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# MAKING BIODEGRADABLE PLASTIC FROM SEAWEED BY OVEN DRYING METHOD

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**Abstract:** Biodegradable plastic is an environmentally friendly plastic that can be decomposed by microorganisms. This study aims to produce bioplastics from seaweed Eucheuma cottonii using the oven drying method and to analyze the resulting physical properties. The study was carried out through several stages: sample preparation, filtrate production, mixing of additives (acetic acid and glycerol), casting, and drying in an oven at 80 °C with drying times varying from 4 to 18 hours. The results showed that 4 hours of oven drying produced bioplastics with a thin and flexible texture, while longer drying times (≥12 hours) resulted in darker colors and brittle textures. Water resistance tests showed that oven-dried bioplastics decomposed faster than those dried under sunlight. Thus, oven drying is effective for accelerating bioplastic production, although the optimal quality is still influenced by heating duration.
**Keywords:** bioplastic, Eucheuma cottonii, oven, biodegradable, glycerol

## 1. INTRODUCTION

Petroleum-based synthetic plastics are widely used in daily life, but they do not decompose easily and have the potential to pollute the environment. One alternative is biodegradable plastic, whose components come from natural materials. Eucheuma cottonii seaweed contains carrageenan that functions as a gel-forming agent so that it has the potential to be a bioplastic raw material. This study examines the manufacture of bioplastics based on E. cottonii using the oven drying method and testing its physical properties.

Conventional plastics made from polymers from petroleum have become the main cause of global environmental problems, especially due to their nature that is difficult to decompose naturally and the accumulation of plastic waste on land and sea. To address this, research on biodegradable plastics made from natural materials continues to develop with a focus on environmentally friendly materials and renewable sources, one of which is seaweed (Virginia, et al, 2025).

Seaweed, especially *Eucheuma cottonii*, has a content of polysaccharides such as carrageenan that can form gels, as well as the ability to be processed into bioplastic films with the addition of plasticizers such as glycerol, as well as other additives to improve its physical properties and decomposing power (Karylle Lyra, et al, 2022).

Several studies have shown that the composition (e.g. plasticizer level) and manufacturing process conditions including temperature and drying time have a significant influence on *tensile strength*, elongation, water resistance, and biodegradation rate (Sinda Intandiana, et al, 2019).

The drying method is one of the critical stages in the production of bioplastics because it affects water evaporation, film structure, and final mechanical properties. Oven drying is more controllable than natural drying (exposed to sunlight) in terms of temperature and humidity, and some studies have shown that using an oven can speed up the drying process and produce a more uniform film. However, too long or too high a temperature can cause damage to the polymer structure so that the film becomes brittle (Bazri, 2023).

Several local researchers in Indonesia have also explored the manufacture of bioplastics based on *Eucheuma cottonii*. For example, the Application of Modified Starch on Carrageenan-Based Bioplastic Spoon from *E. cottonii* which studies water resistance and decomposition with variations in the use of modified starch (Muhamad Dzaky, et al, 2023).

In addition, the research "Bioplastic Production from Eucheuma Cottoni" also examines the influence of the manufacturing temperature and composition of plasticizers on its strength and biodegradability (Gracia Ramaddhani Putri, 2019).

Based on a review of the current literature and previous practices, there are still research gaps related to optimizing oven drying time at a certain temperature to produce bioplastics from *E. cottonii* that have a balance between mechanical strength, decomposition power, and water resistance. Therefore, this study aims to make bioplastics from *Eucheuma cottonii* by oven drying method at a fixed temperature, but with variations in drying time, as well as testing its physical properties and decomposition power.

## 2. RESEARCH METHODS

The method used in this study was experimented at the Tual State Fisheries Polytechnic Laboratory through the drying method.

a. Material : seaweed *Eucheuma cottonii*, acetic acid 10%, glycerol, and aquades.
b. Tool : blenders, cups, hot plates, ovens, scales, and molds.

There are several stages in this study, namely:

1. Sample Preparation

Samples of Eucheuma cottonii *seaweed* were taken in the waters of the Kei Islands, Taar Village, Tual City. Sample preparation is carried out by washing and cleaning with running water which aims to clean the seaweed from sand and coral impurities that stick to the seaweed until it becomes clean. Next, the sample is mashed by cooking to produce a smooth and soft texture like Pulm (seaweed pulp). (Ni Luh Gede Sari Dewi, 2017).

2. Filtrate Manufacturing

    Sample of Eucheuma cottonii *seaweed* pulp 400 ml, mixed until homogeneous in a beaker. Then it is heated for 10-15 minutes with a hot plate. After that, *the Eucheuma cottonii extraction solution is filtered* so that it is separated between the filtrate and the precipitate.

3. The manufacture of bioplastics is the final stage of this study where the sample is squeezed in a beak cup and the extraction results are taken 400 ml then acetic acid and glycerol are added 1 ml each, then heated for 10 minutes on a hot plate. After 10 minutes it is lowered then put in a mold. Then the sample is weighed for wet weight. The final stage is the process of drying the sample with an oven for 4 hours each with a temperature of 80◦C to produce a pale yellow color, and it is dried again for up to 18 hours.

## 4. RESULTS AND DISCUSSION

Drying the sample for 4 hours produces a pale yellow bioplastic with a thin texture resembling conventional plastic. The longer drying time (18 hours) results in a dark, brittle, and even charred brown color, indicating carrageenan degradation due to overheating. Furthermore, mechanical tests and water resistance tests were carried out to assess the physical properties of the bioplastics produced.

Water resistance tests showed that bioplastics dissolve faster (10–15 minutes) than sun-dried bioplastics (1–24 hours). A simple Young modulus indicates that the oven's bioplastics are capable of withstanding a load of 500 g, but become brittle at higher loads. The young modulus is carried out to determine the mechanical properties of bioplastic materials in the form of strength and rigidity. *The best modulus of young* is found in both treatments, namely with the oven and also the sun. In the treatment of the bioplastic oven, it can lift a load of 500 g while in the sun at a load of 500 g, it feels like the bioplastic wants to tear/break. Bioplastics are capable of withstanding load weights of up to 502 g shown in Figure 1.

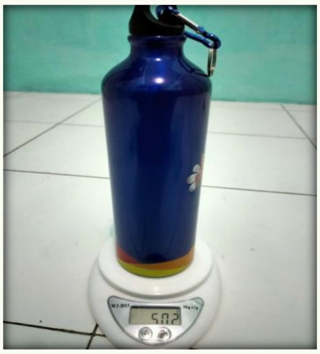
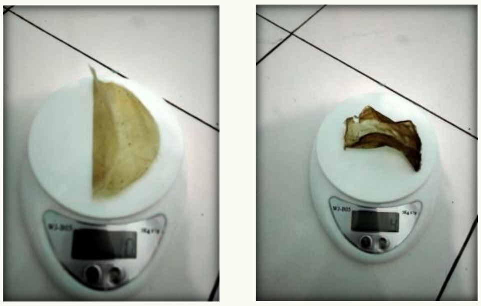


Figure 1. Bioplastics are able to withstand a load weight of 502 g

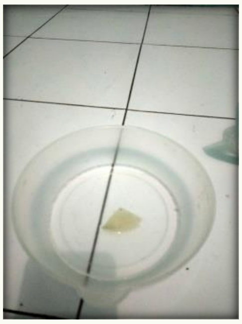
Figure 1 shows that up to a load of 502 g is still tested for its resistance to weight. The solubility test serves to determine the level or solubility of bioplastics in water. The test results show that bioplastics with the Oven treatment dissolve faster in about 10-15 minutes than the sun tends to last for about 1-24 hours. The bioplastic will become a bulging gel and when it reaches the maximum point it will split. The solubility value of bioplastics can be measured by comparing them to bioplastic water resistance with the calculation of water solubility (%) = 100% - *Water solubility* (%). The value of commercial water resistance according to SNI is 99% (Rahmadani, 2020). The greater the concentration of nanocellulose, the greater the maximum point to hold water and has a high concentration, viscosity and barrier properties (Widyaningsih, 2012).

After drying either by oven or sun, that with drying by oven the water resistance test showed that bioplastics decompose more quickly by oven compared to sun drying, shown in Figure 2 and Figure 3.

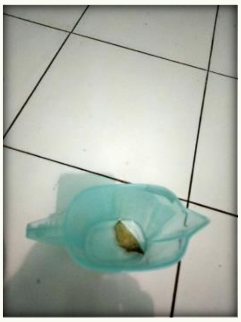


a. Sunlight b. Oven

Figure 2. Initial Weight Loss Bioplastics



a. Sunlight



b. Oven

Figure 3. Bioplastic samples are put in a container filled with water

Based on Figure 2 and Figure 3, the water resistance test treatment was carried out by initial weight weighing of bioplastics with oven and UV drying in Figure 2. The initial weight of the bioplastic, and the Bioplastic Sample is put in a container filled with water in Figure 3. Bioplastic samples are put in a container filled with water, then weighed so that the weight of bioplastic shrinkage is known at the final weight of the sample.

Oven drying is effective in accelerating the production of Bioplastics (Figures 2 and 3), but optimum quality is obtained at a not too long heating time. This is in line with research from Said (2018) and Bazri (2023) that temperature can affect bioplastic production.

## 4. CONCLUSIONS AND SUGGESTIONS

### CONCLUSION

Bioplastics can be made from Eucheuma cottonii with the addition of acetic acid and glycerol using the oven drying method. Optimum conditions are obtained at 4 hours of heating at a temperature of 80 °C. Oven bioplastics decompose faster in water, so they have the potential to be used as an environmentally friendly plastic alternative.

### SUGGESTION

Bioplastics can be done at 4 hours heating and a temperature of 80˚C.

## 5. ACKNOWLEDGMENTS

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