Porang glucomannan based edible film with the addition of mangosteen peel extract

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Abstract. Porang flour is a rich source of glucomannan, while mangosteen peel contains antibacterial and antioxidant compounds. Both of these materials can be combined in making edible films which can be applied for environmentally friendly food packaging. The addition of a plasticizer, such as sorbitol, is expected to provide the elasticity properties of the resulting film. This study aimed to evaluate the edible film properties made from glucomannan with various concentration (3% and 4%), and without the addition of mangosteen peel extract or with the addition of extract of mangosteen peel (1%). The results showed that the edible film with the highest tensile strength was obtained in the edible film made from 4% glucomannan without or with 1% mangosteen peel extract, namely 2.6985 MPa and 2.6697 MPa respectively, while the thicknesses were 0.21 mm and 0.23 mm respectively.

1. Introduction

The synthetic polymer materials usually used in the manufacture of plastic for food packaging, but it is the one of the causes of environmental pollution. The edible film is a thin sheet developed in the manufacture of packaging from biodegradable biopolymers, which can be consumed directly with packaged food [1]. Porang flour has a main component, namely glucomannan, about 50.84-70.70%, a hydrocolloid polysaccharide that can form a gel and has a high viscosity, so it can be used as a basic material for making edible films [2,3].

The utilization of mangosteen peel has been widely used in the field of food and medicine because mangosteen peel contains xanthones which are beneficial for the body as antioxidants, antibacterial, allergy, anti-tumor, antihistamine, and anti-inflammatory [4]. Making edible films from biopolymer materials is brittle so it is necessary to add a plasticizer, one of the plasticizer materials that can be added is sorbitol [5]. The effect of glucomannan concentration and the addition of mangosteen peel extract on the characteristics of the resulting edible film was evaluated in this study.

2. Materials and methods

The materials used in this research were porang flour purchased from porang farmers in East Java, mangosteen peel purchased from Medan local market, sorbitol, aquadest, and ethanol.
2.1. Making extract mangosteen
Mangosteen peel was cleaned and dried for 24 hours in an oven at 60 °C. Dried mangosteen peel was blended and the powder is sieved at 40 mesh. 100 g of dried mangosteen peel powder, dissolved in 600 ml of ethanol, and macerated for 24 hours. The macerated mangosteen peel is filtered to separate the powder and the solvent, then to separate the ethanol solvent from the extract it’s done used rotary evaporator. The extract obtained was heated at 79 °C to remove the remaining ethanol solvent [6].

2.2. Making an edible film
2 and 4 g of porang glucomannan flour were weighed and dissolved in 100 ml of distilled water while stirring until homogeneous for 10 minutes. 3 ml of sorbitol was added to the solution and heated to 60 °C. Mangosteen peel extract is added 0% (control) and 1%, Stirring was kept until the solution is thick. It was poured on a glass mold with a dimension of 20 x 20 cm, using an oven at 60 °C 24 hours [7,8].

2.3. Data analysis
The study was designed with factorial completely randomized design. The parameters analyzed were tensile strength, thickness, transmission rate of water vapor, and the lightness (L*) edible film. The processing of observation data was carried out by analysis of variability, and if the treatment had a significant effect, then a further test was carried out with the Least Significant Range Test.

3. Results and discussion
The edible film from glucomannan extract with different concentrations (3% and 4%) and with or without the addition of mangosteen peel extract can be seen in figure 1. The edible film made from glucomannan with the addition of 1% mangosteen extract has a brown color. The edible film with glucomannan concentration of 4% has a brighter color edible film compared with an edible film made from 3% glucomannan.

![Figure 1](image)

2.1. Tensile strength test of edible film
Data analysis shows that the interaction between mangosteen extract and glucomannan has a significant difference (p<0.05) on the tensile strength test of edible film. The effect of the interaction between glucomannan concentration and mangosteen peel extract on the tensile strength of the edible film can be seen in Figure 2.

The tensile strength test was a parameter of the edible film that indicates the influence of concentration of glucomannan and mangosteen peel extract on the maximum tensile strength in each unit area of the edible film area until it elongated and broke [9]. Increasing the concentration of glucomannan from porang flour will increase the tensile strength of the edible film, this is because glucomannan will form many intermolecular bonds in the edible film matrix [10]. The addition of mangosteen peel extract did not increase the tensile strength of the edible film. The highest tensile strength value was obtained from the treatment of 4% glucomannan concentration (0% extract), namely 2.5709 MPa, and 4% glucomannan concentration (1% extract), namely 2.7100 MPa.
3.2. The thickness of edible film

Data analysis shows that the interaction between glucomannan and mangosteen extract concentration has a significant difference effect ($p<0.05$) on the edible film thickness (Figure 3). The thickness characteristics of the sample are the eligibility requirement for use as food packaging because the thickness of the film will affect other physical and mechanical characteristics, such as tensile strength and water vapor transmission rate.

Edible film pulling strength will increase by increasing the thickness of the film, but the thicker the edible film, the elongation and water solubility will decrease [11]. Increasing the concentration of glucomannan has an impact on increasing the thickness of the film sheet because the difference in the concentration of the edible film making material increases while the volume is constant, resulting in an
increase in the total solids in the film when drying and the polymer that makes up the film increases [12]. The addition of mangosteen peel extract did not affect the thickness of the edible film. The sample thicknesses obtained from the treatment were 0.21 mm and 0.23 mm.

3.3. Transmission rate of water vapor

The result of the transmission rate of water vapor on edible film can be seen in Figure 4. The results value of water vapor transmission rates on edible films greatly affects the shelf life of the product when used as food packaging. The ability of the sample to hold gas particles and water vapor into the packaged product is very important because it will affect the damage to the packaged product.

![Water Vapor Transmission Rate Test](image)

**Figure 4.** Effect of interaction between glucomannan and mangosteen peel extract (0% and 1%) on water vapor transmission rate test.

The water vapor permeability of edible film is the rate of speed of water vapor through a unit area of material whose surface is flat with a convinced thickness, as a result of a unit difference in vapor pressure between two surfaces under certain temperature and humidity conditions [13]. The increase in the concentration of porang flour shows a decrease in the value of the water vapor transmission rate on the edible film, while the extension of mangosteen peel extract did not affect the value of the vapor transmission rate. The lowest water vapor transmission rate was obtained in the treatment of 4% glucomannan concentration without extract and using extract, namely 12.575-12.658 g/m²/hour.

3.4. L* value

![L* Value](image)

**Figure 5.** Effect of interaction between glucomannan and mangosteen peel extract (0% and 1%) on L value
Analysis of data shows that the interaction between mangosteen extract and glucomannan has a significant difference (p<0.05) on the L* value of edible film (Figure 5). The highest L value is 68.223 and the lowest L value is 62.678. The L* value shows the brightness level of the color in the range of 0 (black) – 100 (white). The higher L* value obtained a brighter color. The L value obtained is in line with the previous study [14] which produces L value 60-70. The decrease in L value can occur due to the heating process that occurs in making edible films.

4. Conclusions
The concentration of glucomannan affected the physical quality of the edible film produced, but the addition of mangosteen peel extract did not have a significant effect on the physical quality of the edible film. The edible film made from 4% glucomannan concentration has a thickness of 0.23 mm, a water vapor transmission rate of 12.575-12.658 g/m²/hour, the tensile strength obtained is 2.571–2.710 Mpa, and L* value 62.743–6.225.

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Acknowledgements
Authors wishing to acknowledge to Directorate General of Research Strengthening and Development, Ministry of Research and Technology, National Agency for Research and Innovation, Republic of Indonesia for funding this research through Penelitian Tesis Magister 2020.