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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
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BIODEGRADABLE PLATES MADE FROM RICE AND PEANUT SHELLS

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Abstract: Rice and peanut shells are accessible in Malaysia, as it is easier to find. Rice is readily available as it is the main dish in every household, while peanut shells are often discarded and usually thrown away. These two raw materials were used to make biodegradable plates that consist of five (5) different samples. These samples include, pure rice (100%), pure peanut shells (100%), and a mix of both with ratios of 1:1, 1:2, and 2:1, respectively. The process of making the plates required the rice and peanut shells to be ground into a fine powder and mixed with a small amount of Arabic gum and water. The samples were then placed in an identical mold and heated in an oven to dry the sample. All the samples undergo physical, chemical, and mechanical testing in order to identify the best sample, among the five. The results show that pure rice plates are the best sample as it outperformed the others samples.

Keywords: *Rice, peanut shells, biodegradable plates, chemical testing, mechanical testing*

INTRODUCTION

Biodegradable materials such as straws, plates, and cups were commonly used in the café or restaurant. The usage of this material shows effort in contributing to sustainability through waste reduction. The scope of this study is to investigate the biodegradable plates made from rice and peanut shells by analyzing the sample with three types of tests, which are, physical, chemical, and mechanical. From the testing, the result is used to identify the most suitable material to use as a biodegradable plate. These biodegradable plates might be the solution for the excessive usage of non-biodegradable material such as plastic that might harm the environment in the future. The study is also significant as it promotes the eco-friendly biodegradable material to replace the usage of plastic and other non-biodegradable materials in daily life.

LITERATURE REVIEW

The increase of production and demand in biodegradable packaging will continue to grow due to the improvement of the properties and the decreasing in the cost and will become more competitive compared to conventional packaging materials (Ivankovic´1 et al., 2017). In Indian culture, for example, the usage of plastic plates, leaf-based plates, and cups provides advantages, including renewability, biodegradability, non-toxicity and rich source of antioxidants (Hossam & Fahim, 2023). Waste material such as bagasse for pulp-based dinnerware, where tests confirmed its compliance with safety standards. The primary components of rice grains that influence the eating and cooking quality are lipids, protein, and starch (Zhou et al., 2002). Another raw material that is used in the biodegradable plates is peanut shells. It has a very low moisture content, which eliminate the need for drying treatment and is ideal for generating heat in household or industrial boilers (Perea-Moreno et al., 2018). Fiber from peanut shells exhibit excellent mechanical properties such as high tensile strength, modulus, and aspect ratio, besides being low cost, biodegradability and renewability (Mandala et al., 2023).

MATERIALS AND METHODS

The methodology is divided into three (3) sections. The first part is preparing the five (5) different samples that consist of pure rice (100%), pure peanut shell (100%), and mixes of both rice and peanut shell with ratios of 1:1, 1:2 and 2:1.

The raw material is ground until it becomes a fine powder. The material is then mixed with Arabic gum and hot water before it is transferred to the aluminum foil, pressed until the mixture is compact and heated in the oven. The second part of the sample is testing the sample with physical, chemical, and mechanical testing. The physical testing includes water absorption and burn tests. While for chemical testing, there are pH testing and acetone testing towards the sample. Another type of testing is mechanical testing, which is abrasion and hardness testing. The last part of this study is to collect all the data, analyzed it and identify the best material to be used in making biodegradable plates.

RESULTS

The first type of testing is physical testing, where the mass of the sample was measured before and after the sample was soaked with water for 24 hours. The results are shown in Table 1. Table 2 on other hand, shows the observation of the sample using microscope with a magnification of 100x and the smoke produced by the same after the sample was exposed to fire for 1 minute.

Table 1. The result of physical testing for water absorption for all five (5) samples

Sample	Mass Sample Before absorbed water (g)	Mass Sample After absorbed water (g)	Different in mass (g)	Percentage water absorption (%)
Pure peanut shell	10.52	35.74	25.22	239.71
Pure rice	17.73	24.05	6.32	35.64
1:1	8.32	30.07	21.75	261.66
2 peanut : 1 rice	7.42	24.58	17.16	231.26
2 rice : 1 peanut	8.96	57.74	48.78	544.20

Table 2. The observation of the texture of the sample and the smoke produced after exposed for fire for 1 minute

Sample	Pure peanut shells	Pure rice	1:1	2 peanut : 1 rice	2 rice : 1 peanut
Observation of sample using microscope 100x magnification.					
Rate Smoke*	4	1	3	3	5

*1- less smoke → 5- lots of smoke

The second type of testing is chemical testing, which involved finding the pH level for all the samples and the reaction of the sample if soaked with chemical solution (acetone) for 24 hours. The Table 3 shows the pH level of each sample and the percentage of acetone absorption by the sample.

Table 3. The pH level for the sample and percentage of acetone uptake after soaked in the acetone for 24 hours

Sample	pH Level	Before Sample (g)	After Sample (g)	Different in mass (g)	Percentage of acetone uptake (%)
Pure peanut shells	4.79	10.52 g	15.82 g	5.30	50.38%
Pure rice	6.31	17.73	20.50 g	2.77	15.63%
1:1	4.91	8.32 g	12.68 g	4.36	52.40%
2 Peanut shell : 1 Rice	4.97	7.42 g	16.35 g	8.93	120.35%
2 Rice : 1 Peanut shell	5.21	8.96 g	9.89 g	0.93	10.38%

The last mechanical testing is when the sample undergoes an abrasion test, where the surface of the sample is observed before and after, as shown in Table 4. Besides mechanical testing, the sample is also being tested with the instrument Durometer Type-D to determine the hardness of the surface, as shown in Table 5.

Table 4. The observation of the sample before and after the abrasion testing where the stroke is repeated for 10 times

Sample	Pure peanut shell	Pure rice	1: 1	2 peanut shell : 1 Rice	2 rice : 1 peanut shell
Before					
After					
Observation	• Obvious scratches. • Surface damaged. • Harsh texture	• Minor scratches • Surface is slightly damaged.	• Few slight scratches visible. • Surface not severely damaged.	• Small scratches • Surface is minorly damaged. • Harsh texture	• Small scratches • Surface is not severely damaged.

Table 5. Reading of durometer for each sample

Sample	Min 3 Area Sample
Pure peanut shell	1.167 mm
Pure rice	22.5 mm
1 : 1	4.167 mm
2 Peanut shell : 1 Rice	17.5 mm
2 Rice : 1 Peanut shell	2.83 mm

DISCUSSION/ANALYSIS

The chemical and physical properties for the biodegradable plates composed of different amounts of peanut shells and rice were assessed in this study. According to table 1, the pure rice sample in the water absorption test, is the least to absorb water, which is only 35.64%. Compare to others sample, which have more than 100% absorption, this shows that rice has low porosity materials, which improves the composites and makes them suitable for applications where moisture resistance is important. Water absorption in peanut shells decreased with the increase of weight fraction (Moaead et al., 2021). The pure rice sample also shows that it did not yield much smoke and burned gradually compared to pure peanut shells in the burn test. In addition, the structure of peanut shells can act as a physical barrier within polymer matrices (Liang et al., 2021).

As for chemical testing, the sample with pure rice has the highest pH level value, which is 6.31, while the peanut shells had the lowest, 4.79. According to the reseach, Indica rice starch exhibited acidic properties indicating that hydrogen ion concentration can vary between different types of starch (Singh et al., 2000). As a pH level near neutral is generally more secure and more compatible to be used as a plate to serve food. While the sample also undergoes acetone testing to assess chemical resistance. After soaking in acetone for 24 hours, the sample with a 2 rice : 1 peanut shell ratio, for instance, showed better resistance to solvents by retaining more of its initial mass.

The last part is the testing of mechanical testing. The abrasion tests revealed that the samples that were rich with rice were more resistant on the surface. The pure rice samples retained most of their surface whilst the pure peanut shells sample was damaged more on the surface. The sample also tested using a durometer shows that pure rice had the highest hardness value, 22.5 indicating that the rice increases the material's rigidity. However, the material may become fragile if it is very firm. The pure peanut shell sample and other blends with a higher peanut shell content, on the other hand, showed lower hardness values, which may offer greater flexibility and resistance to cracking under pressure.

CONCLUSIONS

The highest performance of pure rice was observed during various tests. The pure rice sample has also shown a reasonable degree of hardness and ability to absorb water. Besides that, pure rice also has the lowest pH and the ability to resist burning and abrasion. As for the conclusion, the pure rice sample turned out to be the most stable and long-lasting. It is recommended that future studies should explore other waste materials and improve processing techniques to enhance the composite's performance. The usage of integrated husk rice biochar can also enhance soil organic carbon (Asadi et al., 2021). The peanut shell in this study can also actively become microwave assistance biochar that will yields high surface area and porosity (Qiu et al., 2023).

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