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Addition of Chitosan Concentration on Mechanical Properties of Yam Yam (Pachyrhizus Erosus) Starch Edible Film

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Abstract: Edible film is a thin layer used to protect food products whose basic ingredients are environmentally friendly natural ingredients. This study aims to determine the effect of chitosan addition of chitosan on edible films made from yam starch (Pachyrhizus erosus) on the physical and mechanical properties of edible films. In this study using polyethylene glycol plasticizer and variations in the addition of chitosan concentration (0%, 0.5%, 1%, 1.5%, 2%). cm-1, C-H bonds in wave numbers 3000 – 2840 cm^{-1} and C-O bonds in wave numbers 1085 – 1050 cm^{-1}. The results obtained were compared with starch and the results obtained were almost the same as starch standards. The mechanical properties of the maximum tensile strength with the addition of 1% chitosan was 7.091 Mpa, the maximum elongation with the addition of 2% chitosan was 2.3 and the maximum elasticity with the addition of 1% chitosan was 864 Mpa. The mechanical properties of the edible film obtained for tensile strength and elasticity have met the standards set by the Japanese Industrial Standard (JIS) while the elongation value has not met the standards.

Keywords: Edible Film, Yam Starch.

I. INTRODUCTION

Packaging is an important thing to do in maintaining the quality of food security. The main material that plays an important role in the food packaging industry is polymer. In the last 20 years the packaging used is synthetic plastic because it is water, air and heat resistant. However, this synthetic plastic has an unfavorable impact on the environment because it is difficult to decompose in nature and has an impact on environmental pollution. Plastic waste that is disposed of carelessly can last for hundreds of years in this environment because the polymer chains of synthetic plastics are long and take a long time to decompose or break the bonds between polymers (Dewata 2015). The bad impact of synthetic plastic is that it can pollute the soil, water and air so that humans realize the importance of a clean environment, so many studies have been carried out to find food packaging materials that are easily decomposed by the environment so they do not pollute the environment. One of the alternative food packaging materials that are environmentally friendly (biodegradable) is edible film. Edible film is a thin layer made of natural materials that can be consumed and easily degraded(Breemeer Rachel, 2016).

One of the materials that are often used in the manufacture of edible films is divided into three, namely hydrochloride, lipid and composite. Hydrochloride is an edible film made from polysaccharides. Lipids are based on oil and fat, while the composite is an edile film made from lipids and hydrochlorides. One of the ingredients that Often used in the manufacture of edible films is starch which belongs to the type of polysaccharide. Starch is widely contained in fruits and one of them is yam, where yam starch contains 63.62% starch content consisting of amylose 20,719% and 42,901% amylopectin. This yam has a large population in Indonesia (Suharti1, Netty & Djamaan, 2019).

One of the disadvantages of starch-based edible films is that they are easily brittle, break easily and are not flexible (Setiani et al., 2013). Due to the brittleness and breakability of edible films from starch, it is necessary to add plasticizers and other additives to improve the mechanical properties of edible films. Plasticizer is a non-volatile substance that has a high boiling point and when added to other compounds will reduce stiffness and increase the elasticity of the film. Plasticizers that are often used in the manufacture of edible films are glycerol, sorbitol and polyethylene glycol (PEG). Polyethylene glycol (PEG) is added to the edible film to increase the flexibility of the polymer, besides that PEG functions as an antifoaming which prevents the formation of foam due to the stirring process of the edible film. PEG 400 used in the manufacture of edible films ranges from 30%-50% of the weight of starch used (Murni et al., 2013).

Chitosan is a type of chitin-derived pilisaccharide that has undergone a deacetylation process. The addition of chitosan in the manufacture of edible films because it is easily degraded can block moisture, is resistant to water and is easy to form films (Andriani Riska, 2019). Chitosan is polyatomic so that it can be applied in various fields such as absorption of textile dyes, metal adsorbents, cosmetic ingredients and anti-bacterial agents. The biodegradable, nontoxic, biocompatible properties of chitosan make the use of this compound in environmentally friendly industries (Wiyarsi & Priyambodo, 2008)

II. IMPLEMENTATION METHOD

2.1 *Tools and materials*

The tools used in this research are glassware, oven, thermometer, hot plate, magnetic stirer, blender, jar, 90 mesh sieve, desiccator, edible film mold, tensile strength device (trnsile strength), and FTIR. The materials used are yam, chitosan, polyethylene glycol (PEG), 1% acetic acid (CH_3COOH) and aquades.

2.2 *Work procedures*

2.2.1 Jicama Starch Extract

Jicama peeled the skin, taken as much as 1 kg of yam meat. Cut into small pieces, then washed with running water. Then use a blender to crush the yam and add 1000 ml of distilled water. After becoming jicama slurry then filtered and allowed to stand for 4-5 hours to get starch deposits. After 4-5 hours the precipitate was separated from the water to obtain wet starch, dried in an oven at 500C for 3 hours to dry the starch. Finally, the starch was sieved using a 90 mesh sieve.

2.2.2 Making edible films

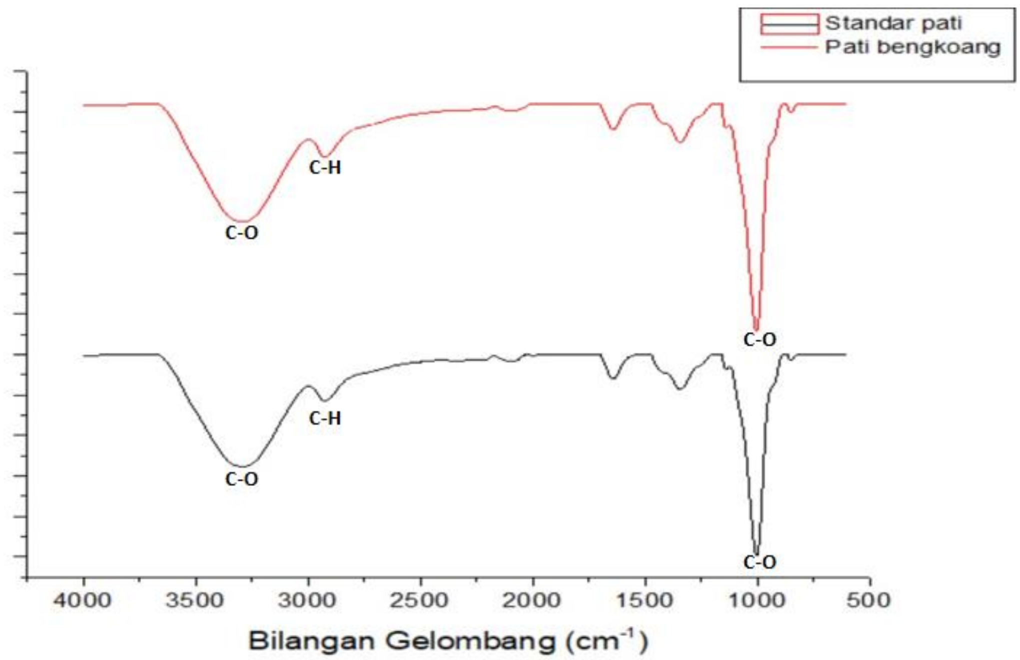
5 grams of yam starch dissolved in 100 ml of distilled water, then added 2 ml of PEG. Heat the mixture at a temperature of 60^0C-70^0C while stirring for 15 minutes. After the gel is formed, let the temperature drop and then add the concentration of chitosan which will be varied, namely 0%; 0.5%; 1%; and 2% w/v to make edible film from yam. The homogeneous edible film solution was put into the edible film mold and cooled at room temperature. Dried in the oven for 3-4 hours at a temperature of 600C until a thin layer (edible film) is formed.

2.2.3 Edible Film Mechanical Properties Test

The edible film sample was cut to a size of 10 x 2 cm after which both ends of the plastic were clamped with a tensile strength tool. The tool is operated until the sample breaks.

III.RESULTS AND DISCUSSION

This research was conducted in the Chemistry laboratory of Padang State University. The first stage is the preparation of yam starch through the extraction process. This extraction process begins with the separation of the yam skin from its flesh, which aims to reduce the browning of the yam starch, then the yam is cut into small pieces and puree using a blender. Then let stand for 3 hours and then get starch deposits and oven and then get yam starch. To determine the sample that we get is true for the presence of starch, a characterization test is carried out using FTIR by comparing yam starch with starch standards (Amylum) with Spectra:

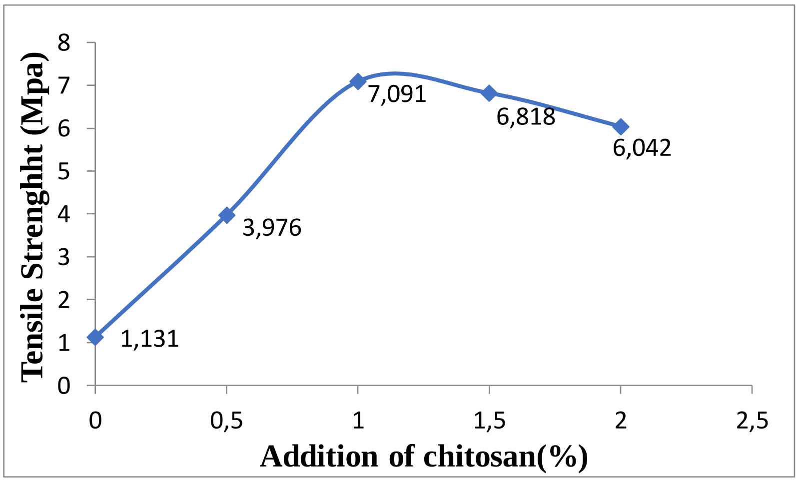


Picture 1 FTIR Analysis of Yam and Starch Starch

Characterization test using the FTIR instrument can be seen that yam starch has C-O bonds at 3000-2840 cm^{-1} and O-H bonds at 3550-3200 cm-1 waves. The results obtained were compared with starch and the results obtained were almost the same.

1. Edible Film Dance Strength Test

Tensile strength is the value of stress (stress) obtained until the film before breaking. The difference in the results of the tensile strength values is due to differences in the composition and concentration of the sample which will affect the resulting tensile strength.

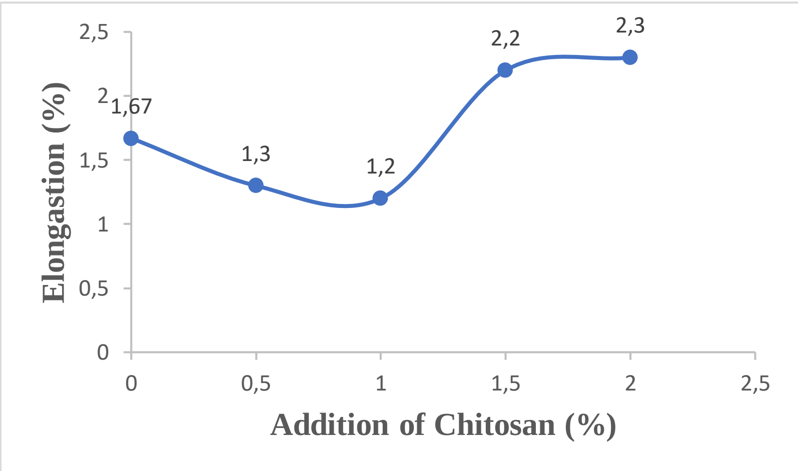


Picture 2 Effect of Addition of Chitosan Concentration on Tensile Strength

Based on the results obtained, the value of tensile strength increased with increasing concentration of chitosan. The value of the tensile strength rose to the optimum point with the addition of 1% chitosan with a value of 7.091 Mpa. The increase in the tensile strength value is due to the fact that chitosan can form hydrogen bonds between starch molecules so that the edible film becomes denser and firmer, making it difficult to break or break (Ali et al., 2017). Then it decreased in the addition of chitosan at a concentration of 1.5% and 2% 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 (Ikhsan, 2021).

2. Percent Elongation of Edible Film

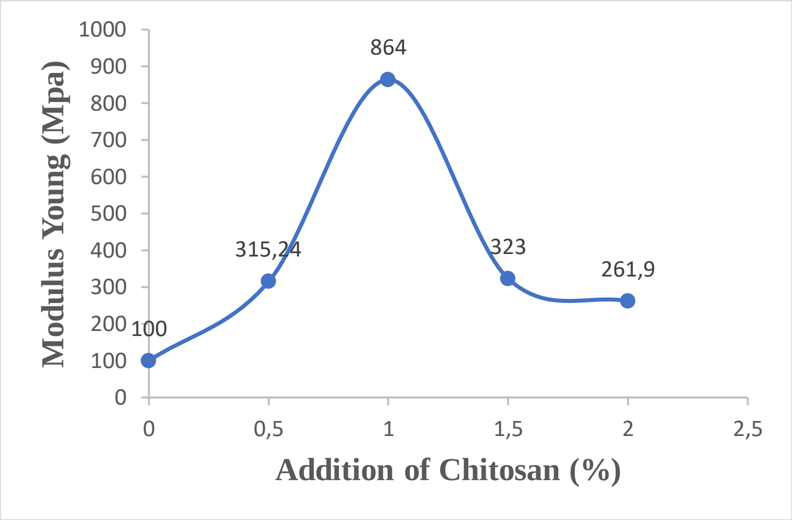
Percent elongation is the change in length from the first to the length after being tested with a tensile strength tool, seen when the edible film breaks. The test results can be seen from the image below:



Picture 3 Effect of the addition of Chitosan Concentration on Elongation

Based on the graph above, it can be seen that with the addition of 1% chitosan, the elongation value decreased by 1.2%. Chitosan can fill the empty space in the edible film matrix so that the intermolecular forces will be reduced resulting in the resulting edible film being less elastic. So that the high value of tensile strength will reduce the value of the length increase on the film so that the edible film becomes easily broken. The addition of polyethylene glycol can reduce the intermolecular forces and can also increase the molecular space and the degree of mobility between the molecular chains (Coniwanti et al., 2014).

3. Modulus Young (Elastisitas)



Picture 4 Effect of Addition of Chitosan on Young's Modulus

The elasticity value continued to increase with the addition of chitosan and reached a maximum point at the addition of 1% chitosan with a Young's modulus of 864 Mpa. After reaching the optimum condition, the elasticity value will decrease again. According to research (Saleh et al., 2017) the elasticity value is influenced by the concentration of chitosan used, where the greater the concentration of chitosan, the greater the elasticity value. The greater the concentration of polymer used, the thicker the number of polymers that make up the matrix, so that the force to break the specimen is greater. This results in great tensile strength and elasticity.

III. CONCLUSION

The addition of chitosan concentration affects the mechanical properties of the edible film. Where the tensile strength and elasticity obtained optimum conditions with the addition of 1% chitosan with a tensile strength value of 7.091 Mpa and elasticity of 864 Mpa. While the maximum elongation was obtained with the addition of 2% chitosan with an elongation value of 2.3%.

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