. Furthermore, a synthetic receptor is strongly required so it can avoid the biological receptor issues. Chemical sensors become another alternative in order to avoid the application of antibodies, enzyme and DNA [16]. These methods use a specific receptor to capture biogenic amines physically or chemically where the electrodes must be modified chemically. The electrodes also must be both chemically stable and conductive. Carbon nanotube, graphene, gold, lithium, platinum and silicon are materials that generally applied by researchers as electrode modifiers to analyze biogenic amines. They are also friendly because they do not use organic solvents. Other advantages of chemical sensors could also be robustness, selective to small samples, tiny and need no skill on analytical chemistry to operate this sensor [17, 18].

However, the use of conducting materials such as gold, platinum and carbon are costly and the modification procedures are not straightforward. In order to solve these issues, polymers modified electrode can be applied to determine biogenic amines from samples using electrochemical technique. Conducting polymer application based composite materials as sensing elements in electrochemical sensor technology has proved to be reliable instrument based on analytical performances [19].