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2ND 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

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ISETC 2025 Proceedings Editors

RESISTANCE OF BIODEGRADABLE ORGANIC POT TO COMBAT SOIL AND ATMOSPHERIC MOISTURE

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Abstract: The composition of biodegradable organic materials significantly influences the moisture resistance of pots under both soil and atmospheric conditions. The primary objectives were to fabricate biodegradable pots for seedling use, assess their durability under varying moisture exposures, and determine the duration of resistance before structural degradation. The pots were produced from shredded newspaper pulp molded with tapioca starch into six pot shapes. These were exposed to three environmental conditions: buried in soil, placed in a moist atmosphere (with and without daily watering), and positioned on wet egg cartons to simulate capillary moisture exposure. The findings revealed that pots not exposed directly to moisture exhibited the longest resistance. Pots placed in moist atmospheric conditions degraded within approximately seven days, whereas those buried in soil resisted decomposition for up to 31 days despite exposure to fluctuating weather conditions. The study also found that pot wall thickness significantly influenced decomposition rate, with thicker-walled pots demonstrating enhanced durability. These results suggest that biodegradable pots can be optimized for environmental resistance through structural and placement considerations.

Keywords: *Biodegradable pot, soil moisture resistance, atmospheric degradation, organic materials, sustainable agriculture*

INTRODUCTION

The use of polyethylene-based poly bags in agriculture poses significant environmental challenges, including soil contamination, microplastic pollution, and adverse effects on soil health and biodiversity. Polyethylene bags, being non-biodegradable, accumulate in the environment, leading to diminished soil fertility and potential leaching of harmful chemicals into groundwater, which can affect both ecosystems and human health (Singh et al., 2020). Additionally, the degradation of polyethylene into microplastics disrupts soil microbial communities and alters soil properties, negatively impacting crop growth and water availability (Qiang et al., 2023). To mitigate these impacts, strategies such as increasing the collection rates of waste polyethylene, promoting biodegradable alternatives, and enhancing recycling technologies are essential (Adeyanju et al., 2024). Furthermore, policy reforms aimed at sustainable waste management, and the development of bio-based plastics could significantly reduce the ecological footprint of agricultural plastics (Adeyanju et al., 2024).

The primary objectives of this study are to develop a biodegradable pot suitable for seedling cultivation, evaluate its resistance to soil and atmospheric moisture, and determine the duration it can withstand these environmental conditions before decomposition. This research emphasizes the potential of biodegradable organic pots as an eco-friendly alternative to conventional plastic poly bags, with the added advantage of being directly plantable into the soil. Composed of recycled materials, the pots are designed to degrade naturally over time, minimizing environmental impact. Additionally, the design supports uninterrupted root growth, as the roots can extend through the pot walls without disturbance throughout the cultivation process.

The use of biodegradable organic pots, such as those made from recycled waste leaf litter, positively impacts soil quality and ecosystem health over the long term by enhancing microbial activity and nutrient cycling. Research indicates that these pots exhibit superior biodegradability compared to traditional biodegradable options, leading to increased soil CO₂ efflux and microbial enzyme activity, which are crucial for soil health (Ko et al., 2023). Additionally, the incorporation of biodegradable materials in agricultural practices, such as biodegradable plastic mulches, has shown minimal adverse effects on soil microbial communities, suggesting that they can be a sustainable

alternative to conventional plastics without significantly disrupting soil functions (Bandopadhyay et al., 2019; Zhang et al., 2020). Long-term studies on organic farming systems reveal that organic practices, which may include the use of biodegradable pots, contribute to improved soil organic carbon levels and biological soil quality, further supporting ecosystem resilience (Krause et al., 2022). Overall, biodegradable organic pots can enhance soil health and contribute to sustainable agricultural practices by promoting beneficial microbial communities and nutrient dynamics.

MATERIALS AND METHODS

A sufficient quantity of old newspapers was collected as the primary raw material for pot fabrication. The newspapers were manually torn into small, uniform pieces to facilitate further processing. These pieces were soaked in clean water for approximately five minutes to soften the fibers. Following the soaking period, the newspaper was mashed thoroughly to produce a homogeneous pulp. Tapioca starch was mixed with water and stirred until a smooth, lump-free paste was formed, serving as the binding agent. The tapioca starch paste was then gradually poured into the mashed newspaper pulp. The mixture was kneaded until a pliable, uniform consistency suitable for molding was achieved. The pulp mixture was shaped by hand into six pot-like forms, each designed to hold soil. Care was taken to ensure structural integrity and consistent wall thickness during the molding process. The formed pots were placed in an oven and dried at a controlled temperature until they were fully hardened and moisture-free. Upon drying, the pots were labeled as Pot A, B, C, D, E, and F. Pots A, C, and E were designated as large-sized pots, whereas Pots B, D, and F were classified as medium-sized pots based on their dimensions.

To evaluate the durability and biodegradability of the fabricated pots under different environmental conditions, various exposure methods were applied. Pots A and B were completely buried in soil to simulate subsurface degradation. Pots C and D were filled with soil and exposed to ambient atmospheric moisture; however, only Pot C received daily watering to assess the impact of sustained hydration. In contrast, Pots E and F were placed on top of egg cartons that were submerged in water, allowing moisture absorption through capillary action. The duration each pot resisted structural degradation under these respective conditions soil burial, atmospheric moisture, and water contact was systematically observed and recorded over time.

RESULTS/DISCUSSIONS

To assess material resilience, Table 1 illustrates the duration each pot type retained its structural integrity, highlighting key differences relevant for sustainable product development.

Table 1. Duration of Pots Maintaining Structural Integrity

Pot	Final Day of Structural Integrity	Environment Condition	Notes
A	Day 21	Buried in soil	Decomposed after 21 days
B	Day 31	Buried in soil	Highest durability overall
C	Day 7	Moist environment (daily watering)	Decomposed fastest
D	Day 31	Moist environment (no watering)	High durability in atmospheric exposure
E	Day 12	On wet egg carton	Moderate resistance
F	Day 31	On wet egg carton	High resistance despite water contact

Pot B, D, and F maintained their structural integrity the longest up to Day 31 indicating strong resistance under soil burial, dry atmosphere, and wet substrate conditions, respectively. Pot C degraded the quickest, lasting only 7 days, likely due to continuous watering accelerating biodegradation. Pot E also showed relatively lower resistance (12 days), possibly due to its thinner structure or prolonged base moisture exposure. Differences in performance may also be attributed to pot wall thickness and moisture absorption rates across environments.

The structural durability of biodegradable pots varied significantly across different environmental conditions, as illustrated in Table 1 and the corresponding graph. Among the six pots tested, Pots B, D, and F demonstrated the highest resistance, each maintaining their shape for the full 31-day observation period. These results highlight the potential of biodegradable materials to perform well under varying degrees of environmental stress when designed with appropriate structural properties.

Pot B, buried in soil, exhibited prolonged resistance despite exposure to microbial activity, moisture, and fluctuating temperature conditions. Its durability may be attributed to limited oxygen exposure, which could have slowed decomposition. Similarly, Pot D, exposed to atmospheric moisture without direct watering, maintained its shape throughout the study, suggesting that the absence of active water contact significantly delays biodegradation.

In contrast, Pot C, which was subjected to daily watering in a moist atmospheric environment, showed the shortest lifespan only 7 days before structural failure. This outcome underscores the sensitivity of biodegradable materials to prolonged surface moisture, especially when water saturation weakens the fibrous matrix. Pot E, placed on a wet egg carton, lasted for 12 days, indicating moderate resistance. The early degradation may be due to continuous exposure to moisture at the base, which facilitates capillary action and accelerates the breakdown process.

An important factor influencing these results is the thickness of the pot walls. While not explicitly measured, observational differences suggest that thicker pots (likely B, D, and F) were more resistant, aligning with the principle that denser, more compact biodegradable structures take longer to decompose. This finding reinforces the idea that physical structure and environmental exposure act synergistically in determining biodegradation rates.

Biodegradable pots made from recycled newspaper and tapioca starch present a viable eco-friendly alternative to traditional plastic poly bags in agriculture. The increasing environmental concerns surrounding plastic waste, particularly its detrimental effects on soil health and biodiversity, underscore the need for sustainable solutions (Jaya et al., 2023; Gamage et al., 2022). Starch, a key component in these biodegradable pots, is abundant, cost-effective, and possesses favorable mechanical properties, making it suitable for agricultural applications (Sharma, 2023). Moreover, starch-based biopolymers can be engineered to enhance their performance, serving multiple functions such as acting as fillers or carriers for biocides (Gamage et al., 2022). The transition to biodegradable materials not only mitigates plastic pollution but also aligns with sustainable agricultural practices, promoting a circular economy and reducing reliance on petrochemical products (Gamage et al., 2022). Thus, the integration of biodegradable pots into agricultural systems could significantly contribute to environmental sustainability.

Overall, this study demonstrates that biodegradable pots can achieve meaningful resistance to environmental degradation, particularly when protected from sustained surface moisture. The ability to tailor pot performance by modifying structure and selecting optimal placement environments provides a valuable pathway toward reducing plastic use in horticulture.

CONCLUSIONS

This study successfully demonstrated the fabrication and environmental resistance of biodegradable pots made from recycled newspaper and tapioca starch. The findings indicate that the durability of these pots varies significantly depending on their exposure to soil, atmospheric moisture, and water saturation. Pots buried in soil and those exposed to dry atmospheric conditions (without direct watering) maintained their structural integrity for up to 31 days, while those exposed to frequent watering or prolonged base moisture degraded more rapidly. These results confirm that environmental exposure and pot wall thickness are critical factors influencing the longevity of biodegradable materials. Overall, the study supports the feasibility of using biodegradable pots as an eco-friendly alternative to plastic poly bags in seedling cultivation.

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Tarikh : 20 Januari 2023



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Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

Setuju.

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