Physical Characteristics of Edible Film from Breadfruit Peel using Xylitol as Plasticizer

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Abstract. Breadfruit peel derived from peeling waste from processed products made from breadfruit. Currently, breadfruit is only used for its flesh, while the peel of breadfruit is usually discarded or used as animal feed. Breadfruit peel flour has a fiber content of 2.65% and starch of 39.56%. The starch content in this breadfruit peel starch can be used as an ingre-dient for the manufacture of environmentally friendly biodegradable plastic, namely edible film. Edible film is a thin layer used as a food wrapper. This research purposes are to iden-tify the characteristics of edible film made from breadfruit regarding their texture and color. The physical characteristics produced are that the edible film has a texture that is flexible, slippery, and easy to tear, while the more composition of the material added, the brightness level of the edible film will increase.

Keywords: Breadfruit, Edible film, Texture, Brightness

1 Introduction

Breadfruit plant which has the scientific name *Artocarpus altilis*. The height can reach 30 meters, and can grow well throughout the year in the tropics [1]. Breadfruit has high contained of carbohydrates, phosphorus and calcium compared to the levels of other nutrients in it [2]. Breadfruit is usually processed into various snacks and made by frying, grilling, boiling and making crackers. Processed from breadfruit produces breadfruit peel waste which is still minimally utilized.

There are a lot of breadfruit in Indonesia, 124,287 tons in 2018 and 122,482 tons in 2019. In the research conducted by Putri, et al [3], breadfruit peel flour has a fiber content of 2.65% and starch of 39.56%. The starch content in breadfruit peel is greater when compared to the starch found in cassava peel which is widely used as an ingredient for making edible films. The starch content in cassava peel is 36.5% [4]. Starch is a raw material that is easy to find in Indonesia. Starch is obtained from the extraction of plants or vegetable materials that contain carbohydrates [5]. One of the non-food materials processed from starch is environmentally friendly plastic.

Edible film is a thin layer that can be consumed which is generally used as food packaging. One example of a food product that uses edible film as a wrapper is meat sausage which can be cooked or eaten together with the wrapping layer. The function of this edible film is to protect the coated food from certain microorganisms and to maintain the quality of the food [6]. In previous studies, edible films can be made using various raw materials. According to the research of Murrieta, et al., [7] the Edible Film from Squid Protein with Xylitol, it produces edible film with a hollow texture and has a slightly yellowish color. Then the research from Wandyah, et al 2019 namely Edible Film from Taro Bulb Starch with Glycerol and Poly-vinyl Alcohol, produced edible film with a smooth texture and clear color. In addition, another research said that Edible Film from Ca-Alginate with Glycerol, PVA, PEG and Ki-tosan produces edible film with a smooth texture and has a clear slightly yellowish color. The purpose of this study was to determine the best color and texture of edible film from various variables [8].

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2 Methodology

2.1 Materials

The materials used in this study were breadfruit peel waste obtained from the Malang Chips Industry Center. Plasticizers in the form of xylitol, chitosan and aquadest are purchased from chemical stores in the Surabaya area, Indonesia.

2.2 Synthesis Process

The tools used in this research are hot plate magnetic stirrer, magnetic capsule, beaker glass, thermometer, stative and mold measuring 15 x 15 cm, Figure 1.

Fig.1. Experimental set-up.

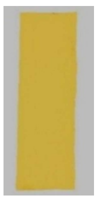
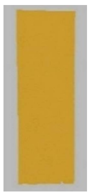
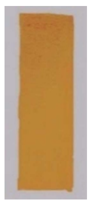
Breadfruit peel starch, xylitol and chitosan were weighed according to the predetermined variables. Then the ingredients are mixed with the addition of 250 ml of distilled water. Then stirred using a hot plate magnetic stirrer at a temperature of 65ºC for 45 minutes. Stir until homogeneous and then poured into a glass plate mold measuring 15 x 15 cm and dried at 60ºC for 6 hours.

3 Result and Discussion

3.1 The Color Characterization

The color of the edible film is very influential on the quality of the appearance of the product that will use edible film as a packaging material. The quality of the edible film will be better if the color of the edible film is getting brighter. The higher the concentration of plasticizer and chitosan, the brightness of the edible film produced will decrease. This is due to the increasing number of dissolved solids so that it can increase the viscosity of the edible film solution which causes the brightness of the edible film to decrease. The previous research concluded that the increase in the viscosity of the edible film solution resulted in the number of dissolved solids which resulted in the increasing of the film-forming polymer so that the brightness intensity of the edible film would decrease along with the addition of plasticizer and chitosan [9].

Table 1. Color Characterization

Variables	Color				
	0,25 gr Kitosan	0,75 gr Kitosan	0,75 gr Kitosan	1 gr Kitosan	1,25 gr Kitosan
0,25 gr Xylitol					
	0,25 gr Xylitol	0,75 gr Xylitol	0,75 gr Xylitol	1 gr Xylitol	1,25 gr Xylitol

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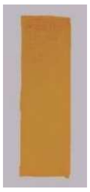
0,25 gr Kitosan					

4 Texture Characterization

For the edible film from breadfruit peel, it has a flexible, slippery texture, and is easy to tear. Texture analysis of the edible film was carried out with a binocular microscope which would produce photos of the microstructure of the edible film. Other research also indicate that the addition of xylitol can reduce hydrogen bonds in the structure of edible films [10].

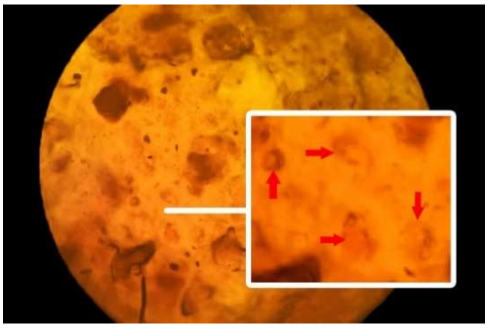


Fig. 2. Edible Film texture (0,25 gr citosan and 1,25 gr xylitol)

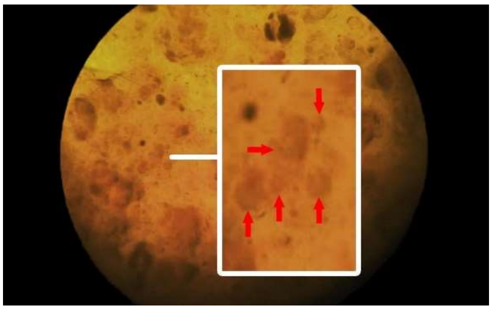


Fig.3. Edible Film Texture (1,25 gr chitosan and 0,25 gr xylitol)

The results indicate that polyols such as xylitol are good enough plasticizers to reduce internal hydrogen bonding thereby increasing intermolecular distances. This can be seen in Figure 2 where the distance between the amylopectin granules is far apart. In addition, the addition of the concentration of chitosan causes the amylose bonds to strengthen on the edible film so that the cracks are reduced which causes the tensile strength to be greater. This can be seen in Figure 3 where the distances between the amylopectin granules are close together and produce a hydrogen bonded matrix. The results of the structural analysis are in accordance with the data from the tensile strength test of the edible film which shows that the higher the addition of chitosan, the higher the tensile strength of the edible film produced.

5 Conclusion

Breadfruit peel waste (Artocarpus altilis) which contains starch can be used as raw material for making edible films with the addition of xylitol and chitosan plasticizers. The edible film has a darker color along with the addition of xylitol and chitosan. Meanwhile, the resulting texture is flexible and easy to tear.

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