

Research Paper

Utilization Of Seaweed (*Eucheuma cottoni*) And Avocado Seeds (*Persea americana*) For Making

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Abstract: Capsules are solid preparations consist of the drug in a soluble hard or soft shell. Capsules are generally made by gelatin, it can also be starch or other suitable ingredients. The manufacture of capsules can be derived from seaweed in terms of abundance which can be used as raw material for making natural and halal capsules. Polysaccharide-based seaweed contains sodium, magnesium and calcium which are bound to sulfate ester groups. In addition, avocado seeds also have the potential with 80.1% starch content. The stages in the research are processing seaweed to be carrageenan, making avocado seed flour and making capsules. The carrageenan that produced according the FAO (Food agriculture Organization) standards including moisture, ash, viscosity, gel strength and heavy metals. This study has combined the ratio between avocado seeds and seaweed with a ratio of 1: 1; 1: 2; 1: 3, 2: 1; 2: 2; 2:3; 3: 1, 3: 2; 3: 3. The capsules obtained have a moisture content ranging from 14- 31%. Total Plate Figures (ALT) indicate the number of microbes in a product according with SNI 7388: 2009. For the tensile strength have the high tensile strength is ratio avocado seeds and seaweed (2: 3), while the high modulus young is a ratio of 1: 1. Therefore, the raw material for capsules from seaweed and avocado seeds effects the characteristics of the capsules and can be use as natural and halal capsules to replace gelatin.

Keywords: Avocado seeds; capsules; seaweed.

1. Introduction

Capsules are one of the solid dosage forms that are widely used in the pharmaceutical world. Capsules are made with the aim of facilitating drug consumption as well as protecting the active substance from environmental influences before it reaches the target in the body. Usually, capsule shells are made of gelatin-a protein substance obtained through the hydrolysis of collagen from animal tissues such as cattle, pigs, or fish. Gelatin has good gelling ability, is flexible, and easy to digest [1]. However, most of the gelatin used in the global pharmaceutical industry is derived from pigskin (44.5%) and cowskin (27.6%) [2], which raises concerns regarding halalness as well as health and ethical issues.

The use of animal gelatine in the pharmaceutical industry has several problems. In addition to halal issues for Muslim consumers, there are also concerns about the potential transmission of diseases such as Bovine Spongiform Encephalopathy (BSE) from cattle [3]. Therefore, the search for alternative raw materials that are halal, safe, and environmentally friendly is needed. One potential natural alternative is carrageenan, a polysaccharide compound extracted from red seaweed such as *Eucheuma cottonii*. Carrageenan has good gel-forming ability, high thermal stability, and is compatible with various active ingredients in pharmaceutical preparations [4].

On the other hand, avocado seed (*Persea americana*) is an agricultural waste that has not been widely utilised. In fact, avocado seeds contain starch with levels reaching 80.1%. The amylose and

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amylopectin content in this starch makes it a potential ingredient in pharmaceutical formulations. Avocado seed starch is known to have low water absorption and good stability, so it can act as an additive to strengthen the structure of carrageenan-based capsules [5]. The combination of carrageenan and avocado seed starch is expected to produce vegetarian capsules that are not only halal and safe, but also have mechanical properties and elasticity that comply with pharmaceutical standards.

Previous studies have explored the use of carrageenan in the manufacture of edible films and vegetarian capsules. However, not many studies have combined carrageenan from *Eucheuma cottonii* with starch from avocado seeds as capsule shell material. Thus, this study has an element of novelty in the form of utilisation of local natural materials that have the potential to increase the economic value of agricultural waste, as well as replace animal gelatin in the pharmaceutical industry [6].

The aim of this study was to evaluate the feasibility of *Eucheuma cottonii* seaweed extract and avocado seed starch as basic ingredients for the manufacture of capsule shells. This study also aims to assess the physical, mechanical, and solubility characteristics of the resulting capsules, to ensure their compliance with pharmaceutical requirements. It is expected that the results of this study can be the basis for the development of vegetarian capsules based on local ingredients that are halal and sustainable [7][8]

2. Research and Methodology

2.1 Materials

The tools used include a thermometer, capsule maker, electric heater, Strengh Machine, Oven, viscometer (Brookfi eld LV), Atomic Absorption Spectrophotometer (AAS), microbiological testing set, Materials used i kappa type seaweed (*Eucheuma cottoni*), avocado seeds, glycerol, food colouring, titanium dioxide, and distilled water, HCl, KCL 9%, glycerol, titanium dioxide, NAOH 8%..

2.2 Research Procedures

2.2.1. Extraction of Avocado Seed Starch

The stage of making Avocado seed starch begins with peeling the skin of the Avocado seed. Next, sorting or separation of seeds from good seeds and seeds that have been damaged or rotten. Washing is done using clean water and enough running water. Size reduction is done with a knife or with a coarse crusher. Milling is done using a wet mill. In this process, water is added approximately 1:1 Extraction or squeezing is the removal of starch from the tissue. Extraction by taking starch in the tissue is done by adding water to the avocado seed pulp then squeezed and filtered using a cloth and then the filter results are deposited. Drying. The starch precipitate obtained as soon as possible in the dry to avoid the formation of acidic odour.[3][9].

2.2.2. Seaweed Extraction

100 grams of seaweed samples were washed to remove sand, salt, lime, coral, pieces of rope and other types of unwanted seaweed. Extracting seaweed with alkaline solution using 100 grams of seaweed, 9% NaOH, 80 grams of 8% KCL. Heating the lye solution at 62°C waterbath temperature, for 3 hours (stirring the sample every one hour). After that, wash the sample up to 4 times soaking (Every one hour). Drying the sample overnight (20-24 hours), at 70°C. Smoothing the sample with a grinder to obtain carrageenan flour [4].

2.2.3. Capsule Preparation

A total of 100 mL of distilled water was heated then 0.5 g of titanium dioxide was added, after mixing then starch and carrageenan in the ratio of 2:1, 3:2, 1:1, 2:3 and 1:2 were added. The solution was then stirred until smooth, after the solution was mixed perfectly glycerin as much as 1 mL and synthetic

dye was added then stirred again. The finished solution was cooled to a temperature of about 60-55°C, then the cover capsule mould was dipped to a depth of 2.5 cm and the body capsule mould was dipped to a depth of 3 cm. The capsules that have been dipped are then turned/inverted so that there is no dripping, and then dried in an oven at 60°C for 3-4 h. The test characteristics are carried out on the capsules obtained.

3. Results and Discussion

3.1 Effect of Tensile Strength on Capsule

The Tensile Strength Test is the most common procedure used to study the stress-strain relationship. The tensile test is carried out with the test specimen pulled from two directions so that its length increases and its diameter decreases.

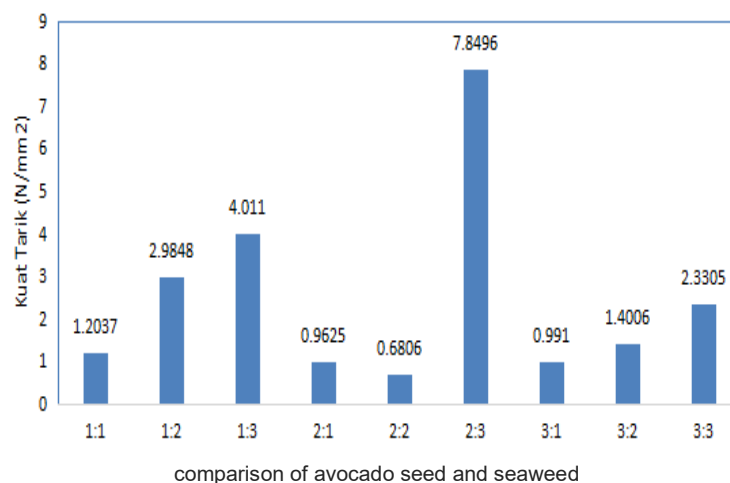


Figure 1: Capsule tensile strength test results

The tensile strength value increases when enough carrageenan is added, this occurs due to the L- guluronate content in seaweed which plays a major role in the gel formation process. Gel formation itself occurs due to the presence of long chains of alginate polymers that bind together. In addition, the nature of alginate is slightly soluble in water so that the structure is quite stable.

3.2 Effect of Young's Modulus on Capsules

The Young's Modulus value indicates a measure of the stiffness of a material. The Young's Modulus diagram is shown in Figure 4.3. Composites with sufficient starch addition have a small Young's Modulus value due to their large plasticity. While the addition of carrageenan from seaweed makes the composite more rigid and reduces plastic properties [10][11].

Based on the diagram above, the best elongation is in the 1:1 ratio between avocado seeds and seaweed extract. Starch-alginate capsules from red seaweed using STTP (sodium tripolyphosphat) crosslinker have Young's modulus compressive strength values of 8,018.18 kN/m² and 65,823.12 kN/m². the results obtained can be higher due to one of the factors of using cross linkers in producing capsules [12][13][14].

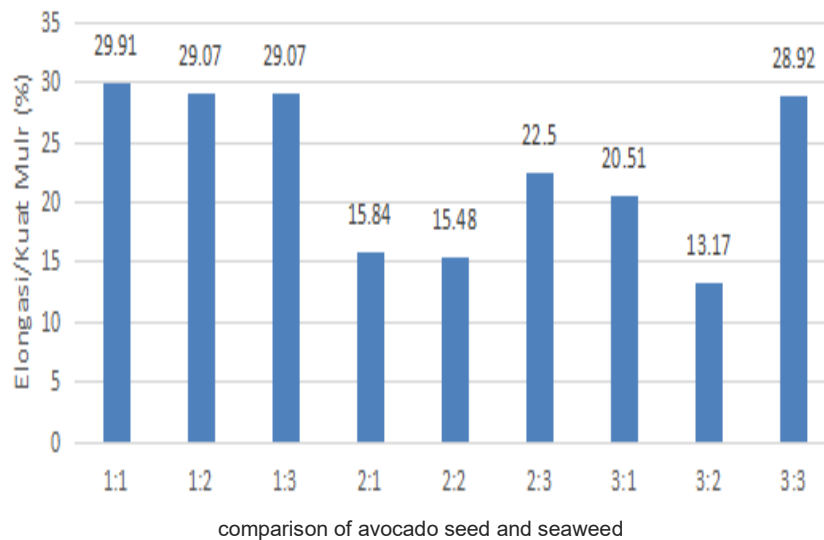


Figure 2: Capsule Elongation Test Results

3.3 Effect of Moisture Content on Capsules

The moisture content of the capsule shell is very important to determine the value because it is related to the resistance of the capsule shell to microbial activity, especially bacteria. Capsule shells are products made from organic materials, namely seaweed. Products made from organic materials will generally be overgrown by moulds and fungi if the moisture content is 20% - 60%, and if more than 60% it will be easily overgrown by bacteria. Commercial capsule shells have a moisture content of 12.5%-15% [16][17].

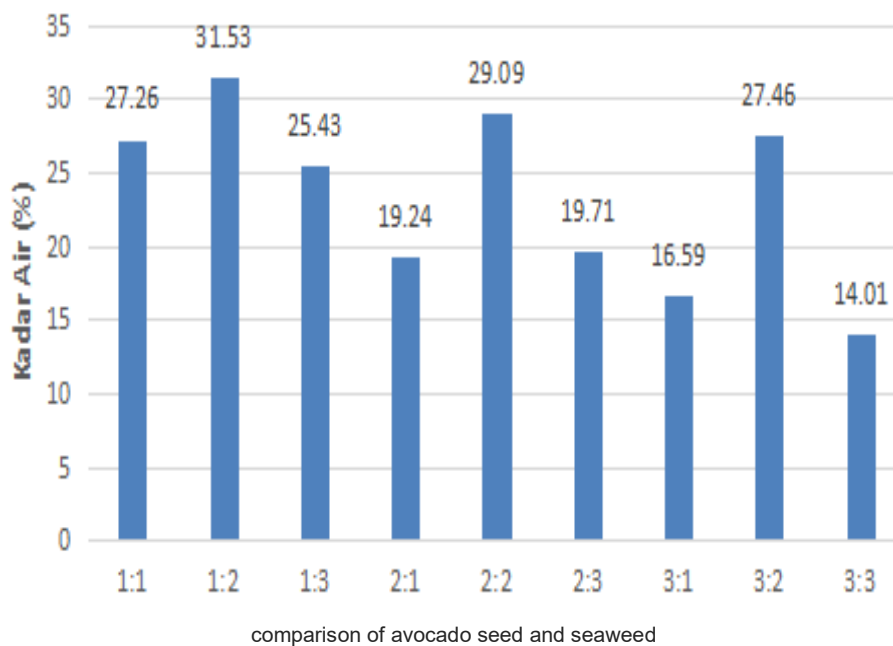


Figure 3: Capsule Moisture Content Test Results

The results of the research conducted moisture content ranged from 14 - 29.09 %. The capsule shells obtained were dried at the same temperature, humidity and drying time, thus the moisture content was only influenced by the viscosity of the seaweed raw material used[18][19].

4. Conclusion

The comparison of avocado seeds and seaweed affects the characteristics of the capsules produced. The highest tensile strength is in the comparison of avocado seed and seaweed with a ratio of 2:3 while the best elongation / creep strength is in the formulation of avocado seed comparison: seaweed extract with a ratio of 1: 1 which is 29.91%.

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