ECP 2025 Conference

The 4th International Electronic Conference on Processes

20–22 October 2025 | Online

MDPI

Development and Characterization of Biodegradable Packaging Material from Sugarcane Bagasse, Rice Straw, and Cogon Grass Leaves

K.K.M.G. Kavindya, K.G.P.N.Bandara

Department of Food Science & Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya

kavigaveshani1998@gmail.com

INTRODUCTION & OBJECTIVES

- The growing global surge in food demand, make the advancement of innovative packaging solutions increasingly vital.
- Polyethylene and plastics, pose significant environmental challenges due to their non-biodegradability.
- In response, biodegradable packaging materials derived from fibers obtained from agricultural byproducts and other readily available fiber sources are emerging as viable alternatives.

Objective

- To develop different formulations of packaging materials by changing ratios of sugarcane bagasse (SB), rice straw (RS) and cogon grass leaf (CGL) fiber.
- To evaluate and compare the physical and mechanical properties and biodegradability of developed packaging materials in each formulation and find the best formulation.

METHODOLOGY

Collecting each raw material and cutting in to pieces with 3-4cm length

⬇

Extracting fibers from each material using NaOH solution and washing extracted fibers thoroughly with water

⬇

Preparing sheets with different formulations of fiber by mixing them together : SB, RS, and CGL fiber in the ratios 1:1:1 (P1), 1:2:1 (P2), and 1:3:2 (P3)

⬇

Assessing physical and mechanical properties and biodegradability of each material

⬇

Selecting the formulation with best properties

⬇

Developing serval packages with different applications

Figure 01: Procedure of preparing the packaging material and analysis of properties

Figure 02: Prepared materials for several applications with P3 (SB : RS : CGL = 1:3:2) formulation

RESULTS & DISCUSSION

Table 01 : Physical and mechanical properties of the prepared films

Property of the film (Mean ± SD)	P1	P2	P3
Biodegradability	58.33 ± 7.22^{ab}	37.50 ± 12.50^{ab}	63.63 ± 9.09^{a}
Water Vapour Transmission Rate	6.48 ± 1.56^{a}	5.89 ± 0.58^{b}	4.71 ± 0.59^{c}
Water Uptake Ratio	277.80 ± 19.20^{b}	304.60 ± 48.80^{a}	197.22 ± 9.62^{c}
Oil Uptake Ratio	174.06 ± 6.40^{a}	144.40 ± 19.20^{ab}	138.90 ± 24.10^{ab}
Water Activity	0.67 ± 0.01^{ab}	0.66 ± 0.01^{ab}	0.66 ± 0.02^{b}
Color Metrix	ΔL* value / Δa* value / Δ b* value	ΔL* value / Δa* value / Δ b* value	ΔL* value / Δa* value / Δ b* value
	-12.11± 0.83^{b} / 6.96 ± 0.43^{ab} / -3.67 ± 0.07^{c}	-14.56 ± 0.93^{bc} / 6.56 ± 0.17^{b} / -4.32 ± 0.63^{b}	-15.74 ± 0.06^{c} / 7.48 ± 0.13^{c} / -1.4167 ± 0.0929^{c}

P1= SB, RS, and CGL fiber in 1:1:1 ratio, P2 = SB, RS, and CGL fiber in 1:2:1 ratio, P3 = SB, RS, and CGL fiber in 1:3:2 ratio

CONCLUSION

- The P3 formulation exhibited the best physical and mechanical properties and biodegradability, making it the most eco-friendly and suitable packaging formulation.
- Thus P3 formulation is the most suitable material for versatile packaging applications such as flexible pouches and molded pulp products due to its superior performance

REFERENCES

- Alamri, Qasem, A. A., Mohamed, A. A., Hussain, S., Ibraheem, M. A., Shamlan, G., Alqah, H. A., & Qasha, A. S. (2021). Food packaging's materials: A food safety perspective. *Saudi Journal of Biological Sciences*, *28*(8), 4490–4499. https://doi.org/10.1016/j.sjbs.2021.04.047
- Alcántara, J. C., González, I., Pareta, M. M., & Vilaseca, F. (2020). Biocomposites from rice straw nanofibers: morphology, thermal and mechanical properties. *Materials*, *13*(9), 2138. https://doi.org/10.3390/ma13092138