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The Effect Of Added Carrageenan On Tensile Strength And Biodegradation Of Edible Film Using Breadfruit Starch

*Hidayatul Ma'ruf and Indang Dewata
Department of Chemistry, Padang State University, Padang-Indonesia
*Email: hidayatul.makruf@gmail.com

Abtrack: Breadfruit has a fairly high starch content of 84.28%, the utilization of breadfruit itself is still not optimal. In Indonesia, breadfruit can thrive in one of the breadfruit-producing cities, namely the city of Padang. One of the uses of breadfruit is in the manufacture of edible films. Edible film is a thin plastic that has a size smaller than 0.3 mm which serves to protect food products. The purpose of this study was to determine the effect of carrageenan on the tensile strength and biodegradation of edible films from breadfruit starch. This study used the addition of carrageenan with variations in concentrations of 0%, 0.5%, 1%, 1.5%, and 2%. Edible film was tested for tensile strength and obtained values at 0% 2.046, 0.5% 4.252, 1% 7.678, 1.5% 4.139, 2% 3.829 where the optimum tensile strength value was at 1% with a tensile strength of 7.678 Mpa while the biodegradation had percent loss at least at a concentration of 2% with a percent loss yield of 11.5%. The higher the concentration used, the more difficult it is for the edible film to be degraded in the soil.

Keywords: Carrageenan, edible film, tensile strength, biodegradation.

I. INTRODUCTION

Plastic is a food packaging material that will cause problems for the environment for several years to come. This is because plastic has properties that are difficult to be degraded by microbes in the soil (Karyantina et al., 2021). Indonesia is one of the largest breadfruit-producing countries because Indonesia has a good climate for the growth of breadfruit itself. Breadfruit can be used as food and can also be used as starch. One of the uses of breadfruit starch is the manufacture of bioplastics (Nurhaeni et al., 2018). Bioplastic is plastic that is easily decomposed, one example of making bioplastic itself is the manufacture of edible films.

Edible has many benefits, one of which is as a food protective material, coating fruits and vegetables which aims to slow down the transfer of gases in the form of water vapor, retain moisture, and reduce loss of aroma and discoloration during storage (Nasution, 2019). In the process of making edible films, it is necessary to have stabilizers and plasticizers which have functions as stabilizers, expand, and thicken and avoids the cracking process (Putra et al., 2017). The plasticizers and stabilizers used in this research are carrageenans and polyethylene glycol.

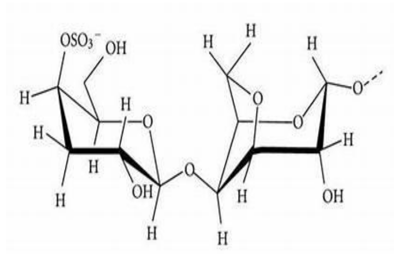

Figure.1 Carrageenan Structure

Carrageenan comes from seaweed extraction which is taken by water or alkaline extraction. Carrageenan comes from the Rhodophyceae (red algae) type of seaweed from the Chondorus, Giratina, Eucheuma, and Hypnia species (Dwimayasanti & Kumayanjati, 2019). Carrageenan has been widely used in the food industry as an ingredient in thickness, and gelling, and also in the pharmaceutical industry. Carrageenan is very good in the manufacture of edible film packaging to increase the durability and quality of the confectionery to be packaged. Carrageenan has been declared safe for use in food at the 57th meeting of the Food and Agricultural Organization of several countries which is the World Health Committee on food in June 2001 in Rome (Nasution, 2019).

Much research on the manufacture of edible films have been carried out before but using banana weevil samples with stabilizers and plasticizers, namely chitosan and carrageenan (Ikhsan et al., 2021). So the researchers here will make edible films using breadfruit starch with stabilizers and plasticizers, namely carrageenan and polyethylene glycol. The purpose of this research is to determine the effect of carrageenan on tensile strength and biodegradation of edible films using breadfruit starch.

II. RESEARCH METHODS

2.1 Tools and Materials

The equipment used in this study were: glassware, heater, magnetic stirrer, thermometer, mold, oven, micrometer screw, 100 mesh sieve, tensile strength, and FTIR.

2.2 Strach Extraction

Peel the skin of the breadfruit and make the liver, then cut it into small pieces and soak it in sodium metabisulfite for 15 minutes. Then blanched for 7 minutes at 80oC. after blanching they were cut into small pieces and blended with a ratio of 2: 1 after blending filtered the dregs and allowed to stand for 3 hours to get starch deposits. After 3 hours, they were washed and added with water and kept for another 4 hours, then the starch precipitate was taken and dried in the oven at 60oC for 6 hours. After the dry starch was sieved using a 100-mesh sieve and breadfruit starch was obtained (Putra et al., 2017).

2.3 Making Edible Film

Making edible films is done by weighing 5 grams of breadfruit starch and dissolved in 100 ml of distilled water. After that, 2 ml of polyethylene glycol 400 was added and 2 ml of carrageenan was added with variations of 0%, 0.5%, 1%, 1.5%, and 2%, respectively. after being mixed, it is heated on a hot plate while stirring at a temperature of 73-75oC for 10 minutes using a magnetic stirrer. After it thickens, it is put into the mold that has been provided and cooled at room temperature and then dried in an oven at 60oC for 4 hours (Hidayah et al., 2015).

2.4 Tensile Strenght Edible film

The tensile strength test is the maximum stress obtained by the edible film when it is pulled until the edible breaks (Hidayati et al., 2019). The edible film was clamped at both ends using a tensile strength device, after which the tool was operated until the sample broke.

2.5 Biodegradation test

The edible film was cut to a size of 2 x 6 cm and then weighed to get the initial weight (w1). Then the edible film is buried or stockpiled to a depth of 15 cm for 6 days. Next, the edible film is removed from the soil and weighed so that it obtained (w2). The results of biodegradation can be determined using the equation (Panjaitan et al., 2017).

$$W\ (\%) = ((W1 - W2)\ /\ W1)\ X\ 100\%$$

III. RESULTS and DISCUSSION

Fig. 2 breadfruit starch edible film with the addition of carrageenan

Tensile Strenght Edible film

Tensile strength is the maximum pressure obtained from the edible film from the initial sample of the test until the sample breaks. The value of tensile strength will show the ability of the edible film to protect a food product to be coated to avoid damage (Aisyah et al., 2018).

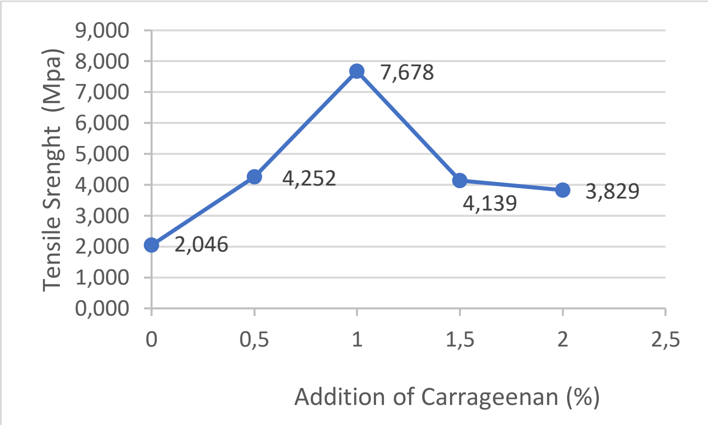

Fig. 3 Effect of addition of carrageenan on tensile strength.

Based on the graph above, it can be concluded that as the carrageenan increases, the tensile strength of edible film increases and then decreases again. The increase in tensile strength of edible films is due to the higher concentration of carrageenan used, the value of the tensile strength tends to increase, which indicates that carrageenan as a mixing biopolymer tends to increase tensile strength and carrageenan can form hydrogen bonds between chains so that the edible film becomes denser (Setiani et al. ., 2013). The higher the concentration of carrageenan used, the more hydrogen bonds formed, so it requires a lot of energy to break the edible film. This causes an increase or a high value of the tensile strength of the edible film.

Biodegradation Test

The biodegradation test was carried out to determine whether the edible film produced could be decomposed by microorganisms in the soil. The biodegradation process can be influenced by several factors, one of which is biological factors. Because the biological process will involve living things such as bacteria, fungi, predators, and other organisms (Hidayah et al., 2015). The effect of carrageenan on the biodegradation test can be seen in the image below.

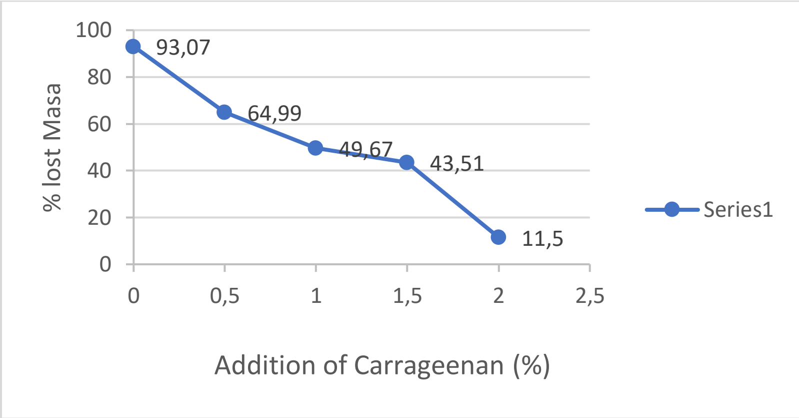

Fig.4 Effect of addition of carrageenan on biodegradation test

Based on the graph above, it is found that edible films made without the addition of carrageenan will experience a faster degradation process than those made with the addition of carrageenan. This is because the degradation process will increase the percent loss of the edible film itself, where the carrageenan itself will inhibit the degradation process of the edible film.

FTIR Characterization

The edible film characterization test was carried out using the FTIR instrument with a wave number of 4000-600 cm-1. The results of the FTIR test can be seen in the following figure.

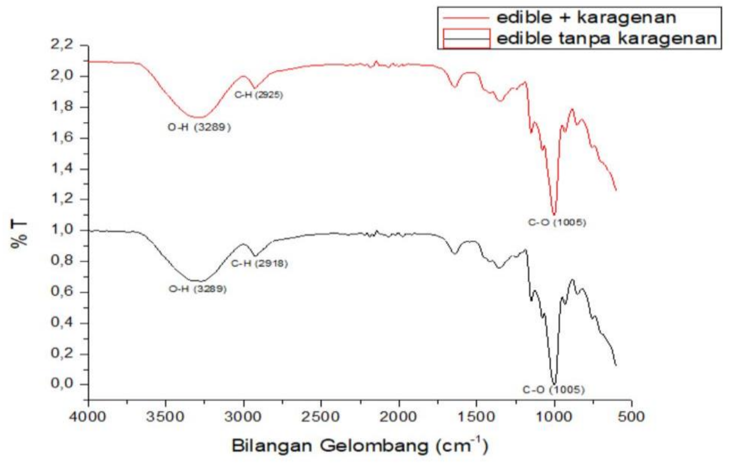

Fig. 5 FTIR spectrum of edible film and edible film + carrageenan

The first test was on edible film which obtained O-H bonds with wave numbers 3000-3750 cm-1, C-H bonds with wave numbers 2700-3000 cm-1, and C-H bonds with wave numbers 1000-1300 cm-1. In the second test, the O-H bonds with wave numbers 3000-3750, C-H bonds with wave numbers 2700-3000 cm-1, and C-O bonds with wave numbers 1000-1300 cm-1 were obtained.

From the testing of the two samples using the FTIR Spectrum, it was found that there was no addition or the emergence of new functional groups, which proves that edible film is a physical process of mixing ingredients.

IV. CONCLUSION

Carrageenan affects the tensile strength test and biodegradation where the higher the concentration of carrageenan used, the higher the tensile strength of the edible film itself, the optimum tensile strength value of edible film lies in the addition of carrageenan with a concentration of 1% with a value of 7,678 Mpa. And the more biodegradation the concentration of carrageenan used, the more difficult it will be for the edible film to be degraded in the soil, the percent loss of edible film which is difficult to degrade lies in the addition of carrageenan with a concentration of 2% with a percent loss of 11.5%. And testing using FTIR proved that no new functional groups emerged from the addition of carrageenan.

Referensi

Aisyah, Y., Irwanda, L. P., Haryani, S., & Safriani, N. (2018). Characterization of Corn Starch-Based *Edible film* Incorporated with Nutmeg Oil Nanoemulsion. IOP Conference Series: Materials Science and Engineering, 352(1)

Dwimayasanti, R., & Kumayanjati, B. (2019). Karakterisasi *Edible film* dari Karagenan dan Kitosan dengan Metode Layer by Layer. Jurnal Pascapanen Dan Bioteknologi Kelautan Dan Perikanan, 14(2), 141.

Hidayah, B. I., Damajanti, N., & Puspawiningtiyas, E. (2015). Pembuatan Biodegradable Film dari Pati Biji Nangka (Artocarpus hetrophyllus) dengan Penambahan Kitosan. Prosiding Seminar Nasional Teknik Kimia "Kejuangan" Pengembangan Teknologi Kimia Untuk Pengolahan Sumber Daya Alam Indonesia, Artocarpus 2009, 1–8.

Hidayati, S., Zulferiyenni., Satyajaya, W. (2019). Optimasi Pembuatan Biodegradable Film dari Limbah Padat Rumput Laut Eucheuma cottoni dengan Penambahan Gliserol, Kiptsan, CMC dan Tapioka. *Jphpi* 2019, 22(2), 340-354.

Ikhsan, M. H., Dewata, I., Nizar, U. K., & Azhar, M. (2021). Pengaruh Penambahan Kitosan Terhadap Kuat Tarik Dan Biodegradasi *Edible film* Dari Pati Bonggol Pisang. Jurnal Kependudukan Dan Pembangunan Lingkungan, 2(1), 44–50.

Karyantina, M., Suhartatik, N., & Prastomo, F. E. (2021). Potensi Ekstrak Kayu Manis (Cinnamomum Burmannii) Sebagai Senyawa Antimikrobia Pada

Edible Film Pati Sukun (Artocarpus communis). Jurnal Teknologi Hasil Pertanian, 14(2).

Nasution, R. S. (2019). Aplikasi Dan Karakterisasi *Edible Film* Dari Karaginan (Eucheuma Cottonii) Pada Buah. Amina, 1(1), 18–27. https://doi.org/10.22373/amina.v1i1.10.

Nurhaeni, Dwiasmukti, P., Prismawiryanti. (2018). Modifikasi Pati Sukun (*Articarpus Altilis)* Menggunakan Anhidrida Asam Asetat Dan Aplikasinya Pada Pembuatan MIE. KOVALEN, 4(1): 33-40.

Panjaitan, R. M., Irdoni., & Bahruddin. (2017). Pengaruh Kadar dan Ukuran Selulosa Berbasis Batang Pisangterhadap Sifat dan Morfologi Bioplastik Berbahan Pati Umbi Talas. Jom FTEKNIK, 4(1), 1–7.

Putra, A. D., Johan, V. S., & Efendi, R. (2017). Pembuatan *Edible film* Pati Sukun the Addition of Sorbitol As a Plasticizer in the Production *Edible films* Based Breadfruit Starch. Jom Fakultas Pertanian, 4(2), 1–15.

Setiani, W., Sudiarti, T., & Rahmidar, L. (2013). Preparasi Dan Karakterisasi *Edible film* Dari Poliblend Pati Sukun-Kitosan. *Jurnal Kimia VALENSI*, *3*(2). https://doi.org/10.15408/jkv.v3i2.506