JKPL Jurnal Kependudukan dan Pembangunan Lingkungan
ISSN 2775-7471 (P) 2775-748X (E)
Vol 3 No 1 Juni 2022

Optimization Of Chitosan Concentration In The Making Of Edible Film From Corn (Zea Mays L.)

*Deasycha Novelidia Pramesta[1] and Indang Dewata[2]
Chemistry department, FMIPA Padang University, Padang-Indonesia

*Email: [1]deasychanovelidia19@gmail.com

Abstract. Edible film is a thin plastic that has a thickness of less than 0.3 mm and is made from edible materials. This study aims to determine the effect of the concentration of chitosan in the manufacture of edible films, as well as to compare the physical and mechanical properties of edible films obtained with the standard values set by the Japanese Industrial Standard (JIS) Z1707. In this study, variations in the concentration of chitosan were carried out to obtain a good edible film, with a concentration variation of 0%; 0.5%; 1%; 1.5%; and 2%. The obtained edible films were analyzed for thickness, tensile strength and elasticity (Young's modulus). Based on the research conducted, it was found that along with the addition of chitosan, the thickness, tensile strength and elasticity values increased. Thickness values range from 0.07 to 0.09 mm. The value of tensile strength and elasticity value obtained the optimum value at 1% chitosan concentration with a tensile strength value of 9,655 Mpa and an elasticity value of 12.41 Mpa. The thickness, tensile strength and elasticity values obtained meet the standard values set by the Japanese Industrial Standard (JIS).

Keywords: Chitosan, Edible Film, Corn Starch.

I. INTRODUCTION

Plastic is now inseparable in every aspect of our lives. In addition to being convenient, it is affordable and readily available in a variety of sizes. However, plastic waste that is difficult for microorganisms to decompose will accumulate over hundreds of years, causing an environmental impact (Dewata & Tarmizi, 2015). As a result, along with growing environmental awareness, there is growing interest in using alternative packaging that is environmentally friendly and comes from resources, one of which is bioplastic.

Components of bioplastics can be recycled and made from renewable materials (Fathanah et al.,2018). The edible film is one of today's most widely used bioplastics. Edible film is a thin layer made of edible material, prevents the transfer of moisture, carbon dioxide, oxygen, aroma, and dissolved substances in food, coats the food, and serves as a carrier for additives (Bourtoom, 2008).

The constituent components of edible films include hydrocolloids (alginates, polysaccharides, proteins). Lipids (fatty acids, acyglycerol, wax) and composites (a mixture of hydrocolloids and lipids) (Bourtoom, 2008). The main ingredients in the manufacture of edible films include starch. Starch is a natural food ingredient of the polysaccharide group which is widely used in the manufacture of edible films. This is due to the ability of starch in the formation of tissue or matrix (Amaliya et al., 2014). Of the various types of starch, corn starch is the main choice in the formation of the film matrix because it has low hygroscopic properties at 50% RH (Relative Humidity) which is 11%. The main content in corn is starch (72-73%) with amylose content of 25-30% and amylopectin 70-75% (Amaliya et al., 2014).

In the manufacture of edible films, plasticizers are used to improve the shape of the film, maintain integrity and avoid cracking (García et al., 2000). Polyethylene glycol is an effective plasticizer because it has the advantage of reducing internal hydrogen bonds from intermolecular bonds.

Chitosan is a compound that is insoluble in H_2SO_4 and water, slightly soluble in HNO_3, and well soluble in CH_3COOH (Azhar, 2016). Due to its good mechanical properties, ability to decompose by microorganisms, non-toxic nature, ability to inhibit moisture, and water resistance, chitosan is more commonly added to edible films (Chillo et al., 2008). Based on the description above, the researchers will utilize corn starch into edible film with the addition of chitosan and polyethylene glycol (PEG) plasticizer.

Characterization of physical and mechanical properties of edible films :

1. Thickness
   Thickness is a physical property of edible film whose size can be influenced by the hydrocolloid concentration of edible film formation and the size of the mold (Afriyah et al., 2015).
2. Tensile strength
   Tensile strength is the maximum tensile strength achieved, from which the film can last until the film finally break (Purwanti, 2010).
3. Modulus Young
   Modulus Young is a basic measure of the strength of a film (Salsabila & Ulfah, 2017).

II. RESEARCH METHODS

1. Tools
   The tools used in this research are glassware, oven, magnetic stirrer, heater, thermometer, desiccator, edible film mold, and tensile strength device.
2. Materials
   This study used ingredients including corn, aquades, 1% CH_3COOH, chitosan, and polyethylene glycol (PEG).

3. Research procedure

Starch extract from corn

Corn kernels are sorted and then soaked in clean water and washed in running water. Then the corn kernels are crushed using a blender. Blend the corn kernels by adding water as much as 2:1 of the weight of the corn kernels to be crushed. Next, it is filtered using a filter. The obtained filtrate was precipitated for 24 hours. The precipitate obtained was washed with clean water and then dried using an oven at 65˚C until dry starch was obtained (P & Layuk, 2010).

Making edible film

Edible film was made by dissolving 6 grams of corn starch with 100 ml of distilled water. The starch solution was then added with 2 ml of polyethylene glycol. The mixture was then stirred on a hot plate using a magnetic stirrer at a temperature of 60 - 70˚C for 15 minutes. Then add chitosan with a variation of 0% addition; 0.5%; 1%; 1.5; and 2 (w/v) into the edible film solution mixture. homogeneous edible film solution, at room temperature and then copied into the concrete. Edible film is dried at 60˚C within 3 hours using an oven (Robiana et al., 2017).

III. RESULT AND DISCUSSION

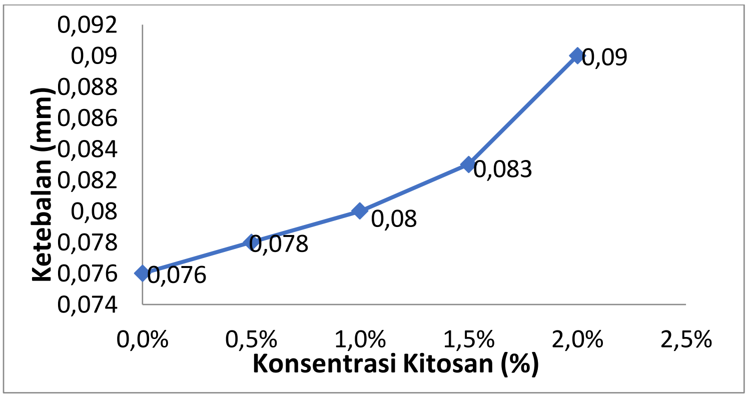
Tarch is a natural food ingredient group of polysaccharides composed of amylose and amylopectin. The process of synthesizing edible films using starch as a base material occurs in the gelatinization process. Gelatinization is a process that occurs when starch is heated in water and causes hydrogen bonds to be broken. The broken hydrogen bonds cause the amylose to diffuse out of the starch granules to be replaced by water. Water is trapped in the starch granules so that water cannot move freely and causes swelling of the starch granules. Continued heating resulted in the formation of a gel edible film as a result of the gelatinization process. Excellent gel results obtained was copied into a mold and dried in an oven at a temperature of 60˚C for 3 hours. Here are the results of the edible film:

Picture 1. Corn starch Edible film

Characterization of physical and mechanical properties of edible films :

1. Thickness of *edible film*

Film thickness is the most important parameter because it can affect the properties of edible films. Thick edible films have higher tensile strength values (Rusli et al., 2017). The following are the results of the analysis of the thickness of the edible film from corn starch with variations in the concentration of chitosan:

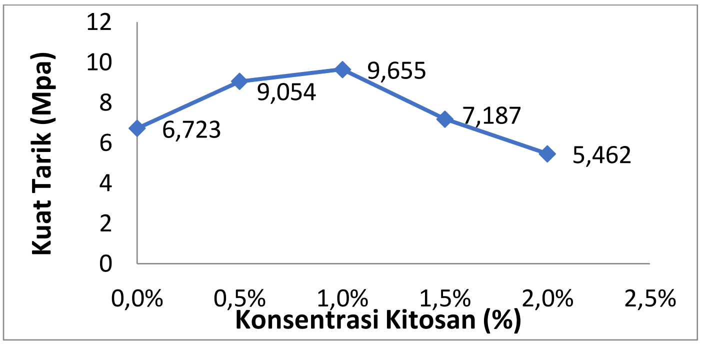


Picture 2. The effect of chitosan concentration on the thickness of the edible film

When chitosan is added, the edible film typically becomes thicker. This is because, when chitosan is added at a higher concentration, the solution's viscosity and total dissolved solids increase, resulting in a thicker edible film upon drying (Aisyah et al., 2018). The findings indicate that the addition of chitosan affects the edible film's thickness. The thickness of the edible film on the addition of chitosan ranged from 0.07 to 0.09 mm. The edible film that was produced met the Japanese Industrial Standard's minimum thickness requirement of < 0.25 mm.

2. Tensile strength of edible film

According to Purwanti (2010), tensile strength is the maximum tensile strength that a film can attain before eventually breaking. The ability of edible films to shield coated food from damage is indicated by their tensile strength value (Aisyah et al., 2018). The analysis of the tensile strength of edible films made from corn starch and chitosan at different concentrations yielded the following outcomes:



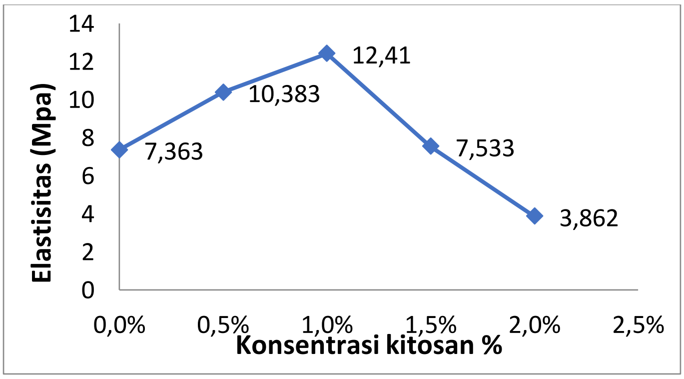
Picture 3. The effect of chitosan concentration on the tensile strength of edible films

Based on the results obtained, the tensile strength value increases with increasing chitosan concentration and then decreases again. The tensile strength value increases because chitosan can form intermolecular hydrogen bonds which make the edible film denser and stronger, making it more difficult to break (Fathanah et al., 2018). The addition of chitosan in the manufacture of edible films is able to form a strong polymer matrix so that the intermolecular tensile strength of the edible film becomes stronger. The tensile strength value increased with the addition of 1% chitosan.

The value of tensile strength was decreased at a concentration of 1.5% chitosan. This is because the matrix on the edible film has passed the saturation point so that the addition of chitosan no longer affects the tensile strength value (Darni et al., 2017). Thus it can be concluded that the optimum value of tensile strength is the addition of 1% chitosan. From the results obtained, the edible film meets the tensile strength standard, which is > 0.392 Mpa set by the Japanese Industrial Standard.

3. *Modulus Young*

Elasticity is a basic measure of the strength of a film. The following are the results of the elasticity value of edible film with the effect of adding chitosan:



Picture 4. Effect of chitosan concentration on the elasticity of edible film

The elasticity value increased as chitosan was added, and the maximum value was reached when 1% chitosan was added. The elasticity value will again decrease once the optimal condition is reached. Ariska & Suyatno (2015) found that the concentration of chitosan used affects the elasticity value. The greater the concentration of polymers used, the thicker the matrix and the greater the force required to break the specimen. As a result, it has great elasticity and tensile strength. The elasticity value of edible film from corn starch has met the standards set by the Japanese Industrial Standard, namely > 0.35 Mpa.

IV. CONCLUSION

The thickness, tensile strength, and elasticity values are affected when the concentration of chitosan is added. The thickness value increased with the chitosan concentration, which ranged from 0.07 to 0.09 millimeters. With a tensile strength of 9,655 Mpa and an elasticity of 12.41 Mpa, the addition of 1% chitosan produced the optimal values for the tensile strength and elasticity. The Japanese Industrial Standard (JIS) has been met by the obtained thickness, tensile strength, and elasticity values of edible films.

References

Afriyah, Y., Dwi, W., Putri, R., & Wijayanti, S. D. (2015). Penambahan Aloe vera L . Dengan Tepung Sukun (Artocarpus communis) dan Ganyong (Canna edulis Ker .) Terhadap Karakteristik Edible Film. *Jurnal Pangan Dan Agroindustri*, *3*(4), 1313–1324.

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

Amaliya, R. R., Dwi, W., & Putri, R. (2014). Karakterisasi Edible Film dari Pati Jagung dengan Penambahan Filtrat Kunyit Putih sebagai Antibakteri. *Jurnal Pangan Dan Agroindustri*, *2*(3), 43–53. https://jpa.ub.ac.id/index.php/jpa/article/view/51

Ariska, R. E., & Suyatno. (2015). Pengaruh konsentrasi karagenan terhadap sifat fisik dan mekanik *Edible Film* dari pati bonggol pisang dan karagenan dengan plasticizer gliserol. *Prosiding Seminar Nasional Kimia*, 34–40.

Azhar, M. (2016). Biomolekul Sel Karbohidrat,Protein dan Ezim. In *UNP Press Padang*.

Bourtoom, T. (2008). Edible films and coatings : characteristics and properties. *International Food Research Journal*, *15*(3), 237–248.

Chillo, S., Flores, S., Mastromatteo, M., Conte, A., Gerschenson, L., & Del Nobile, M. A. (2008). Influence of glycerol and chitosan on tapioca starch-based edible film properties. *Journal of Food Engineering*, *88*(2), 159–168. https://doi.org/10.1016/j.jfoodeng.2008.02.002

Darni, Y., Utami, H., Septiana, R., & Fitriana, R. A. (2017). Comparative Studies of the Edible Film Based on Low Pectin Methoxyl with Glycerol and Sorbitol Plasticizers. *Jurnal Bahan Alam Terbarukan*, *6*(2), 158–167. https://doi.org/10.15294/jbat.v6i2.9707

Dewata, I., & Tarmizi. (2015). *Kimia Lingkungan Polusi Air, Udara dan Tanah* (pp. 12–13). Pers UNP Padang.

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

García, M. A., Martino, M. N., & Zaritzky, N. E. (2000). Lipid addition to improve barrier properties of edible starch-based films and coatings. *Journal of Food Science*, *65*(6), 941–944. https://doi.org/10.1111/j.1365-2621.2000.tb09397.x

P, S., & Layuk, P. (2010). Mempelajari Sifat Mekanik dan Barrier Edible Film dari Pati Jagung. *JIK*, *4*. https://doi.org/10.3130/aijt.5.211_5

Purwanti, A. (2010). Analisis Kuat Tarik dan Elongasi Plastik Kitosan Terplastisasi Sorbitol. *Jurnal Teknologi*, *3*(2), 99–106.

Robiana, M. Yashin Nahar, & Hamidah Harahap. (2017). Pemanfaatan Gliserin Dari Residu Gliserin Sebagai Plasticizer Untuk Pembuatan Bioplastik Dengan Bahan Baku Pati Bonggol Pisang Kepok. *Jurnal Teknik Kimia USU*, *5*(4), 26–32. https://doi.org/10.32734/jtk.v5i4.1551

Rusli, A., Metusalach, Salengke, & Tahir, M. M. (2017). Karakterisasi Edible Film Karagenan Dengan Pemlatis Gliserol. *Jurnal Pengolahan Hasil Perikanan Indonesia*, *20*(2), 219–229.

Salsabila, A., & Ulfah, M. (2017). Karakteristik Ketebalan Edible Film Berbahan Dasar Bioselulosa Nata De Siwalan Dengan Penambahan Gliserol. *Bioma : Jurnal Ilmiah Biologi*, *6*(1), 569–576. https://doi.org/10.26877/bioma.v6i1.1469