



Utilization of Composite Board from Button Top Shells and Guest Tree Fiber

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Abstract: The growing need for affordable, sustainable and environmentally friendly materials in construction and furniture has encouraged researcher to explore alternatives to traditional wood-based panels. The study aimed to determine the mechanical properties of the composite board in terms of flexural strength, compressive strength, and density; assess its acceptability based on appearance, texture, and firmness; evaluate its applicability for furniture and wall cladding; and test for significant differences among three treatment formulations. An experimental-developmental research design was employed, utilizing a Completely Randomized Design (CRD) with three treatment combinations varying in the proportion of button top shells and guest tree fiber while maintaining epoxy resin as a constant binder. Findings revealed that Treatment C (230g button top shells 20g guest tree fiber) generally exhibited the highest mechanical performance in terms of flexural and compressive strength, while Treatment B (220g button top shells 30g guest tree fiber) showed the most stable density results. In sensory evaluation, all treatments were rated acceptable, with Treatment A (210g button top shells 40g guest tree fiber) obtaining higher scores in appearance and Treatment C (230g button top shells 20g guest tree fiber) rated highest in firmness. In terms of applicability, all treatments were considered suitable for furniture and wall cladding applications. However, only appearance showed a significant difference among treatments, while texture, firmness, acceptability, and applicability showed no significant differences.

Keywords: Composite Board, Button Top Shells, Guest Tree Fiber, Natural Fiber Composite, Shell-Based Composite

I. INTRODUCTION

Researchers are investigating alternatives to conventional wood-based panels due to the increasing need for reasonably priced, environmentally friendly, and sustainable materials in furniture and building. The capacity of composite boards to offer good mechanical strength, durability, and resistance to climatic conditions has drawn attention. Despite these advancements, widely used materials like particleboard and plywood still mostly rely on virgin wood and synthetic adhesives, especially urea-formaldehyde resins, which are known to produce hazardous emissions and raise environmental concerns (Azman et al., 2021)[1].

A composite board is a material produced by combining two or more distinct constituent materials, typically a matrix and a reinforcement, whose synergistic interaction results in properties superior to those of the individual components alone (La Rosa et al., 2019)[2]. Due to these advantages, composite boards are widely used in construction (e.g., wall panels, partitions, and flooring), furniture manufacturing, packaging materials, and interior applications, where lightweight, cost-effective, and sustainable alternatives to solid wood are increasingly demanded.

This study is to explore the possibilities of button top shells and guest tree fibers as alternative raw materials for composite board manufacture that are plentiful and locally accessible, motivated by the growing need for sustainable composite materials. Both materials are easily accessible locally, free, or quite inexpensive. Because of this, producing composite boards is practicable, accessible, and reasonably priced. Additionally, this encourages using local resources rather than depending on imported ones.

The primary purpose of the study aimed to utilized button top shells and Guest tree fiber as a composite board. Specifically, it sought to:

1. determine the mechanical properties of the composite board from button top shells and guest tree fiber in terms of compressive strength, flexural strength, and density;
2. determine the acceptability of the composite board from button top shells and guest tree fiber in terms of sensory qualities such as appearance, texture, and firmness among three (3) treatments;



3. determine the acceptability of composite board from button top shells and guest tree fiber when applied as material for furniture making and wall cladding;

II. METHODOLOGY

This study employed the experimental-developmental method of research to achieve its objectives which involves a systematic process designed for scientific testing, typically examining the relationship between two variables. In this method, one group of variables is kept constant to serve as a control, while the other varies to observe effects (Sirisilla, 2023).

III. EXPERIMENTAL DESIGN AND TREATMENTS

Three treatments were designed and formulated to develop the composite board using the fiber of the guest tree and button top shells. Treatment A composed of 210g button top shells, 40g guest tree fiber, 118ml epoxy resin, Treatment B composed of 220g button top shells, 30g guest tree fiber 118ml epoxy resin and Treatment C composed of 230g button top shells, 20g guest tree fiber, 118ml epoxy resin. This controlled setup allowed the researcher to isolate the effects of the independent variable (material composition) on the dependent variables, which included mechanical properties, sensory acceptability, and applicability.

A. Materials

The following are the materials to be used in the process of composite board; Mortar and pestle, sieving screen, putty trowel, composite board molder, weighing scale, measuring cup, button top shells, Guest tree fiber, oil and epoxy resin.

B. Cost Analysis

Component	Unit	Description	Value	Remarks
Button Top Shells	230 grams	Raw materials		Collected
Guest Tree Fiber	250 grams	Raw material		Collected
Epoxy resin	118 ml	Binding agent	80	Purchased
Oil	1 ml	Release agent	5	Purchased
Molder	4"x 12"x 1/4"			Fabricated
		Total	85	

IV. RESULTS AND DISCUSSION

The data showed in table 1 presents the computed mean of mechanical strength of composite board such as compressive strength, flexural strength and density. The results indicate that all treatment exhibited compressive strengths within a close range, showing that the composite boards possessed good mechanical performance. However, Treatment C demonstrated the best overall performance due to its highest mean compressive strength of 31.9. According to earlier research, when the fiber content is appropriately tuned, the addition of particle reinforcements to natural fibers can increase the compressive strength of composite materials (Ilyas et al., 2022) [3]. Similarly, studies on shell-based fillers showed that when calcium-rich particulate materials are successfully bound with polymer binders, they enhance matrix densification and increase load-bearing ability (Liu et al., 2019) [4].

In terms in the flexural strength Treatment C recorded the highest mean flexural strength among all treatments, indicating that increasing the proportion of button top shells and reducing the amount of guest tree fiber improved the board's resistance to bending forces. The findings indicate that the composition of button top shells and guest tree fiber influences the flexural strength of the composite board. Increasing the amount of button top shells appears to enhance the mechanical performance of the material, particularly in terms of flexural strength. Among the treatments, Treatment C demonstrated the best performance.

In terms of Density the findings indicate that the varying proportions of button top shells and guest tree fiber influenced the density of the composite board. Among the treatments, Treatment B exhibited the highest density, suggesting better



compactness and structural integrity, while Treatments A and C also demonstrated relatively high-density values suitable for composite board applications. The results imply that button top shells and guest tree fibers have the potential to produce durable and compact eco-friendly composite boards for furniture making and other practical uses. The obtained results are consistent with research on natural fiber-reinforced composites, which found that optimal fiber content and appropriately compressed filler particles enhance density. Sharma et al. (2022)[5] claim that balanced fiber-to-filler ratios in hybrid composites result in increased resin impregnation and less void formation, which improve density.

TABLE 1. MECHANICAL PROPERTIES OF COMPOSITE BOARD IN TERMS OF COMPRESSIVE STRENGTH, FLEXURAL STRENGTH AND DENSITY

Treatment	Compressive Mean	Verbal Interpretation	Flexural mean	Verbal Interpretation	Density Mean	Verbal Interpretation
A	31.87	High Compressive Strength	22.89	Low Flexural Strength	2.11g/cm ³	Very High Density
B	31.3	High Compressive Strength	63.81	High Flexural Strength	2.17g/cm ³	Very High Density
C	31.9	High Compressive Strength	70.15	High Flexural Strength	2.14g/cm ³	Very High Density

The data showed in table 2 presents the acceptability of the composite board in terms of sensory qualities such as appearance, texture and firmness.

In terms of Appearance Treatment A (210g button top shells and 40g guest tree fiber) obtained the highest mean score of 4.60, described as Very Acceptable. This indicated that evaluators strongly preferred its visual characteristics. The higher fiber content in Treatment A may have contributed to a more natural and heterogeneous surface texture, which enhanced its aesthetic appeal.

For texture, Treatment A (210g button top shells 40g guest tree fiber) again recorded the highest mean score of 4.10, described as Acceptable. This result suggested that the higher fiber proportion contributed to a smoother tactile surface due to improved interlocking between fibers and shell particles, which reduced surface roughness.

In terms of firmness, Treatment C (220g button top shells 30g guest tree fiber) achieved the highest mean score of 4.43, described as Very Acceptable. This indicated superior structural rigidity, likely due to the higher proportion of button top shells (230g), which enhanced compaction and resistance to deformation. The reduced fiber content also minimized internal flexibility, resulting in a stiffer composite structure.

TABLE 2 ACCEPTABILITY OF COMPOSITE BOARD IN SENSORY QUALITIES SUCH AS APPEARANCE, TEXTURE AND FIRMNESS

Acceptability Attributes	Treatment A 210g Button Top Shells 40g Guest Tree Fiber)		Treatment B 220g Button Top Shells 30g Guest Tree Fiber		Treatment C 230g Button Top Shells 20g Guest Tree Fiber	
	Mean	Verbal Interpretation	Mean	Verbal Interpretation	Mean	Verbal Interpretation
Appearance	4.60	Very Acceptable	3.90	Acceptable	4.00	Acceptable
Texture	4.10	Acceptable	3.70	Acceptable	3.87	Acceptable
Firmness	3.97	Acceptable	3.90	Acceptable	4.43	Very Acceptable
Overall Mean	4.22	Very Acceptable	3.83	Acceptable	4.10	Acceptable

The data showed in table 3 presents the acceptability of the composite board when you applied in Furniture and Wall Cladding. For furniture making, Treatment A (210g shells, 40g fiber) obtained the highest mean score of 4.47, described as Very Acceptable. This indicated strong suitability for furniture applications. The higher fiber content likely contributed to improved workability and bonding flexibility, allowing the material to adapt well to shaping and structural assembly in furniture components. The fiber reinforcement may have also enhanced surface finishing quality, which is critical in furniture production.



For wall cladding, Treatment A (210g button top shells, 40g guest tree fiber) again obtained a high mean score of 4.43, described as Very Acceptable. This suggested that its balanced flexibility and surface quality made it highly suitable for interior and decorative wall applications. The fiber-rich composition likely enhanced adhesion and reduced brittleness, which is important for cladding installations.

TABLE 3. ACCEPTABILITY OF COMPOSITE BOARD WHEN APPLIED IN FURNITURE MAKING AND WALL CLADDING

Product	Treatment A 210g Button Top Shells 40g Guest Tree Fiber)		Treatment B 220g Button Top Shells 30g Guest Tree Fiber		Treatment C 230g Button Top Shells 20g Guest Tree Fiber	
	Mean	Verbal Interpretation	Mean	Verbal Interpretation	Mean	Verbal Interpretation
Furniture	4.47	Very Acceptable	4.10	Acceptable	4.17	Acceptable
Wall Cladding	4.43	Very Acceptable	4.03	Acceptable	4.40	Very Acceptable
Overall Mean	4.35	Very Acceptable	4.06	Acceptable	4.13	Acceptable

V. CONCLUSION

Based on the findings, the following conclusions were drawn:

In Mechanical properties, Treatment C (230g Button Top Shells, 20g Guest Tree Fiber) consistently demonstrated the highest flexural and compressive strength. Meanwhile, Treatment B (220g Button Top Shells 30g Guest Tree Fiber) showed the most stable density performance, and Treatment A (201g Button Top Shells 40g Guest Tree Fiber) generally exhibited lower and more variable mechanical results. This implies that a higher proportion of shell particles contributed to improved strength and compaction of the composite board.

It was concluded that Treatment A (201g Button Top Shells 40g Guest Tree Fiber) was most preferred in terms of appearance while Treatment C (230g Button Top Shells 20g Guest Tree Fiber) was rated highest in firmness. Texture was found to be relatively consistent across all treatments, indicating that all formulations produced acceptable surface quality.

All composite board treatments were acceptable for furniture making and wall cladding. Treatment A was considered more suitable for furniture making and wall cladding applications and Treatment C also considered very applicable for wall cladding. Overall, the study confirmed that all formulations possess practical usability in construction-related applications.

REFERENCES

- [1]. Azman, M. A. H. M., Sobri, S. A., Norizan, M. N., Ismail, H., & Nurazzi, N. M. (2021). Life cycle assessment of particleboard: Investigation of environmental parameters. *Polymers*, 13(13), 2043. <https://doi.org/10.3390/polym13132043>
- [2]. La Rosa, A. D., et al. (2019). Development of composite boards from agricultural waste and marine shells. *Journal of Cleaner Production*, 227, 1120–1128.
- [3]. Sirisilla, S. (2023). Bridging the gap: Overcome these 7 flaws in descriptive research design. Enago Academy. <https://www.enago.com/academy/descriptive-research-design/>
- [4]. Ilyas, R. A., Sapuan, S. M., Ishak, M. R., Zainudin, E. S., & Atikah, M. S. (2022). Development and characterization of natural fiber–reinforced polymer composites: A review. *Journal of Materials Research and Technology*, 18, 2512–2538. <https://doi.org/10.1016/j.jmrt.2022.03.123>
- [5]. Sharma, S., Gupta, M., & Singh, N. (2022). Hybrid natural fiber composites: Processing and mechanical behavior. *Journal of Cleaner Production*, 335, 130324.