ISETC2025

UNIVERSITI TEKNOLOGI MARA

ISETC2025

2 ND INTERNATIONAL SCIENCE, ENGINEERING AND TECHNOLOGY COLLOQUIUM



THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A SUSTAINABLE WORLD

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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

HEALTH RISKS ASSESSMENT OF HEAVY METAL CONTAMINATION IN PROCESSED BAMBOO STARFRUIT (*Averrhoa bilimbi)*

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Abstract: This study investigates the heavy metal contamination in processed bamboo starfruit (*Averrhoa bilimbi*) and its potential health risks to consumers. Heavy metals may leach from metal containers during food processing, leading to toxic exposure. The objective of the research was to determine the concentration of selected heavy metals (aluminium, chromium, copper, iron, nickel, lead, and zinc) in bamboo starfruit samples processed using different containers (beaker, aluminium pot, biscuit tin, and frying pan). Samples were subjected to acid digestion and analysed using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Results showed that aluminium concentration was highest in the aluminium pot (855.00 mg/kg), followed by biscuit tin (784.50 mg/kg), frying pan (720.00 mg/kg), and beaker (575.33 mg/kg). Hazard Quotient (HQ) analysis revealed aluminium exposure exceeded the safe limit (HQ > 1) across all containers, while iron and nickel exposure generally remained within safe limits, except for nickel in the aluminium pot. These findings highlight significant health risks associated with aluminium contamination. Future recommendations include the use of safer cooking materials, improved monitoring of heavy metals in food processing, and further studies incorporating advanced analytical techniques and risk assessment models considering local dietary habits.

***Keywords*:** *Heavy metals, bamboo starfruit, health risk, ICP-OES, Hazard Quotient*

INTRODUCTION

Processed bamboo starfruit (*Averrhoa bilimbi*) is widely consumed for its culinary and medicinal properties in Southeast Asia. However, concerns arise regarding heavy metal contamination during processing, particularly due to the leaching of metals from cooking containers. Exposure to heavy metals such as aluminium and lead can cause serious health issues including neurotoxicity and organ damage. This study aimed to (i) determine the concentration of aluminium, chromium, copper, iron, nickel, lead, and zinc in processed bamboo starfruit, (ii) compare these concentrations with regulatory standards (FDA, WHO, Malaysia Food Act 1983), and (iii) assess potential health risks through hazard quotient analysis. Some of the previous studies highlighted metal leaching due to acidic food interactions with containers, justifying the need for a localized assessment of bamboo starfruit processing.

MATERIALS AND METHODS

Approximately 2 kg of bamboo starfruit samples were collected and processed by boiling in four different containers which are beaker (control), aluminium pot, biscuit tin, and frying pan. After boiling for one hour, samples were dried, ground and subjected to acid digestion using nitric and hydrochloric acids. The digested samples were analysed for heavy metals using ICP-OES (Maloupa et al., 2019). The Estimated Daily Intake (EDI) and Hazard Quotient (HQ) were calculated based on standard ingestion rates (0.2 kg/day) and average adult body weight (70 kg) (USEPA, 2000).

RESULTS AND DISCUSSION

Aluminium was found in high concentrations across all container types, with the aluminium pot exhibiting the highest level at 855.00 mg/kg. Iron and nickel were also elevated in the aluminium pot. Chromium and copper levels remained relatively low across all samples. Lead levels were low, with a maximum of 2.00 mg/kg in the frying pan sample. HQ

analysis indicated that aluminium exposure in all samples posed a health risk (HQ > 1). Iron and nickel exposures were generally within safe limits except for nickel in the aluminium pot, which showed an HQ of 3.11, indicating potential health concerns. The findings highlight the significant impact of container materials on the extent of heavy metal contamination that occurs during the food processing of bamboo starfruit.

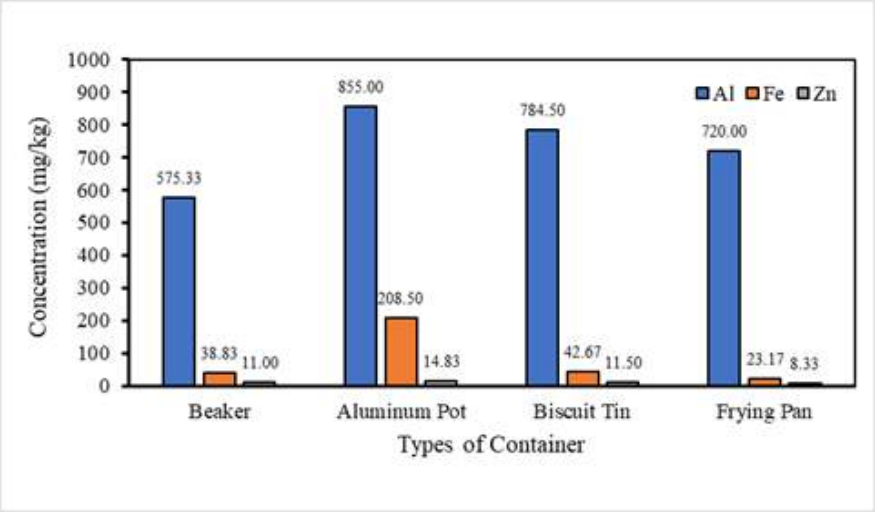


Figure 1. Concentration of Al, Fe and Zn in different containers

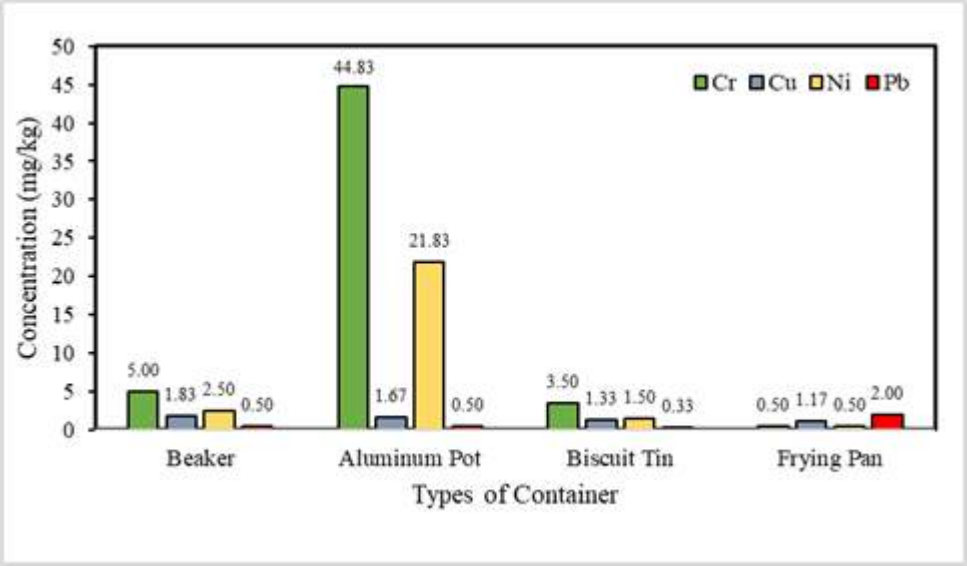


Figure 2. Concentration of Cr, Cu, Ni and Pb in different containers

CONCLUSIONS

The processed bamboo star fruit exhibited significant aluminium contamination when cooked in metallic containers, posing potential health risks to consumers. The Hazard Quotient (HQ) values for aluminium (Al) and chromium (Cr) in all containers exceeded the acceptable safety threshold, indicating potential health risks associated with their consumption from processed bamboo starfruit. In contrast, the HQ values for iron (Fe) remained well below the safety limit in all cases, suggesting that iron exposure does not pose a significant health concern. Overall, the results highlight aluminium and chromium as the primary contributors to health risk, while iron remains within safe exposure levels. It is recommended to use non-metallic or certified safe cookware to minimize contamination. Future studies should consider increasing sample diversity, utilizing more sensitive analytical techniques such as ICP-MS, and employing advanced risk assessment models tailored to local consumption habits to better predict public health outcomes. Continuous monitoring and stricter regulations on food processing materials are essential to ensure consumer safety.

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