ASEAN Journal of Science and Engineering

Journal homepage: http://ejournal.upi.edu/index.php/AJSE/

Bioplastic from Seaweeds (*Eucheuma Cottonii*) as an Alternative Plastic

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ABSTRACT

This study aims to determine the capability of seaweed (Eucheuma cottonii) as a bioplastic material on varying concentrations of glycerine (10, 20, and 30mL) in terms of (1) tensile strength, and (2) biodegradability. In making the bioplastic, the researchers dried and extracted several seaweeds, used glycerine as the plasticizer, water as the solvent, corn-starch as the thickener, and vinegar to help the starch dissolve easily. After mixing all the ingredients on a hot pan, we placed them on a flat surface lined with foil as soon as possible before the product starts to solidify. It took 3-4 days to harden, depending on how thick the product is. The results in testing the tensile strength revealed that the less amount of glycerine allowed the harder bioplastic produced. The biodegradability test showed that glycerine components caused the plastics to differ in size, shape, moisture, texture, and how fast they degrade, as well as the tensile strength. However, in testing biodegradability, there is no significant difference in the level of glycerine concentration. This study presents how the seaweed bioplastic was created, what it contributes to the community, and how the ecosystem benefits from it, such as reducing the usage of synthetic plastic.

ARTICLE INFO

Article History:
Submitted/Received 29 Feb 2021
First revised 10 Apr 2021
Accepted 10 Aug 2021
First available online 19 Aug 2021
Publication date 01 Sep 2022

Keyword:
Biodegradability,
Bioplastic,
Glycerine,
Plastic pollution,
Seaweed,
Tensile strength.

1. INTRODUCTION

One of the serious problems the world is facing today is plastic pollution. This study shows the capability of bioplastic to reduce the usage of synthetic plastics. Guso is a seaweed alga that belongs to the red algae family (*Rhodophyta*), where agar is obtained and used for bioplastic processing.

The main objective of the research was to reach the biodegradable plastics industry as alternatives to non-biodegradable plastics (Naesa *et al*., 2019). Algae serve as a good candidate for bioplastic processing. Seaweed is getting considered as an alternative resource to produce biofuels, biochemicals, and food (Sudhakar *et al*., 2018). Due to the seaweeds' high biomass, it is used as one of the alternatives for the development of bioplastics (Rajendran *et al*., 2012). Seaweed is commonly used as bioplastic in the packaging industry (Gade *et al*., 2013).

The purpose of conducting this research is to determine the seaweed's capability as bioplastics as alternatives to synthetic plastic and to explore different ways to enhance bioplastic properties made from seaweed and find a better and more reliable approach for making seaweed-based bioplastic. This study aims to determine the capability of seaweed (*Eucheuma cottonii)* as bioplastic material on varying concentrations of glycerine (10, 20, and 30 mL) in terms of (1) tensile strength, and (2) biodegradability. In making the bioplastic, the researchers dried and extracted several seaweeds, used glycerine as the plasticizer, water as a solvent, corn-starch as the thickener, and vinegar to help the starch dissolve easily.

2. METHOD

This research used a descriptive-experimental design with a quantitative approach to minimize petroleum-based plastic production by manufacturing biodegradable plastic. **Table 1** shows the formulations used in this study. To produce the product, this study used dried seaweed, cornstarch, water, vinegar, and glycerine. All chemicals were purchased from local markets and used without purification.

In the production of bioplastic, the seaweeds were dried and extracted. Then, it was put on a hot pan, together with the other components. After mixing all the ingredients until it thickens, the mixture was poured on a flat and dry surface lined with a foil as soon as possible before the product starts to solidify. It took three to four days for the bioplastics to harden, depending on how thick the product is.

Table 1. The formulations used in this study.

Formula 1	Formula 2	Formula 3
• Dried Seaweed 50g	• Dried Seaweed 50g	• Dried Seaweed 50g
• Cornstarch 30g	• Cornstarch 30g	• Cornstarch 30g
• Water 60mL	• Water 60mL	• Water 60mL
• Vinegar 5mL	• Vinegar 5mL	• Vinegar 5mL
• 10mL Glycerine	• 20mL Glycerine	• 30mL Glycerine

3. RESULT AND DISCUSSION

Table 2 shows the characteristics based on tensile strength. In the table, the researchers performed 3 trials in F1, F2, and F3. We used a spring balance to measure the strength of the samples. Treatment F1 (10 mL of glycerine) was the most capable of handling materials with

DOI: http://dx.doi.org/10. 17509/xxxxt.vxix
p- ISSN 2776-6098 e- ISSN 2776-5938

an average of 17.97 N while treatment F3 (30 mL of glycerine) was the least capable with an average of 6.2 N.

The biodegradability of the bioplastics was determined by burying them in the ground using the Soil Burial Method (see **Table 3**). **Table 3** shows that the treatment F1 (10 mL of glycerine) has the highest percentage among the other formulas with an average weight loss of 56.25%. It was then followed by treatment F3 (30 mL of glycerine) with an average weight loss of 55%. Lastly, treatment F2 (20 mL of glycerine) got the least percentage with an average weight loss of 49.5%.

Table 4 shows that the computed P-value, which is 1.63E-05 or 0.0000163, is less than the alpha level, 0.05. Given the results, the researchers concluded that the alternative hypothesis can be accepted.

Based on **Table 5**, the results show that the computed F, with the value of 0.04, is less than the F critical value that is 4.25. Also, the resulting P-value, which is 0.95, is greater than the alpha level (0.05). The researchers accepted the null hypothesis and rejected the alternative hypothesis.

Table 2. Result for testing the tensile strength.

Samples	Test 1	Test 2	Test 3	Total	Mean
F1 (10mL glycerine)	18.63 N	17.65 N	17.65 N	53.93 N	17.97667 N
F2 (20mL glycerine)	9.8 N	10.78 N	7.84 N	28.42 N	9.473333 N
F3 (30mL glycerine)	5.88 N	5.88 N	6.86 N	18.62 N	6.206667 N

Table 3. Result for testing the biodegradability.

Samples	Test 1 (Day 1- 3)	Test 2 (Day 4-6)	Test 3 (Day 7-9)	Test 4 (Day 10-12)	Total	Mean
F1 (10mL glycerine)	0.125	0.50	0.75	0.875	2.25	0.5625
F2 (20mL glycerine)	0.090	0.36	0.72	0.810	1.98	0.4950
F3 (30mL glycerine)	0.110	0.44	0.77	0.880	2.20	0.5500

Table 4. Analysis of variance for tensile strength.

Source of Variation	Sum of Squares	df	F	P-value	F critical
Between Groups	221.51069	2	115.3220996	1.63E-05*	5.1432528
Within Groups	5.76240	6			
Total	227.27309	8			

Table 5. Analysis of variance for biodegradability.

Source of Variation	Sum of Squares	df	F	P-value ns	F critical
Between Groups	0.01861667	2	0.04537125	0.9558597	4.2564947
Within Groups	1.023225	9			
Total	1.033541667	11			

4. CONCLUSION

Based on the observations, the result in testing the tensile strength revealed that the lower the level of the concentration of the glycerine, the harder and firmer the bioplastic becomes. The biodegradability test showed that the amount added and glycerine components caused

DOI: http://dx.doi.org/10.17509/ijost.v6ix
p- ISSN 2528-1410 e- ISSN 2527-8045

the plastics to differ in size, shape, moisture, texture, and how fast they degrade. In addition, there is a significant difference in the level of glycerine concentration in testing the tensile strength. However, in testing biodegradability, there is no significant difference in the level of glycerine concentration.

5. ACKNOWLEDGMENTS

Special thanks to the researchers' parents for their unconditional love, guidance, and support.

6. AUTHORS' NOTE

The author(s) declare(s) that there is no conflict of interest regarding the publication of this article. The authors confirmed that the data and the paper are free of plagiarism.

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DOI: http://dx.doi.org/10. 17509/xxxxt.vxix
p- ISSN 2776-6098 e- ISSN 2776-5938