Extraction and Characterization of Glucomannan from Porang (*Amorphopallus oncophyllus*) with Size Variations of Porang

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ABSTRACT

Porang (*Amorphophallus oncophyllus*) is a tuber plant with high economic value as a raw material for making glucomannan. In this context, glucomannan possesses soluble properties, enabling the material to form a gel and contribute to thickening used in the food, pharmaceutical, and chemical industries. The extraction process uses porang harvested at the age of 3 years, with a size ranging from 10 to 20 cm. Even though the content is established, crucial information regarding the yield and different physical properties, such as viscosity, moisture content, and whiteness, remains unknown. Further analysis on glucomannan extraction should be performed with different age variations, before and after 3 years, namely 1 year, 2 years, and 4 years. Therefore, this study aimed to characterize and test the porang effects of various ages on the yield and physical properties of glucomannan, including viscosity, moisture content, and whiteness. The glucomannan extraction process included heating, filtering, 1:1 extraction, grinding, drying, flouring, and sieving. The results showed that the yield ranged from 49.33 - 69.33%, while the physical properties, including viscosity, moisture content, whiteness, and glucomannan content ranged from 31.556 - 39.556 m. Pas, 4.74 - 6.99%, 81.14 - 83.24%, and 95.13 - 97.57%, respectively. The variations in age of 1 year, 2 years, and 4 years affected yield, but the porang tubers had no effect on glucomannan content, and the quality of the flour on viscosity, moisture content, and whiteness. The variations with different ages met commercial standards, and the best variation was 1-year-old porang tubers with the highest yield of 65.33%. Concerning the physical properties, the highest viscosity, moisture content, whiteness, and glucomannan content was 39.556 m. Pas, 17%, 83.24% and 95.13%, respectively. Therefore, the plant could be harvested at 1 year old for extraction to meet export needs.

Keywords: Age of porang; glucomannan; glucomannan extraction

INTRODUCTION

Porang (*Amorphophallus oncophyllus*) is one of the tuberous plants thriving in tropical climates. Currently, this food material in the form of chips and flour in Indonesia, is exported to be processed into glucomannan due to high demands from several countries as a food and industrial ingredient. Porang has high economic value as a raw material for glucomannan due to its wide range of uses in the food industry.

Glucomannan is a polysaccharide in the mannan family and is a polymer of D-mannose and D-glucose. This polymer is easily soluble and can form a gel, improve texture, and thicken. Some studies indicate

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that glucomannan has prebiotic effects on humans (Harmayani et al., 2014). Furthermore, it is used as a food additive due to the ability to absorb water, act as an emulsifier and stabilizer, thicken, and create a packaging barrier. In the pharmaceutical field, konjac glucomannan enhances drug bioadhesion, and in chemistry, serves as a film-forming agent, a preservative for fresh food, a hair conditioner in cosmetics, an emulsifier, and a surfactant (Zhang et al., 2005).

The process of extracting glucomannan from the porang tuber includes two main stages, namely the conversion and extraction from the flour. The production process begins with washing the tubers, cutting into chips, drying using a cabinet, and milling into flour. Subsequently, the porang flour is sifted and blown with a blower, and the flour obtained during the blowing process is ready for extraction.

In a previous study, (Sumarwoto, 2005) porang plants with a minimum of two vegetative periods have higher content of 47-55%. According to (Chairiyah et al., 2014), glucomannan levels were higher during the resting phase compared to 2 weeks before and after the period, with a content of 29%. Amorphophallus konjac plants have higher glucomannan compared to the early growth stage, with a content of approximately 90% (Chua et al., 2012). Furthermore, the content of tubers harvested from plants in the 3rd growth period is higher than in the 2nd period, with a content of 99% (Gusmalawati et al, 2019). According to (Budiman et al, 2012), porang tubers planted for 4 years reach optimal growth and are ready for harvest, with content ranging from 41-49%. Based on the idea that glucomannan content is significantly influenced by the harvest age, further study is needed to investigate the quality since no analysis has been conducted on the topic.

Characterization study on the physical properties of glucomannan has been conducted with a 3-year harvest age, as stated by (Mahendra, 2015) The yield was approximately 58.22%, while viscosity, moisture content, and whiteness were around 60,000 m.Pas, 6.72%, and 86.74%, respectively. According to (Wasiarahmah, 2019), the yield, viscosity, moisture content, and whiteness were 65.39%, 38,933 m.Pas, 9.7%, and 85.3%. Therefore, the characterization of glucomannan with variations in the harvest age of porang tubers is unknown. Further studies should be conducted to extract the polymer using harvest age variations of 1 year, 2 years, and 4 years, to assess the influence on the yield and physical properties, including viscosity, moisture content, whiteness, and glucomannan content. This is necessary in understanding the quality of glucomannan to enhance commercial production.

METHODS

Materials

The main materials used included porang tubers, Aluminum Sulfate $(Al_2(SO)_4)_3$ (≥17%) which is produced by PT. Indonesia Acids Industry, Aquadest, and 96% ethanol. Porang flour was prepared from freshly harvested tubers (*Amorphophallus oncophyllus*) in Nglanggerang Village, Pathuk District, Gunungkidul Regency. The tubers used were 1 year, 2 years, and 4 years old with diameters ranging from 10-20 cm. Aluminum Sulfate $(Al_2(SO)_4)_3$, which was white in color, Aquadest, and 96% ethanol were purchased from a chemical supply store.

The main extraction process equipment used included a stirred water bath and a vacuum dryer. The water bath had Matsuka electric motor specifications from Japan, a voltage of 500 volts, a frequency of 50 Hz, a power of 1.3 Kw, and an extraction chamber capacity of 10 L. The electric motor used was of the Wipro brand from India with a voltage of 220 volts, an electric current of 3.61 Amperes, a frequency of 50 Hz, a power of 0.5 hp, and a mixer speed of 75 rpm. The vacuum dryer used had specifications with the Kanaba brand from Indonesia, capacity of 24 pans, length of 80 cm, width of 30 cm, a machine length of 100 cm, machine width of 100 cm, machine height of 200 cm, electric heater of 6000 watts, 6500 watts of power, and the material was made of 304 stainless steel. The vacuum dryer was heated using a heater, and there was a blower component. These water baths and vacuum dryers were produced in the Sleman area, Yogyakarta.

Glucomannan Extraction from Porang Flour

The extraction process began with the transformation of porang tubers into flour, followed by the conversion into glucomannan flour using the method described in (Tatirat & Charoenrein, 2011). The processes started with heating using a stirring water bath with 100 g of porang flour, 10 g of aluminum sulfate, and 10 L of distilled water. Subsequently, filtration was carried out to obtain the filtrate using ethanol 96%, which coagulates to form a wet cloud glucomannan. The product was filtered and ground into small-sized wet cloud glucomannan before drying using a vacuum dryer. The achieved dry cloud glucomannan was subjected to a milling and sieving process to produce uniform flour, ready for quality testing.

Data analysis

Rendement

According to (Nurjanah, 2010), the yield of glucomannan flour produced in this study can be measured. The yield is obtained from the final mass value of glucomannan after the end of the extraction process divided by the initial mass of porang flour used as seen in Equation 1.

$$Yield = \frac{weight\ of\ glucomannan\ after\ drying}{initial\ weight\ of\ porang\ flour} \times 100\% \quad (1)$$

Viscosity

The viscosity of the glucomannan solution was determined using a Brookfield Viscometer. A total of 1% solution was stirred for one hour and the measurements were carried out using spindle number 7 and RPM rotation speeds of 0.5, 1, 2.5, and 5.

Moisture content

According to (Midayanto & Yuwono, 2014), measuring the moisture content was conducted by weighing an empty container used to hold the glucomannan flour to be dried in an oven. The scale was then zeroed, and a 2 g sample to be tested for its moisture content was placed in the container before being put into an oven and left for 24 hours. Furthermore, the weight of the container plus the sample was measured to obtain the moisture content value of the glucomannan flour as calculated using Equation 2.

$$X = \frac{m_1 - m_2}{m_1 - m_3} \times 100\% \quad (2)$$

where,

X = moisture content in the sample, in grams per 100 grams (g/100g)

m_1 = mass of weighing cup and sample, in grams (g)

m_2 = mass of weighing cup and mass of dried sample, in grams (g)

m_3 = mass of weighing cup, in grams (g)

Color

According to (Impaprasert et al., 2014), measuring the color of glucomannan flour can be carried out using a Chromameter with a black background and analyzing the L* (brightness), a* (green or red), b* (blue or yellow) values. The degree of whiteness can be measured by following Equation 3.

$$W = 100 - \sqrt{(100 - L)^2 + a^2 + b^2} \quad (3)$$

Glucomannan content

The measurement of glucomannan content was tested using the analytical procedure (Republic of China, 2002) with Equation 4.

$$Glucomannan(\%\ db) = \frac{\varepsilon\ x\ (5T - T_0)\ x\ 50}{m\ x\ (1 - w)\ x\ 1000}\ x\ 100 \quad (4)$$

Where:

ε = the ratio between the molecular weight of the glucose and mannan residues in glucomannan to the molecular weight of the glucose and mannan produced after hydrolysis = 0.9

T = Glucomannan hydrolyzate glucose content (mg)

T0 = Glucomannan solution glucose content (mg)

m = sample mass (g)

w = sample moisture content

RESULTS AND DISCUSSION

Rendement

Figure 1 shows that the yield of the glucomannan extraction process has an average value ranging from 49.33% to 69.33%. The yield obtained for all variations is higher than the findings in (Tatirat & Charoenrein, 2011), which reported glucomannan flour yields of 32.5% to

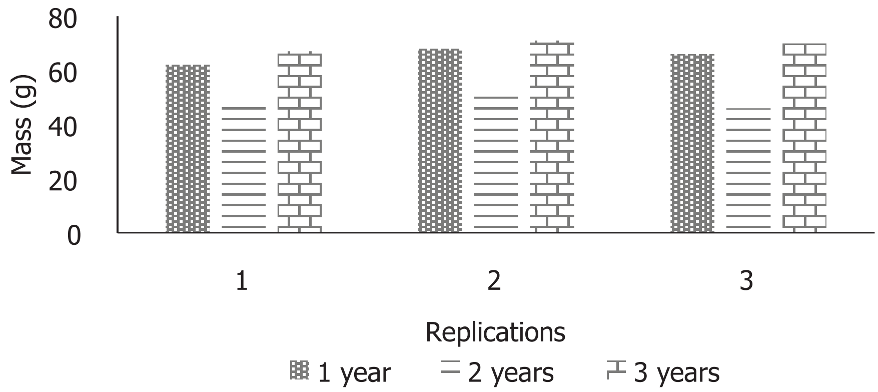

Figure 1. Glucomannan flour yield results

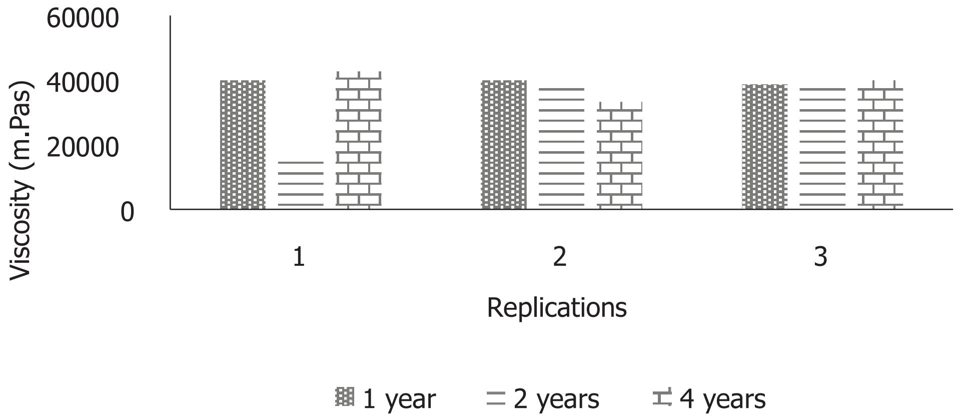

Figure 2. Viscosity test results

35.4% using an extraction process with heating at 75 °C. In this variation of the extraction process, 96% ethanol was used, which effectively lifted and coagulated cloud glucomannan from the porang flour slurry filtrate, resulting in higher production. One-way ANOVA statistical testing with a significance level of 0.05 was performed to examine the interaction between different porang tuber harvest age treatments and yield. The variation in porang tuber harvest age had a significant impact on yield, as indicated by the significance value being less than 0.05, specifically 0.000. Therefore, there were differences or effects of using different harvest ages in the same extraction process.

Viscosity

Figure 2 shows that the glucomannan flour solution has a viscosity value with an average of 31,556 – 39,556 m.Pas. The results obtained are in accordance with European standards with a minimum viscosity limit of at least 20,000 m.Pas (Commission et al., 2001). One-way ANOVA statistical testing with a significance limit of 0.05 was carried out to determine the interaction between variations in the harvest age of different porang tubers on viscosity. The variations in the harvest age do not affect viscosity because the significance value is greater than 0.05, namely 0.476. This is because there is no difference through the same extraction process since the viscosity results are the same or good for all ages of porang tubers.

Moisture content

In Figure 3, the measurement results indicate that the moisture content of glucomannan has an average value ranging from 4.74% to 6.99%. According to (BSN, 2006), the moisture content in good flour should be below 14.5%, meeting the Chinese standards, and falling into the top-grade category of below 11%. One-way ANOVA statistical testing with a significance level of 0.05 was conducted to assess the interaction between different harvest age treatments and moisture content. The variation in porang tuber harvest age does not have a significant effect on moisture content since the value is greater than 0.05, specifically 0.214. Therefore, there was no difference in moisture content among

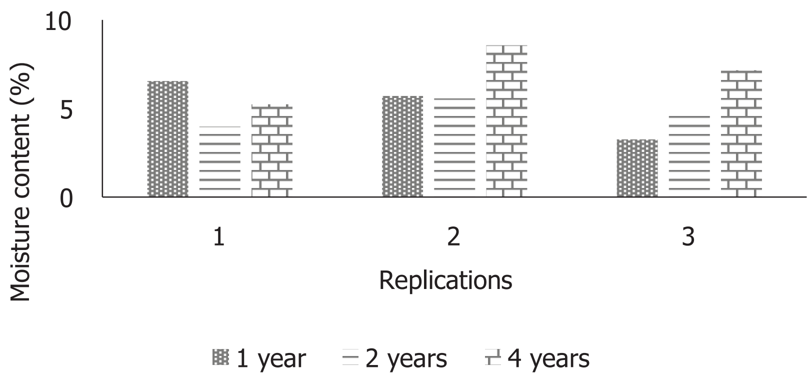

Figure 3. Moisture content test results

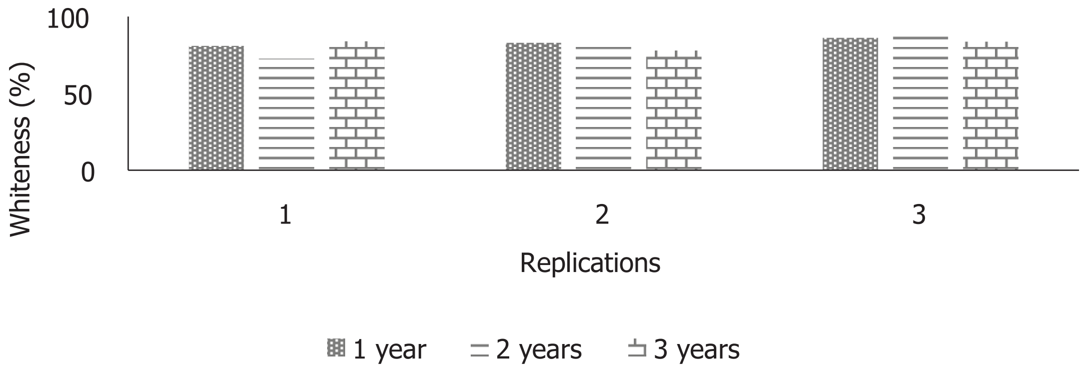

Figure 4. Glucomannan flour color index test results

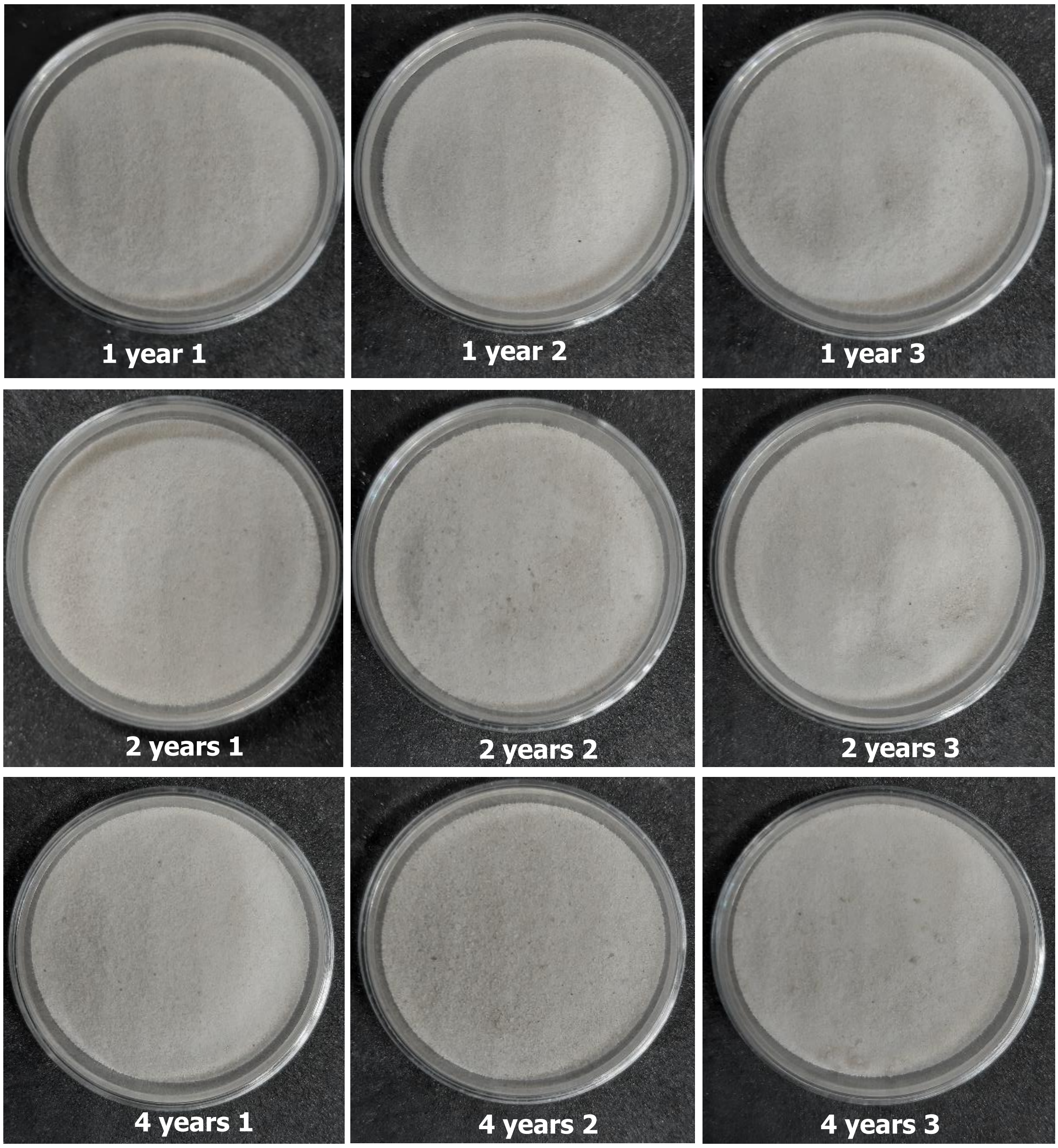

Figure 5. Visual appearance of glucomannan powder

glucomannan flours extracted from porang tubers of different ages using the same extraction process.

Color

Figure 5 shows that glucomannan flour from porang flour extraction using vacuum drying with the third repetition of the 2-year harvest age variation appears to be whiter compared to others. As shown in Figure 4, the whiteness values range from 81.14% to 83.24%. The results for all variations are higher than the findings of (Impaprasert et al., 2014), where glucomannan flour with a value above 80% was obtained after washing with 50% alcohol and drying. One-way ANOVA statistical testing with a significance level of 0.05 was conducted to examine the interaction between different porang tuber harvest age treatments and whiteness. The variation did not have a significant effect on whiteness since the value is greater than 0.05, specifically 0.886. Therefore, there was no difference in whiteness among glucomannan flours extracted from porang tubers of different ages using the same extraction process.

Glucomannan Content

In Figure 6, the measurement shows the glucomannan content value with an average value of 95.13 - 97.57%. The results have met the Chinese standard for grade 1 quality, namely more than 85%. The glucomannan content in the flour is below 100%, meaning there are other components such as protein, starch, and fiber. One-way ANOVA statistical testing with a significance limit of 0.05 was carried out to determine the interaction of variations in the harvest age of different porang tubers. The variations did not affect the glucomannan content because the significance value was greater than 0.05, namely 0.230. Therefore, there was no effect on the content from all harvest ages of porang tubers extracted through the same process.

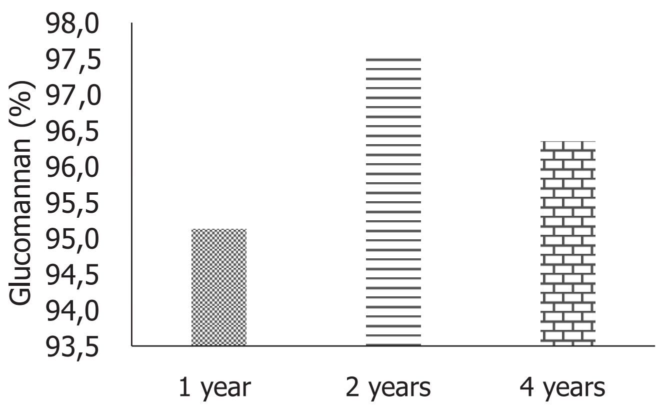

Figure 6. Glucomannan content test results

CONCLUSION

In conclusion, the best age variation was at 1 year of age, yielding highly favorable results. This group showed an average yield of 65.33%, with commendable physical properties, including the highest viscosity, whiteness, low moisture content, and glucomannan content results of 39,556 m.Pas, 83.24%, 5.17%, and 95.13%, respectively. The statistical tests reported that there was an influence of variations in the harvest age of porang tubers on the yield. However, there was no influence on the content and quality of glucomannan flour in terms of whiteness, viscosity, and moisture content. In this context, a 1-year-old harvest could be extracted to meet the standards for commercialization of export demand.

SUGGESTION

It is necessary to carry out further testing regarding the chemical compound content of glucomannan to determine the ingredients and components of glucomannan.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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