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"Flourish and Nurturing Sustainable Innovation for a Prosperous Nation"

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Editorial Board

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Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector

Assalamualaikum warahmatullahi Wabarakatuh, Salam Sejahtera, Salam Malaysia MADANI and Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most Merciful.

It is a great honor to welcome you to the Johor International Innovation, Invention, Competition, and Symposium 2024 (JIIICaS 2024). This event connects various disciplines, focusing on education and engaging educators, students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and determination to turn those ideas into reality. The remarkable projects showcased today highlight the dedication and spirit of all participants. Initiatives like this not only explore new technologies but also cultivate skills and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor Branch, we are fully committed to fostering a dynamic culture of innovation, promoting the commercialization of new products, and encouraging meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all sponsors, judges, the College of Computing, Informatics and Mathematics, UiTM Pasir Gudang Campus as the event organizer, as well as to the researchers and participants for their hard work in making this event a success. Let us continue striving for innovation and excellence. May the ideas presented today inspire us and lay the groundwork for future achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
Johor Branch

(A-ST048) BIOSHELL: SUSTAINABLE PHARMACEUTICAL CAPSULES FROM RECYCLED FRUIT PEELS

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ABSTRACT

Traditional pharmaceutical capsules are made from animal-derived gelatine and synthetically from hydroxypropyl methylcellulose (HPMC). Both sources face sustainability issues, the animal-derived gelatine raises concerns related to animal welfare. Furthermore, both sources lead to environmental degradation because of intensive resource use and chemical processes. BioShell is an organic capsule that was developed from fruit peels to solve sustainability and animal welfare issues. Around 1.3 billion tonnes of food produced for human consumption worldwide is wasted. This led to significant environmental and economic issues. The improper disposal of food waste also can contribute to greenhouse gas emissions from landfill sites as the common food waste treatment. Recycling food waste can reduce waste production, especially in the food and beverage (F&B) production industry. The objective is to develop capsules used for pharmaceutical industries from fruit peels that come from the waste of F&B industries. The raw materials of fruit peels like oranges and apples are collected from the F&B industries. These fruit peels will be extracted by an enzymatic process to extract the pectin and proteins that can be converted into biopolymers and transformed into capsules called BioShell. The BioShell are an innovative capsule developed in Malaysia, that is produced from food waste and is useful for pharmaceutical industries. This capsule can reduce the food waste that needs to be treated by recycling it to produce useful products in the pharmaceutical industry.

Keywords: Recycling, Food Waste, Sustainability, Bio Capsule, Pharmaceutical

1.0 INTRODUCTION

The Food and Agriculture Organisation (FAO) of the United Nations has determined that every year, over 1.3 billion tonnes of food, or more than one-third of all food produced, is lost, or wasted along the food supply chain from basic production to ultimate consumption (Nordin et al., 2020). As discussed by Thyberg & Tonjes, 2016, food waste is food intended for human consumption but thrown away or not eaten by people. Food waste was divided into three categories by the European Commission: food lost during the production phase, food waste that could have been consumed but was lost during consumption, and avoidable food waste that could have been consumed but was lost during consumption (Garcia et al., 2017). Reducing food waste

can be one strategy to preserve sustainable growth as 95% of food waste disposed of in landfills leads to the emission of methane gas and other greenhouse gasses (Quested et al., 2011). Sources of food waste may come from the food industry during the production phase including fruit peels, leaves, stems, and seeds.

The idea is to reduce inedible food waste by upcycling the waste collected from the food industry to produce products that may benefit humans. This innovation is to extract pectin from the fruit peels to produce capsules for pharmaceutical industries. Interestingly, up to 50% of the weight of the fruit is made up of peel waste, typically burned or thrown in the trash. By using these byproducts more, waste, and environmental issues may be decreased. In addition, this material has a great deal to use in active packaging systems because contains an abundance of bioactive components, which permit significant anticancer, antibacterial, and antiviral activity (Hanani et al., 2018). Thus, this study aims to develop a capsule called “BioShell” that can be applied by pharmaceutical industries in preparing capsules for medication without interfering with the pharmacodynamics of the active ingredients.

2.0 OBJECTIVE

The objective of this study is to develop a capsule used for pharmaceutical industries from fruit peels that come from the waste of food and beverage industries. The proposed rapid test kit is designed to be low-cost and convenient to use.

3.0 METHODOLOGY

The unprocessed orange and apple fruit peel waste is collected from the food and beverage industries in Johor Bahru, Johor. After cleaning and chopping them into small pieces, the peels are dried for 48 hours at 30°C in a cabinet dryer. The dried peels are milled into powder by a mill machine and stored in the freezer before further procedure. Briefly, 500 g of powdered peels are dissolved in 4000 ml of deionised water at the ratio of 1:8 (w/v) with pH 1.65 adjusted with concentrated sodium hydroxide (NaOH) and hydrochloric acid (HCl). Then, the mixture is placed for one hour in a water bath (95 °C) and cheesecloth is used to filter and separate the residue. The filtrate is added with 95% ethanol at a filtrate-to-ethanol ratio of 1:2 and left for 12 hours. After removing contaminants with three washes of 70% ethanol and then undiluted ethanol, the precipitated pectin is collected by filtering it through cheesecloth and drying it in a vacuum oven. This pectin extraction method is modified and adopted from Obarisiagbon et al. 2023.

16g of pectin is weighed and dissolved in 384 g of distilled water to form a gel-like mixture. The gel-like mix is transferred into a glass box. After being dipped into the gel mixture, the capsule body mould with the capsule shell size 000 dimensions is flattened and heated at 50 °C in the oven. Utilising a size 000 capsule cap mould, the same procedure is repeated. The gel mixture is reheated until it melts. After being heated for 20 minutes in the oven, the capsule shell was once more dipped in the gel mixture and reheated to 50 °C until it dried and was taken out of the mould. Every capsule is tested for dissolution in acid solution, disintegration in water, and mechanical properties tests, including tensile and elongation tests. BioShell capsules that pass the test will be further used as capsules.

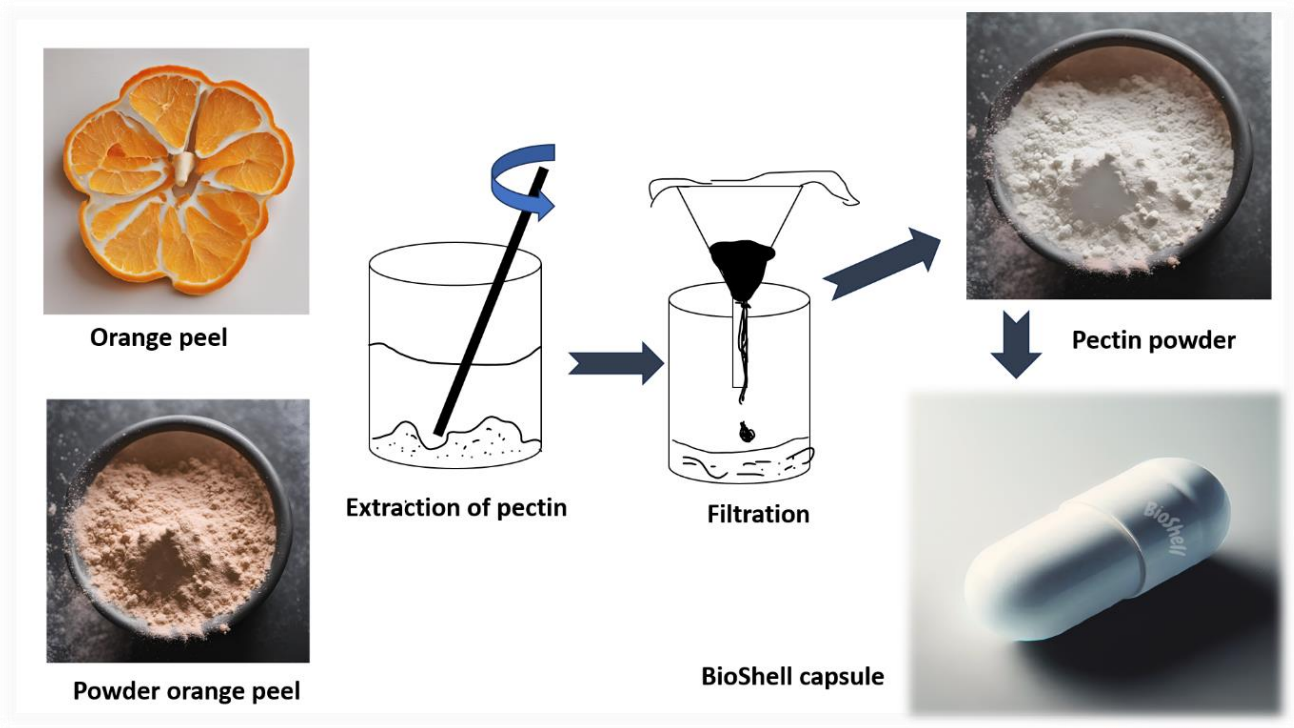

Figure 1: Development of BioShell from Pectin of orange peel

4.0 RESULTS

BioShell capsule that develops from the Pectin of the orange peel will be a potential capsule for drug delivery in the pharmaceutical industry. BioShell passed the dissolution, disintegration and mechanical properties test that can replace the traditional capsule that is produced from a material called gelatin, mostly based on pork products. Pectin, a polymer that is mainly extracted from plant products has strong adhesive qualities for creating gels and capsules. Because the capsule shells produced in this study resembled the specifications of pharmacopoeia capsule shells and the characteristics of commercial capsule shells, BioShell may be a substitute material for hard capsule shells. Moreover, pectin has been reported successfully used in controlled release systems, gastro-retentive systems, colon-specific delivery systems and mucoadhesive delivery systems (Sriamornsak, 2011).

5.0 CONCLUSION

It is proposed that this invention could solve one of the sustainable development issues in Malaysia. Producing BioShell from the non-edible fruit peel can reduce the production of food waste that may lead to harmful effects on the environment. Consequently, the development of a sustainable BioShell capsule supports the nation's efforts with its dedication to the Sustainable Development Goals.

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