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Optimization Of Additional Chitosan On Mechanical Properties Edible Film From Avocado Seed Starter

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Abstract : Edible film is a thin plastic with a thickness of less than 0.25 mm which serves to protect food products. The purpose of this study was to determine the optimum concentration of addition of chitosan to edible film made from avocado seed starch on mechanical properties and to compare the mechanical properties of edible film with the value of Japenese Industrial Standard (JIS) Z1707. This research was conducted by adding 4% polyethylene glycol as a plasticizer and varying the addition of chitosan with a concentration of 0%; 0.5%; 1%; 1.5%; and 2%. The optimum conditions for the addition of chitosan at a concentration of 1%, with a tensile strength value of 1.235 Mpa, an elasticity value of 4.643 Mpa, and an elongation value of 0.266 Mpa. The tensile strength and elasticity values of the edible film have met the Japenese Industrial Standard (JIS) Z1707 but the elongation value has not met because the edible film produced is fragile so it breaks easily and causes the edible film to have a low elongation value.

Keywords: Chitosan, Edible film, Avocado seeds

I. PRODUCTION

Plastic has become an inseparable part of society. Plastic waste includes non-organic waste and is harmful to the environment because it takes a long process and time of 1,000 years to decompose naturally in soil and 450 years to decompose in water. The use of plastic as packaging material causes the accumulation of plastic waste through environmental processes that do not decompose naturally by microorganisms in the soil, causing pollution and environmental damage (Fathanah et al., 2018). Therefore, it is necessary an environmentally friendly alternative to plastic is bioplastic. Bioplastics are one of the most innovative materials that come from nature and are biodegradable (Sidek et al., 2019). One example of a bioplastic product is the manufacture of edible film.

Edible film is a plastic that has a thickness of less than 0.25 mm to coat food so it can be eaten andhelps protect food from the movement of water vapor, oxygen and dissolved substances. (Ismaya, et al., 2020). Edible films are made of hydrocolloid, fat and composite materials with the addition of plasticizers and surfactants. Edible films made without the addition of plasticizers are brittle and difficult to form homogeneous films. The plasticizer used is polyethylene glycol which is soluble in water, neutral, and non-volatile which serves to reduce tensile strength by reducing intermolecular forces so as to increasethe elongation value of the edible film.

Edible film made from starch has a weakness, namely it has a weaker barrier against water, this is because starch has hydrophilic properties. Weaknesses that exist in edible films can be overcome by adding materials that have hydrophobic properties such as chitosan because they can increase the mechanical strength of edible films (Aisyah et al., 2018).

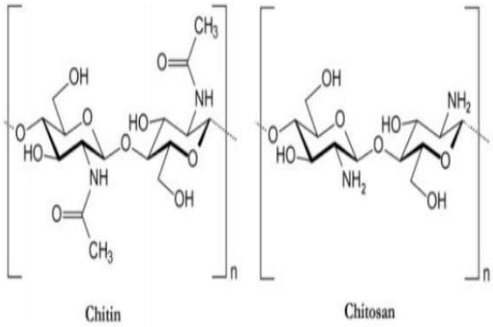

Figure 1. Structure Chitosan

Chitosan has polycationic properties, in the form of a solid and has a yellowish white color. Chitosanis soluble in organic acid solvents. Chitosan is a poly-(2-amino-2-deoxyβ-(1-4)-D-glucopyranose) with the molecular formula $(C_6H_{11}NO_4)n$ obtained from chitin deacetylation (Beni Setha, Fitriani Rumata, 2019) derived from shrimp waste in the form of shells, heads,and tails. Chitosan has hydrophobic properties, so it has a structure that is resistant to water and can easily form gels and film membranes (Fathanah et al., 2018). Chitosan includes compounds that are insoluble in water and H_2SO_4, slightly soluble in HNO_3 and can dissolve well using CH_3COOH. The cationic nature of chitosan is something special, because most polysaccharides are neutral or negatively charged when under acidic conditions (Chi et al., 2015).

Many researches on the manufacture of edible films have been carried out before, however, using hump samples with glycerol plasticizer and chitosan stabilizer. So the researchers here will make edible films using avocado seed starch with chitosan stabilizer and polyethylene glycol plasticizer . The purpose of this study is to determine the optimum conditions by adding chitosanto the mechanical properties of edible film from avocado seeds using polyethylene glycol plasticizer and then comparing the mechanical properties of the edible film with the Japenese Industrial Standard (JIS) Z1707.

II. IMPLEMENTATION METHOD

2.1 Tools and Materials

The equipment used are: glassware, thermometer, *magnetic stirer,* blender, filter cloth, knife, *edible film mold,* oven, analytical balance, 60 mesh hot plate sieve and tensile strength. The materialsused are: Avocado seed starch, polyethylene glycol, chitosan and acetic acid.

2.2 Starch Extraction

The manufacture of starch from avocado seeds refers to (Lubis, 2018) which is as much as 1 kg of avocado seeds that have been peeled and sliced off the outer skin. The sliced seeds were then soaked in 3000 ppm sodium metabisulfite solution for 30 hours with a ratio of avocado seeds and soaking solution of 1:5 (g/mL). The avocado seeds are then mashed with a blender with the addition of1:1 water (1 kg of avocado seeds plus 1 liter of water) then produce pulp and then filtered using a filter cloth. Then washed with distilled water 3 times. The suspension was deposited for 12 hours, then the precipitate was dried using an oven at atemperature of 50°C until the starch was dry and then filtered using a 60 mesh sieve.

2.3 Making Edible Film

Edible film from avocado seed starch is made by dissolving 5 grams of starch and adding 100 mLof distilled water. The starch solution was then added with 400 4% polyethylene glycol into the mixtureas much as 2 mL. The mixture was heated and stirred on a hot plate using a magnetic stirrer at a temperature of 60°C-70°C for 15 minutes. Add chitosan with variations in the addition of 0%, 0.5%, 1%, 1.5%, 2% w/v into a homogeneous mixture of edible film solution then cooled at room temperatureand copied into a mold then the edible film is dried in the oven for 3 hours at 60°C (Robiana et al., 2016)

2.4 Mechanical Properties Edible film

2.4.1 Tensile Strength

Tensile strength test to determine the maximum stress value that the edible film can withstand when it is pulled before the edible film is broken (Hidayati et al., 2020). Edible films were clamped at both ends using tensile strength tool . Then the tool is operated until broken sample.

2.4.2 Elasticity

Elasticity test to determine the size of the resistance or stiffness of a material. Elasticity indicates the stiffness of the edible film to pressure or extensibility (Oluwasina et al., 2019). Elasticity measurements were carried out using the same method as the tensile strength test.

2.4.3 Elongation

Elongation test to get the maximum length change value of the edible film until it breaks. Elongation can indicate the flexibility and ability of edible films to stretch (Oluwasina et al., 2019). Elongity measurements were carried out using the same method as the tensile strengthtest.

III. RESULT AND DISCUSSION

The purpose of making *edible films* is to produce plastic that is easily biodegradable. This plastic made from avocado seed starch produces plastic in the form of a transparent sheet. The aroma of this *edible film* is dominated by the aroma of starch from avocado seeds.

Figure 2. Edible film from avocado seeds

Edible film tensile strength

Tensile strength is the maximum stress that a *material* can withstand when stretched before it breaks. The higher the tensile strength of the edible film, the better the quality of the edible film produced.

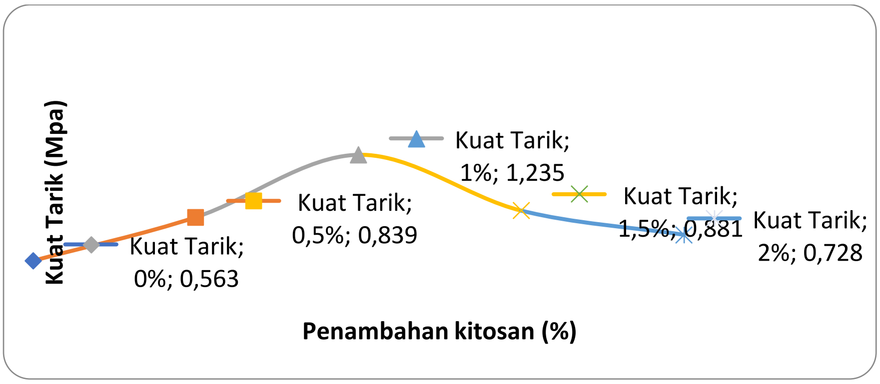

Figure 3. The effect of the addition of chitosan on the tensile strength of *edible films*

From the picture, it can be seen that the tensile strength value of edible film increases with increasingchitosan concentration. This increase in tensile strength is due to the ability of chitosan to form intermolecular hydrogen bonds. This makes *the edible film* denser, stronger and less likely to break.(Fathanah et al., 2018). According to Sulistyo (2018), the addition of chitosan to edible films can form a strong polymer matrix, there by increasing the tensile strength between the molecules of the edible film. The tensile strength value increases with the increase in the concentration of chitosan, namely when 1% chitosan is added, but when 1 is added, 5% chitosan tensile strength value began to decrease. This is due to the weakening of the hydrogen bonds between the starch bonds and the matrix in the *edible film* that has passed the saturation point, so that the addition of chitosan does not affect the tensile strength value (Darni & Utami, 2010).

So that it can be known the optimum value of tensile strength with the addition of 1% chitosan of 1.235 Mpa. From the overall tensile strength value obtained with variations in the concentration of chitosan,it has met the minimum standard of tensile strength that has been set by the Japanese Industrial Standard, which is 0.392 Mpa..

Edible film Elasticity

Elasticity or Young's modulus is the ratio between stress and deformation of the sample, calculatedby the slope of the stress-strain curve obtained in the tensile test *(Chiumarelli & Hubinger, 2012).*

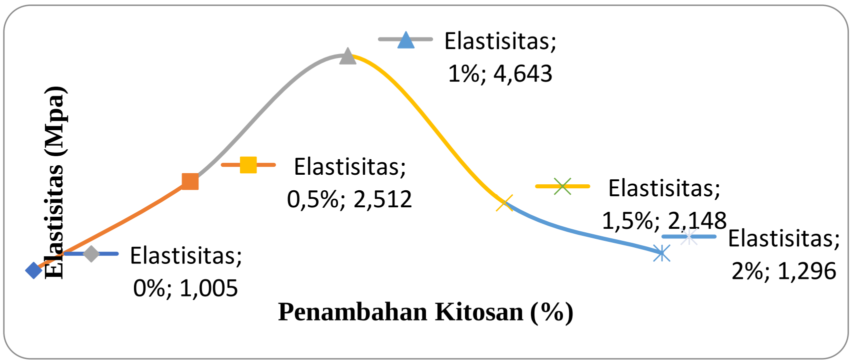

Figure 4. The effect of the addition of chitosan on the elasticity of *edible films*

Based on the picture, it can be seen that the elasticity value increased along with the addition of chitosan concentration. The maximum elasticity value occurs at the addition of 1% of 4.643 Mpa. According to research (Ariska& Suyatno, 2015) the elasticity value is influenced by the concentration of chitosan used, where the more mass of chitosan, the greater the elasticity value. The higher the concentration of polymer used, the greater the amount of polymer that composes the matrix and the greater the force to break the sample

. The maximum elasticity value occurs at the addition of 1% of 4.643 Mpa. After reaching the maximum condition, the value of the elastic modulus will decrease again. The elasticity value of edible film from avocado seed starch has met the standards set by the Japanese Industrial Standard, which is 0.35 Mpa.

Edible film Elongation

Elongation or elongation is the percentage change in the length of *the edible film* when the *edible film* is pulled until it breaks (Murni et al., 2013). The elongation value is influenced by the addition of plasticizers in the manufacture of *edible films*. The *plasticizer* used in this research is polyethylene glycol.

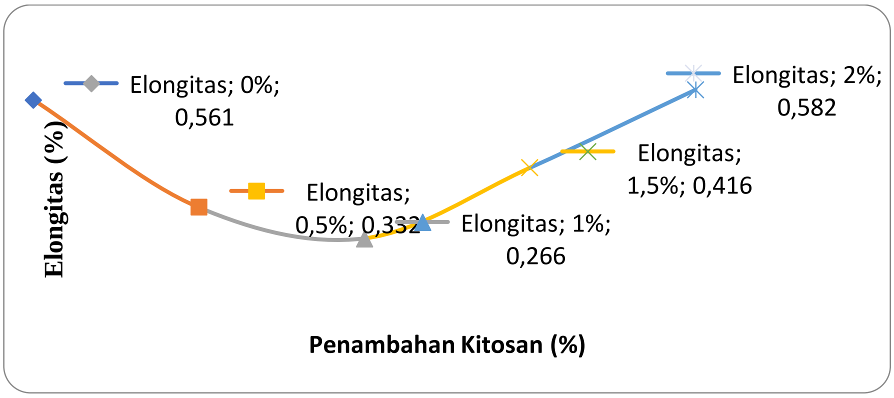

Figure 5. The effect of the addition of chitosan on the elongation of *edible film*

Based on the figure, it can be seen that the elongation value decreased with increasing concentration of chitosan with a concentration of 1% and increased starting from the addition of 1.5%. The decrease in elongation value is caused by chitosan because chitosan fills the empty space in the edible film so that the intermolecular forces on the polymer decrease

The elongation value of *edible film* from avocado seed starch does not meet the standard elongation value set by the Japanese Industrial Standard, which is greater than 10%. Anugrahati (2003) about *edible film* made from pectin albedo with an elongation value of 0.3-0.5%. He explained, the stronger the edible film produced, the greater the stress required to break the edible film. When experiencing a breaking force, the elongation capacity of the edible film is smaller and the value of the edible film's elongation is low.

IV. CONCLUSION

The mechanical properties of edible films include tensile strength, elasticity and elongation. Where the tensile strength and elasticity obtained optimum conditions at the addition of 1% chitosan concentration with a tensile strength value of 1.235 Mpa and an elasticity value of 4.643 Mpa. The value obtained is in accordance with the standard, namely the *Japanese Industrial Standard*. The elongation value of edible film does not meet the standard because the value is below 10% because the edible film produced is fragile so it breaks easily andcauses the edible film to have a low elongation value.

Reference

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). https://doi.org/10.1088/1757-899X/352/1/012050

Ariska, R. E., & Suyatno. (2015). Mekanik Edible Film Dari Pati Bonggol Pisang Dan Karagenan Dengan Plasticizer Gliserol the Effect of Carrageenan Concentrations on Mechanical and Physical Properties of Edible Films From Banana Weevil Starch and Carrageenan With Glycero Plasticizer As Foo.

Beni Setha, Fitriani Rumata, B. br. S. (2019). Karakteristik Kitosan Dari Kulit Udang Vaname Dengan Menggunakan Suhu dan Waktu Yang Berbeda dalam Proses Deasetilasi. *Jurnal Pengolahan Hasil Perikanan Indonesia*, *22*(3), 498–507.

Chi, R., Cheung, F., Ng, T. B., Wong, J. H., & Chan, W. Y. (2015). *Chitosan: An Update on Potential Biomedical and Pharmaceutical Applications*. https://doi.org/10.3390/md13085156

Chiumarelli, M., & Hubinger, M. D. (2012). Stability, solubility, mechanical and barrier properties of cassava starch - Carnauba wax edible coatings to preserve fresh-cut apples. Food Hydrocolloids,

Darni, Y., Lismeri, L., Hanif, M., & Evaniya, D. S. (2019). *Peningkatan Kuat Tarik Bioplastik dengan Filler Microfibrillated Cellulose dari Batang Sorgum*. *18*(2), 37–41. https://doi.org/10.5614/jtki.2019.18.2.1

Furqon Cipta Ismaya, Nurul Hidayati Fithriyah, T. Y. H. (2020). *Pembuatan dan karakterisasi edible film dari nata de coco dan gliserol*. *13*(1).

Oluwasina, O. O., Olaleye, F. K., Olusegun, S. J., Oluwasina, O. O., & Mohallem, N. D. S. (2019). Influence of oxidized starch on physicomechanical, thermal properties, and atomic force micrographs of cassava starch bioplastic film. International Journal of Biological Mac

Robiana, A., Nahar, M. Y., & Harahap, H. (2016). *Untuk Pembuatan Bioplastik Dengan Bahan Baku Pati Bonggol Glycerin Utilization Of Glycerin Residue As Plasticizer For*. *5*(4), 26–32.

Sidek, I. S., Fauziah, S., Draman, S., Rozaimah, S., Abdullah, S., & Anuar, N. (2019). *I Tech Mag Current Development On Bioplastics And Its Future Prospects : AN*. *1*, 3–8.

Sulistyo, F. T., Utomo, A. R., Setijawati, E., Studi, P., Pangan, T., Pertanian, F. T., Katolik, U., & Mandala, W. (2018). Pengaruh Konsentrasi Karagenan terhadap Karakteristik Fisikokimia Edible Film Berbasis Gelatin . Effects of Carrageenan Concentration towards Physicochemical Characteristic of

Gelatin Based Edible. Jurrnal Teknologi Pangan Dan Gizi, 17(2), 1–13.

U Fathanah, M R Lubis, F Nasution, M. S. M. (2018). *Characterization of bioplastic based from cassava crisp home industrial waste incorporated with chitosan and liquid smoke Characterization of bioplastic based from cassava crisp home industrial waste incorporated with chitosan and liquid smoke*. https://doi.org/10.1088/1757-899X/334/1/012073