The Potential of Coconut Husk *(Cocos nucifera)* and White Leg Shrimp Shells *(Litopenaeus vannamei)* as Bioplastic

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Abstract: This study aimed to produce a potential bioplastic film using coconut husk and white leg shrimp shells with different concentrations. The research methodology used an experimental design that involved four tests to investigate the significant differences of the bioplastic film. The result showed that Concentration C, which contains 25% lignin and 75% chitosan, has the most effective bioplastic film in terms of thermal behavior. Thus, the first null hypothesis was rejected. The test results also showed that there was a significant effect of different concentrations in terms of heat resistance; however, there was no significant difference in terms of the tensile strength, water absorbability, and biodegradability of the film. With regard to the second hypothesis, the null hypothesis was rejected with regard to heat resistance and accepted with regard to tensile strength, water absorbability, and biodegradability. This study concluded the potential of coconut husk and white-leg shrimp shells as bioplastics.

Key Words: bioplastic; lignin; chitosan; coconut husk; shrimp shells

1. INTRODUCTION

Arikan et al. (2015), stated that bioplastics are among the most environmentally friendly materials currently created. The Goal 12: Responsible consumption and production, is promoting recycling and waste reduction among businesses, industries, and consumers. The study solely focused on examining the potential of the white leg shrimp shells and coconut husk. The researcher is only up to the purpose of gathering the necessary data that is related to the topic.

2. METHODOLOGY
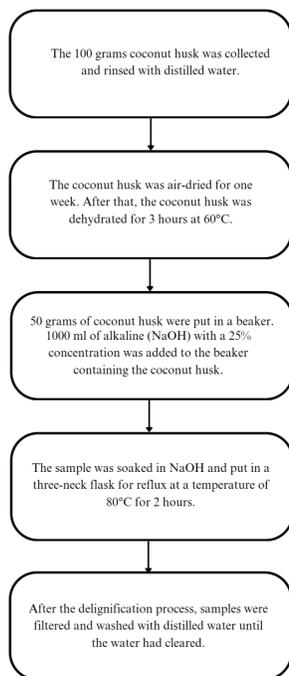
2.1 Methodology Flowchart

The 100 grams coconut husk was collected and rinsed with distilled water.

The coconut husk was air-dried for one week. After that, the coconut husk was dehydrated for 3 hours at 60°C.

50 grams of coconut husk were put in a beaker. 1000 ml of alkaline (NaOH) with a 25% concentration was added to the beaker containing the coconut husk.

The sample was soaked in NaOH and put in a three-neck flask for reflux at a temperature of 80°C for 2 hours.

After the delignification process, samples were filtered and washed with distilled water until the water had cleared.

Figure 1. Lignin Extraction from Coconut Husk *(Cocos nucifera)*

The 100 grams of white leg shrimp shells were collected and weighed. The shrimp shells were rinsed with distilled water.

The shells were put in the dehydrator for 3 hours at 60°C.
The dried shells were collected and powderized using a grinder and a blender.

Subject 10 grams of powdered shells to a treatment using 2N hydrochloric acid, maintaining a solid-to-solvent ratio of 1:15. Perform the treatment for 2 hours with continuous stirring, using a water bath set at 50°C on a hot plate.

The 5% (2 N) sodium hydroxide (NaOH) with a ratio of 1:20 was used to remove proteins by heating the mixture at 50°C for 2 hours. The deproteinized product was collected and washed with distilled water.

1g of chitin was added to 50% NaOH for 1 hour using an autoclave. It was followed by washing with distilled water until it reached a neutral pH and drying the sample.

Figure 2. Chitosan extraction from White Leg Shrimp shells (Litopenaeus vannamei)

The experiment involved collecting and weighing 100 grams of coconut husks, dehydrating them at 60°C for 3 hours, powderizing them, and then weighing 50 grams. The samples were then soaked in 10000mL NaOH alkaline, refluxed at 80°C for 2 hours, and filtered. The husks were washed with distilled water to clear the water.
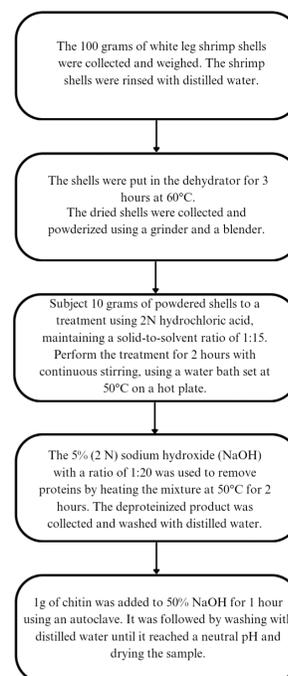
White leg shrimp shells were collected, weighed, and dried for a week. After dehydration, they were powdered using a mortar and blender. Chitosan extraction was done through demineralization, deproteination, and deacetylation. Demineralization involved treating shells with hydrochloric acid for 2 hours, followed by washing with tap water and distilled water. Deproteinization involved treating shells with NaOH for 2 hours, followed by washing. Deacetylation involved adding chitin to NaOH for 1 hour, followed by washing with distilled water.
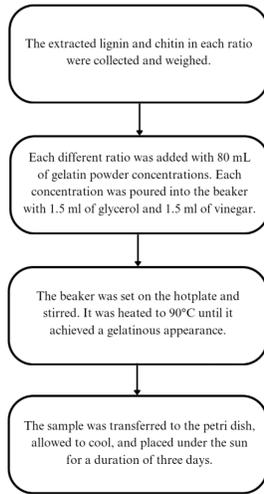
Figure 3. Bioplastic Film Production

The extracted lignin and chitin were measured in different ratios and combined with 80mL Gelatin powder. The mixture was stirred, heated at 90°C, and then placed in a petri dish. It was then left to cool and exposed to sunlight for three days.

3. RESULTS AND DISCUSSION

Table 1 shows load test results, comparing different weights until breaking. ANOVA test results show no significant difference in tensile strength between concentrations. Since the table f=5.14 is greater than the computed value f=4.32, Ho is accepted.

Table 1. Load Test Results

	A 2:2 Lignin Chitosan	B 3:1 Lignin Chitosan	C 1:3 Lignin Chitosan
Trial 1	7 grams	13 grams	18 grams
Trial 2	3 grams	25 grams	13 grams

Trial 2	13 grams	18 grams	18 grams

Table 2. Data Summary

Groups	N	$\sum x$	Mean	$\sum x^2$	Standard Deviation
A	3	23	7.67	227	5.0332
B	3	56	18.67	1118	6.0277
C	3	49	16.33	817	2.8868
Total	9	128	14.222	2162	

Table 3. ANOVA Summary

Source	DF	SS	MS	F-Stat	P-Value
Between Groups	2	201.56	100.78	4.32	0
Within Groups	6	140	23.33		
Total	8	341.56			

Table 4 displays water absorption results of bioplastic film soaked in 100ml water for 24 hours, showing no differences in absorbability between different concentrations.

Table 4. Water Absorption Results

	A 2:2 Lignin Chitosan	B 3:1 Lignin Chitosan	C 1:3 Lignin Chitosan
Trial 1	dissolved	dissolved	dissolved
Trial 2	dissolved	dissolved	dissolved
Trial 3	dissolved	dissolved	dissolved

Table 5 demonstrates the biodegradability of bioplastic film samples

in soil for 7 days. Results show slight shrinkage in Concentration A, B, and C, with no significant differences in biodegradability across different concentrations, indicating no significant differences.

Table 5. Biodegradability Test Results

	A 2:2 Lignin Chitosan	B 3:1 Lignin Chitosan	C 1:3 Lignin Chitosan
Trial 1	slightly shrunk	slightly shrunk	slightly shrunk
Trial 2	shrunk	slightly shrunk	slightly shrunk
Trial 3	shrunk	slightly shrunk	no trace of shrinking

Table 6 displays heat resistance results of bioplastic film, with significant differences between concentrations. ANOVA test reveals f=5.14 less than computed value f=7, thus Ho was rejected.

Table 6. Heat Resistance Results

	A 2:2 Lignin Chitosan	B 3:1 Lignin Chitosan	C 1:3 Lignin Chitosan
Trial 1	45°C	45°C	135°C
Trial 2	135°C	45°C	135°C
Trial 3	45°C	45°C	135°C

Table 7. Data Summary

Groups	N	$\sum x$	Mean	$\sum x^2$	Standard Deviation
A	3	225	75	22275	51.9615
B	3	135	45	6075	0
C	3	405	135	54675	0
Total	9	765	85	83025	

Table 8. ANOVA Summary

Source	DF	SS	MS	F-Stat	P-Value
Between Groups	2	12600	6300	7	0
Within Groups	6	5400	900		
Total	8	18000			

Table 9. Post-Hoc Tukey HSD

Treatment Pairs	Tukey HSD Q Statistics	Tukey HSD p-value	Tukey Inference
A vs B	1.7321	0.4836095	insignificant
A vs C	3.4641	0.1064961	insignificant
B vs C	5.1962	0.0241126	*p<0.05

4. CONCLUSIONS

The researchers found out that the extracted lignin from coconut husk and the extracted chitosan from white leg shrimp shells can be used as components for making bioplastic film. There was a difference between different concentrations of the film; therefore, in the first hypothesis, the null hypothesis was rejected. Different concentrations had significant differences in terms of heat resistance only. In the second hypothesis, the null hypothesis was rejected in terms of thermal behavior and

accepted in terms of tensile strength, water absorbability, and biodegradability. Therefore, concentration C is the most effective bioplastic film among the other concentrations.

5. RECOMMENDATIONS

Researchers recommend extending experimentation period, increasing raw material quantities, and comparing bioplastic film product to commercial bioplastic for accurate results and future use.

6. ACKNOWLEDGMENTS

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7. REFERENCES

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