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UTILIZATION OF BANANA HUMP (*Musa paradisiaca L*) IN MAKING EDIBLE FILM WITH ADDITIONAL CARAGENAN

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Abstract : The purpose of the study was to determine the optimum conditions for the effect of adding carrageenan to edible films made from banana weevil starch on the chemical structure, mechanical properties and physical properties, and to compare the mechanical properties of edible films. This research was conducted by adding polyethylene glycol with a concentration of 4% and varying carrageenan with a concentration of 0%; 0.5%; 1%; 1.5%; and 2%. The optimum conditions for the addition of carrageenan were found at a concentration of 1%, with a tensile strength value of 28.76 Mpa, and an elasticity value of 2311.83 Mpa. As for the physical properties, namely thickness and biodegradation, the value increased with increasing carrageenan concentration. Spectra of edible film without carrageenan and edible film with the addition of OH at the addition of OH at wave numbers 3500 – 3200 $cm^{-1,}$ CH at wave numbers 3000 – 2800 cm^{-1}, and CO at wave numbers 1085 – 1050 cm^{-1}

Keywords: Banana Humo, Edible Film, Polyetilena Glicol, Carrageenan

I. INTRODUCTION

Synthetic plastic is an amorphous solid polymer that cannot undergo a biodegradation process so it is very difficult to be broken down by microorganisms. The use of this plastic continues to increase every year. Causing the accumulation of garbage, so that it has an impact on environmental pollution (Dewata & Tarmizi, 2015, Umar et al., 2017).

Indonesia is the largest producer of plastic waste into the sea after China, which is around 187.2 tons of plastic waste per year (Jambeck et al., 2015). Plastic waste that is in the waters for a long time can be decomposed into micro-sized plastics or also called microplastics. Microplastics are more dangerous because they can be eaten or enter the body accidentally (Meilindri & Dewata, 2017; Iswandi & Dewata, 2020). Therefore, an environmentally friendly plastic alternative is needed, one of which is edible film.

Edible film is a thin plastic with a thickness of less than 0.3 mm and serves to protect food products (Paul, 2020). Edible film raw materials come from food

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Vol 2 no 2 Tahun 2021

ingredients such as proteins, lipids and polysaccharides, especially starch (Nur Hanani et al., 2014).

Starch is an abundant polysaccharide reserve in plants. The main source of starch comes from the extraction of tubers, roots and seeds (Menzel, 2014). One source of starch that can be used to make edible films is banana hump, Banana weevil is a tuber starch-rich plants. Banana hump has a composition of 76% starch, 20% water, and 4% other ingredients (Yuanita, 2008).

On the other hand, edible films from starch have weaker barrier properties against water due to their high hydrophilicity (Iswandi, 2012; Suput et al., 2015). The deficiency in edible films from starch can be overcome by adding hydrophobic materials such as carrageenan, which is expected to increase the mechanical strength of the edible film.

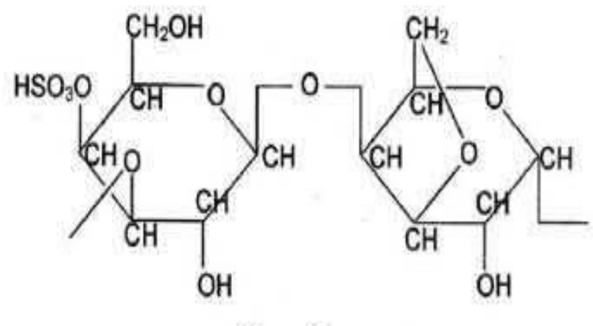

Figure 1. Structure of Carrageenan

II.RESEARCH METHOD

2.1 Tools and materials

The equipment used in this study were glassware, heating, magnetic stirrer, thermometer, edible film mold, oven, desiccator, screw micrometer, tensile strength instrument and FTIR instrument.

2.2 Extraction of Starch

The banana weeds were washed and cut into smaller sizes (± 0.5 cm) and soaked in a 50% (W/V) citric acid solution for 15 minutes. The banana hump is then washed using distilled water until clean and mashed using a blender. The banana hump porridge is filtered and allowed to settle. The starch precipitate was dried at a temperature of 65^{0}C for 3 hours using an oven. The process of extracting starch from banana weevil using the method (Wardah & Hastuti, 2015; Umar & Dewata, 2017)

p_ISSN = 2775-7541
e_ISSN = 2775-748x
Vol 2 no 2 Tahun 2021

2.3 Edible Film Synthesis

2.3.1 Edible film with variations in addition of carrageenan

Edible film was made by dissolving 5 grams of banana hump starch flour with 100 mL of distilled water. The starch solution was then added with 2 mL of 4% polyethylene glycol, then the mixture was heated using a hot plate at a temperature of 70-80^{0}C for 10 minutes and stirred using a magnetic stirrer. Add rage with 0% increment variation; 0.5% ; 1% ; 1.5% ; 2% w/v. Then the edible film solution is put into the mold and cooled at room temperature then dried using an oven at a temperature of 60^{0}C for 4 hours (Hidayah et al., 2015)

2.4 Edible Film Characterization

2.4.1 Edible film thickness test

Measurements were carried out randomly at 5 different points. The thickness valuesobtained are then added and divided to obtain the average thickness value (Ballesteros-Mártinez et al., 2020).

$$Thickness = \frac{thickness\ of\ 5\ points}{5}$$

2.4.2 Edible film tensile strength test (Tensile strength)

The tensile test is the maximum stress that the edible film can withstand when it is pulled before the edible film breaks (Hidayati et al., 2019). The edible film sample was clamped at both ends using a tensile strength tool. Then the tool is operated until the sample breaks.

$$Tensile\ strength = \frac{F}{Ao}$$

Information:
F: applied load (N)
Ao: Cross-sectional area up to (m2)

2.4.3 Edible film biodegradation test

The biodegradation test was carried out using the method carried out by (Panjaitan et al., 2017). The edible film was cut to a size of 2 x 6cm and then weighed using an analytical balance to get the initial weight (W1). The weighed edible film was then buried in the soil at a depth of 15cm for 15 days. . after that the sample was removed from the soil and cleaned, then weighed again on the analytical balance to get the final weight (W2). Just calculate how much % lost edible film.

$$\%\ Weight\ (W) = \frac{(W1 - W2)}{W1}\ x\ 100\%$$

p_ISSN = 2775-7541
e_ISSN = 2775-748x
Vol 2 no 2 Tahun 2021

(Panjaitan et al., 2017)

2.4.4 FTIR Test

Characterization of the structure of edible films using the FTIR instrument aims to determine the functional groups and bonds contained in the edible film. Edible film samples were characterized at a wave number of 4000 – 600 cm-1.

Keterangan: = $\frac{W1-W2}{W1}$ x 100% (Panjaitan et al., 2017)

Figure 2.Edible Film from banana hump starch with the addition of polyethylene glycol and carrageenan

III. RESULT AND DISCUSSION

Edible film thickness

The thickness of the edible film affects the mechanical characteristics of the edible film. Edible film that is too thick has a high tensile strength value. The following is the effect of adding polyethylene glycol and carrageenan to the thickness of the edible film.

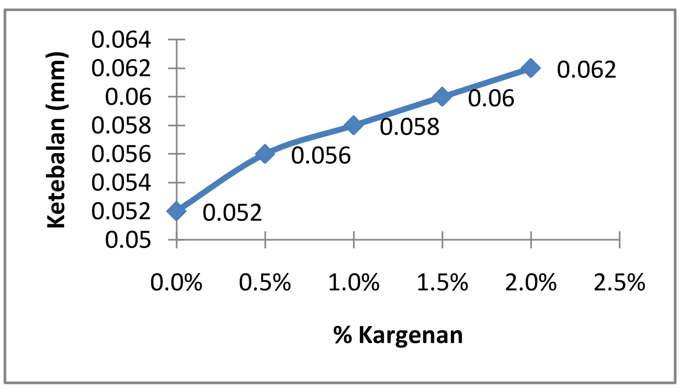

Figure 3. Thickness Value

JKPL
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e_ISSN = 2775-748x
Vol 2 no 2 Tahun 2021

The thickness of the edible film tends to increase along with the increase in the concentration of polyethylene glycol and carrageenan. This is because kareganan will increase the viscosity of the solution, causing an increase in the thickness of the edible film (Aisyah et al., 2018).The overall edible film produced has a thickness below the maximum standard of 0.25mm.

Tensile Strength Edible Film

The tensile strength value shows the ability of edible films to hold or protect food products (Aisyah et al., 2018). The following is the effect of adding polyethylene glycol and carrageenan to the tensile strength of edible films.

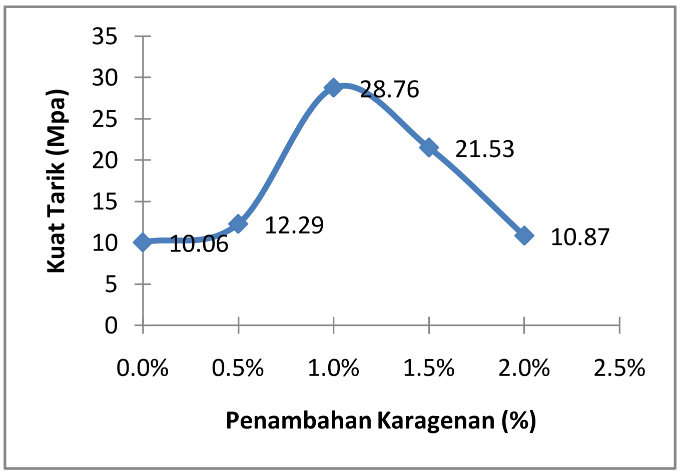

Figure 4. Tensile Strength

The value of tensile strength increased with increasing concentration of carrageenan, but when the addition of 1.5% carrageenan the value of tensile strength began to decrease. This is because the matrix on the edible film has passed the saturation point, so the addition of carrageenan does not affect the tensile strength value (Darni & Utami, 2010). From the overall tensile strength value obtained with variations in carrageenan concentration, it has met the minimum standard of tensile strength that has been set by the Japanese Industrial Standard, which is 3.92 Mpa.

Biodegradation Edible Film

The biodegradation process is influenced by the type of soil and the number of decomposing microorganisms present in the soil. More than 90 types of microorganisms including: aerobic, anaerobic, photosynthetic, archaebacterial, and eukaryotic (Emadian et al., 2017, Umar et al, 2018, Dewata and Umar., 2019). The following is the effect of adding carrageenan to the biodegradation process of edible film.

p_ISSN = 2775-7541
e_ISSN = 2775-748x
Vol 2 no 2 Tahun 2021

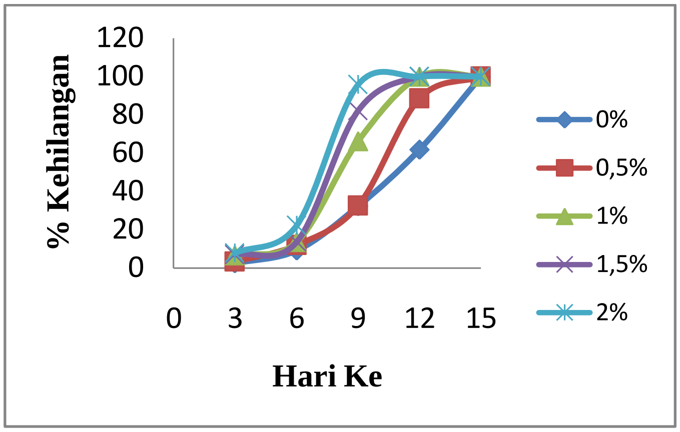

Figure 5. Biodegradation Value

From the picture above, we can see that the biodegradation of edible film increases with increasing concentration of carrageenan addition. The greater the concentration of carrageenan added, the greater the % loss or % biodegradation of edible film every day. Degraded edible films are characterized by being damaged after burial in the soil. Edible films are easily degraded because they contain hydroxyl (OH) and carboxyl (CO) groups, which causes edible films to be easily degraded or decomposed in nature.

FTIR

Characterization of edible film structure using FTIR instrument to determine functional groups and bonds. Performed at wave numbers 4000 – 600 cm-1. The following is the FTIR edible film spectra.

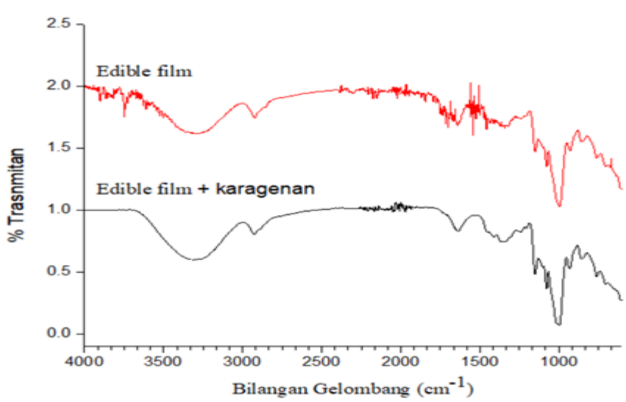

Figure 6. Spectra FTIR Edible Film

The picture above shows the presence of O-H bonds at wave numbers 3500 – 3200 cm-1, C-H bonds at wave numbers 3000 – 2800 cm-1, and C-O bonds at wave numbers 1085 – 1050 cm-1. Based on the results of the FTIR edible film testing that has been carried out, no new functional groups were found. This shows that the

p_ISSN = 2775-7541
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Vol 2 no 2 Tahun 2021

edible film synthesis process is a process of physical change, so that the resulting edible film has properties similar to its constituent components.

IV. CONCLUSSIONS

The optimum conditions for the addition of carrageenan were obtained at a concentration of 1% carrageenan addition. With a tensile strength value of 28.76 Mpa. Meanwhile, the thickness and biodegradation increased with increasing carrageenan concentration.The FTIR spectra of edible film showed the presence of O-H bonds at wave numbers 3500 – 3200 cm-1, C-H bonds at wave numbers 3000 – 2800 cm-1, and C-O bonds at wave numbers 1085 – 1050 cm-1. This shows that there is no new bond or structure formed from the process of making edible film.

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p_ISSN = 2775-7541
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Vol 2 no 2 Tahun 2021

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