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Effect Blanching Methods And Soaking Solution Sodium Bisulfit On The Physical And Chemical Characteristics Of Porang (Amorphophallus Muelleri Blume) Flour

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ABSTRACT

The porang plant belongs to the Arceae family which is a type of tuber plant. Porang tubers contain glucomannan which can be useful in the food and non-food industries. Porang tubers contain calcium oxalate which causes itching and can even harm health. Porang tubers also contain carotene, polyphenol oxidase,and tannins that can cause browning reactions. Different blanching methods (boiling and steaming) continued by soaking in different concentrations of sodium bisulfite (0.5%, 0.75%, 1.00%) were used in this study. Determining the effect of sodium bisulphate and blanching and soaking methods on the physical and chemical properties of porang flour.The higher concentration of soaking and increase ash content, water absorption capacity, glucomanan content, and improve color, yellowish white color and can reduce water content and calcium oxalate.

Keywords*: Amorphophallus muelleri blume; Blanching; Sodium Bisulfite;*

INTRODUCTION

Porang plant (*Amorphophallus muelleri* Blume***)*** is a tuberous plant belonging to the *Arceae* family that lives in the wild. Porang plants can grow in tropical and subtropical regions. Porang plants have long been known by the people of Indonesia. However, its utilization has not been maximized because it is considered a wild plant. Porang plants have a high productivity value to be cultivated. Porang cultivation is one of the efforts to diversify foodstuffs and provide industrial raw materials that can increase the value of porang commodities in Indonesia (Sari & Suhartati, 2015). Porang cultivation can be done in the lowlands and mountains with various planting methods.

East Kalimantan is one of the provinces on the Island of Borneo with fertile soil conditions and a favorable climate this area can grow various types of plants, one of which is the porang tuber plant. Porang plants have components such as dietary fiber, starch, protein, glucomannan, and several vitamins and minerals (Nasir et al., 2015). At the beginning of 2021, a total of 143 farmers with a land area of 92.72 hectares, which are divided into several regions such as Samarinda, Balikpapan, Kutai Kartanegara, Berau and others have cultivated porang plants (Humas Provinsi Kaltim 2021).

Porang tubers before being processed into food are usually made into chips. Porang chip processing that has the potential to be developed is porang flour. Porang flour processing aims to preserve, and save shelf space and as a food diversification ingredient. In addition, the form of flour allows for more flexible utilization as raw material for food and non-food industries. The utilization of porang flour has been widely used such as making wet noodles with 15% porang flour substitution which has an impact on the water content, protein, fat, carbohydrates, and texture of wet noodles (Panjaitan *et al.,*1945). In making mulberry jelly

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with the proportion of porang flour 50: carrageenan 50 produces the best characteristics (Sugiarso and Nisa 2015)

Flour development continues to improve both processing technology and modification of raw materials, the use of porang tubers is one of them. Processing tubers into flour is one of the efforts to diversify food. (Efendi et al., 2015). However, in the processing of porang flour, browning reactions can occur which will reduce the visual value of the flour produced. The cause of the browning reaction in processed flour is due to the high content of carotene, polypenol oxidase, and tannins (Wardhani, *et al.* 2017). Browning reaction is a chemical reaction that causes a change in the color of food ingredients to brownish (Haryani et al., 2016). Browning reactions consist of two types, namely enzymatic and non-enzymatic reactions. Enzymatic reactions are influenced by several factors, one of which is enzymes, enzymes that affect the browning process are polyphenol oxidase (PPO) enzymes (Haryani et al., 2016)While non-enzymatic browning reactions occur due to the reaction of reducing sugars with free amine groups from amino acids. One way that can be used to prevent browning reactions is by blanching and soaking with sodium bisulfite solution as a prevention of browning reactions.

The blanching process is a preliminary heating process for food ingredients that aims to inactivate enzymes (Syepty *et.al*. 2018). In addition, the blanching process can increase mass transfer in the tissue and affect the drying process. Heating in the blanching process causes the tissue to become softer and causes a larger tissue opening so that the evaporation rate is faster (Daulyah, 2017). The temperature and duration of heating also affect the physicochemical properties of flour. As in research (Pratiwi, 2020) The higher the temperature and duration of heating can reduce the water content, ash content, and amylose content of cassava flour and increase solubility and swelling power.

The use of sodium bisulfite in food processing can inhibit the browning reaction catalyzed by the phenolase enzyme. Based on research conducted by Pasaribu (2016) sodium bisulfite can be a browning inhibitor in flour that is composed of monomer saccharides and binds to Cu so that the enzyme work process can be inhibited. And (Zainuri, Sukmawaty, Basuki, E., Handayani, B.R., Sulastri, Y., Paramartha, DNA., Sayuna, Y., Anggraini, 2021) stated the soaking in salt solution and blanching technology significantly reduced the calcium oxalate concentration in the porang flour. With the treatment of blanching and soaking in sodium bisulfite solution in the manufacture of *Amorphophallus paeoniifolius* starch produces brighter flour (Muhammad et al., 2021). This study was conducted to determine the effect of blanching treatment and soaking with sodium bisulfite on the physical and chemical characteristics of porang flour.

METHODS

Material

The materials used were porang tubers obtained from farmers in Purnasari Jaya Village, Berau Regency, and $NaHSO_3$. Materials for analysis used are HCl (CoA and SDS available at lab-honeywell), phenylhydrazine, KMnO4, NaOH, acetic acid, NaH_4OH, $CaCl_2$, and H_2SO_4 (merck KGaA, Germany).

Tool

used in the manufacture of porang flour, cabinet dryer (memmert), flour grinding machines (sayota/SCG-178), colorimeter (Type CS10, China product).

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Research Design

Porang tubers were cleaned from the soil and washed to remove dirt then peeled off the skin until there was no skin left and used gloves. Weighed as much as 500 g for each treatment of porang tubers, sliced with a thickness of 5 mm. Sliced porang tubers were blanched (steam and boiled) at 80 ^oC for 5 minutes with a ratio of 500 g in 1000 ml of water then washed and drained. The blanching porang tubers were soaked in sodium bisulfite solution with variations of 0.5%, 0.75%, and 1% for 10 minutes (Pasaribu, 2016). After soaking, they were washed and drained then dried using an oven at 60 ^oC for 20 hours. Porang chips were ground with a flouring tool and sieved using 60 mesh size. his research used a two-factor Randomised Block Design (RBD). The first factor was the blanching method at 80^oC for 5 minutes by boiling and steaming. The second factor was the concentration of the soaking solution (sodium bisulfite) consisting of the levels, namely 0.50, 0.75, and 1.00. sliced porang without any treatment was used as a control treatment. The sliced blanched porang was soaked for ten minutes at room temperature each treatment was repeated 3 times.

Test Parameters

Yield (Sudarmadji et al., 2010)

To calculate the yield of porang flour produced, the following formula was used

$$yield\ (\%) = \frac{weight\ of\ flour\ produced\ (g)}{porang\ weight/1(g)} \times 100\%$$

Water absorption capacity (Saloko et al., 2022)

The physical characteristics and granule content of flour and starch are associated with their water absorption ability. The amount of water available for starch gelatinization during cooking is determined by the water absorption capacity. One gram of the material was weighed for the test, and 10 milliliters of distilled water were then added. The mixture was homogenized after 30 seconds of use of a vortex apparatus. After 15 minutes of room temperature storage, the sample was centrifuged for 5 minutes at 3500 rpm. After the supernatant was decanted, the volume was measured. One gram of flour's water absorption capacity is given as its volume absorbed. The following formula was used to calculate the water absorption capacity:

Water absorption capacity (mL.g-ˡbk)= $\frac{water\ volume\ (mL) - supernatant\ volume\ (mL)}{weight\ sample\ (g)}$

Color **(**Hutching *et al.,* 1999**)**

Samples of flour that had been made were tested for color. The CS10 colorimeter, which fastens the sample to the sensor glass, was used to measure color. This gadget is calibrated using a white color standard prior to use.Three color characteristics make up the Hunter notation color test: brightness (represented by the notation L*), color intensity (represented by the notation b*), and chromatic color (represented by the notation a*). The values of a*, b*, and L* are all between 1 and 100. A brightness or lightness parameter is represented by the L* notation, where a value of 0 indicates black and a value of 100 indicates white. The reflected light that results in the achromatic colors of white, black, and grey is then represented by the L* value. The a* notation expresses the mixed chromatic colors of red and green with +a* (positive) values ranging from 0 to +100 for red and -a* (negative) values from 0 to -80 for green. Meanwhile, the b* notation expresses the mixed chromatic color between blue and yellow with +b* (positive) values from 0 to +70 for yellow and -b* (negative) values from 0 to -70 for blue.

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Water content (**Sudarmadji *et al**., 2010)

The sample was weighed as much as 1 g using a moisture analyzer cup. The moisture analyzer was set at 105 ^oC then the cover on the moisture analyzer was closed and waited for 5 minutes until the water content results appeared and the results obtained were recorded.

***Ash content** (*Sudarmadji *et al.,* 2010*)*

For the ashing process, prepare a porcelain cup containing the sample from the moisture content test. Then put it into the furnace, and heat it until it becomes ash. The ashing process is carried out in 2 stages, the first is heated using a temperature of 450 ^oC for approximately 1 hour. After that, the furnace temperature was increased to 550 ^oC. After the sample became ash, the furnace temperature was lowered to 100 ^oC. Then the cup containing the ash was cooled in a desiccator for 15 minutes and the cup containing the sample was weighed.
The presentation of the ash content analysis results was calculated using the following formula:

(%) ash content = $\frac{w_2 - w_3}{w_1} \times 100$

Note :
W_1 = sample weight (g)
W_2 = weight of porcelain test (g)
W_3 = final weight (weight of cup + sample after ignition).

Glucomanan (Badan Standarisasi Nasional Indonesia, 2020)

Weigh the test sample in the form of fine powder weighing 1 g (W0). The test sample should be put into a 100 mL Erlenmeyer. Add heating stones and 30 mL of strong HCl (bd 1.025). After 3.5 hours of reflux, filter with filter paper. Use boiling water to rinse the precipitate on the filter paper. Mix the two filtrates, add three drops of phenolphthalein, and then alkalize the mixture with 10% NaOH until it takes on a pink hue. Using litmus paper, acidify the filtrate by adding concentrated acetic acid until the solution becomes acidic. After the solution has evaporated to a tiny volume (about 30 to 40 mL), filter it. 10 mL of distilled water, 1.5 mL of concentrated acetic acid, and 1.5 mL of phenylhydrazine should all be added to the mixture. After letting the mixture come to room temperature, store it in the refrigerator for:

KM = $\frac{2/3\, W_1}{W_0} \times 100\%$

Description:
KM = is the glucomannan content, expressed in percent (%)
2/3 = is the conversion factor of mannose phenylhydrazine to total mannose
W0 = is the weight of the test sample, expressed in grams (g)
W1 = is the weight of the precipitate, expressed in grams (g)

Calcium oxalate (Badan Standarisasi Nasional Indonesia, 2020)

Weigh 2 g of porang flakes flour, put it into a 250 mL erlenmeyer, then suspend it in 190 mL distilled water. Heat the suspension solution at 100°C for 1 hour. Then cool the solution, then add water until it becomes 250 mL and filtered; the filtrate is divided into 2 parts of 125

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mL each. Put each portion of the filtrate into a glass cup and add drops of methyl red indicator, then add concentrated NH_4OH solution (drop by drop) until the test solution changes color from pink to a stable pale yellow. Heat each portion then to 90°C, cool, and filter to remove the precipitate containing iron ions. Heat the filtrate to 90°C and add 10 mL of 5% $CaCl_2$ solution with continuous stirring. Cool the filtrate and let it stand overnight at 5°C. Centrifuge the solution at 2500 rev/min for 5 min; 6) Decant the supernatant and completely dissolve the precipitate in 10 mL of 20% (v/v) H_2SO_4 solution. Bring the two filtrates together to 300 mL. Heat 125 mL of filtrate to almost boiling. Titrate with 0.05 M KMnO4 solution (already standardized) until a pale pink color appears, stable for 30 seconds to pink. Calculate the calcium oxalate content based on the formula:

Calcium oxalate (mg/100 gr) = $\frac{volume\ KMnO_4 \times 0{,}00225 \times 2{,}4}{weight\ sampel \times 5/1} \times 10^5$

Data Analysis

The resulted porang flour was analyzed for data were obtained and analyzed by one-way ANOVA using the sigmaplot data processing program. If there is a significant difference at the α 5% level in the variance analysis, the Tukey test is carried out at the α 5%.

RESULT AND DISCUSSIONS

Physical properties of flour porang Yield

The blanching method and sodium bisulfite soaking concentration significantly affected the yield value. The steamed blanching treatment and soaking with 0,50%, 0.75% and 1% sodium bisulfite had yield values of 13.18%, 12.79%, and 10.80% lower than the boiled blanching method and soaking with concentrations of 0,50%, 0.75%, and 1% with yield values of 13.69%, 13.61%, and 11.06%. This is because the value of water content in the steamed blanching method is lower so it affects the yield. According to Erni *et* al (2018) along with the evaporation of water content in the material, the resulting yield content is also reduced. For the highest yield value, the control treatment without blanching and sodium bisulfite immersion has a yield value of 15.27%,this is because the water content value of porang flour produced in the control treatment is 7.59%, higher than the water content value in the treatment of blanching and immersion methods with another sodium bisulfite, it is proven that water content affects the yield of flour produced. the higher the water content, the higher the yield value produced (Daulyah, 2017).

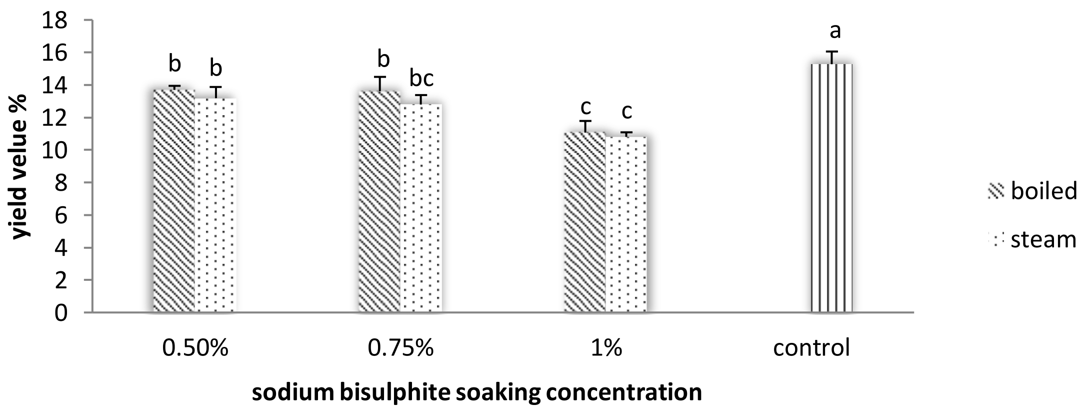

Figure 1: Graph of the Effect of Blanching Method and Soaking with Sodium Bisulfite on the Yield of Porang Flour

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Water absorption capacity

Figure 2 illustrates how the water absorption capacity is impacted by the blanching technique and soaking in sodium bisulfite. The heating process during blanching has an impact on the material's ability to absorb water because it can break down relatively compact macromolecules into somewhat tenuous ones, making the material more pliable (Aini et al., 2016). The average value of the steamed blanching method is higher than that of the boiling blanching method, as shown in Figure 2, and the water absorption capacity of flour tends to increase with the addition of sodium bisulfite concentration. This is because the material's glucomannan content influences the amount of water absorption capacity that is generated. Glucomannan has a 138–200% water-absorbing capacity (Sumarwoto, 2005). Among the special properties of glucomannan is that it can dissolve in water and insoluble NaOH 20%, and glucomannan that dissolves in water can form a gel (Ulfa & Nafi'ah, 2018). Ayu and Widjanarko's research (Ayu Sari & Bambang Widjanarko, 2015) stated that glucomannan has the properties of expanding and absorbing water so that it can be used as binding agents to replace the function of sodium tripolyphosphate (STTP) as a binder.

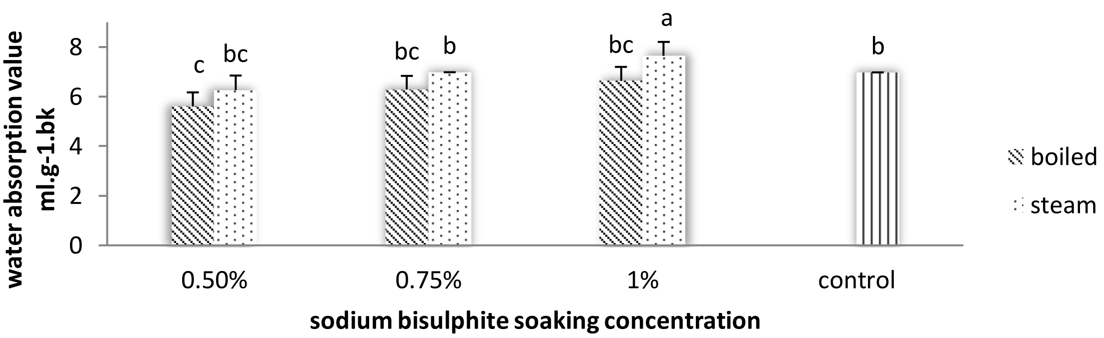

Figure 2 : Figure Effect of Blanching and Soaking Method with Sodium Bisulfite on Water Absorption Capacity

Color L* (lightness)

Figure 3 shows that the blanching and soaking methods with sodium bisulfite significantly affected the brightness value (L*) of the porang flour produced. The average value of blanching and soaking treatments with sodium bisulfite was 81.41-84.02 higher than the control and tuber control treatments. The cause of the increase in brightness (L*) is influenced by several factors, the first of which is blanching and soaking with sodium bisulfite where the blanching process is an attempt to activate enzymes so that the color contained in the material can be maintained. The heat in the blanching process is in direct contact with the material so that it can inactivate the polyphenolase enzyme (Syepty et al., 2018). The second factor is the soaking process with sodium bisulphite. Soaking with sodium bisulfite can inhibit microbial growth and reduce sulfide bonds in amino acids to interfere with enzyme work and prevent enzymatic browning reactions so that the product is brighter (Darmajana, 2010). Sodium bisulfite is a chemical that can inhibit damage to food and prevent decomposition by microorganism attacks (Saputrayadi & Marianah, 2018).

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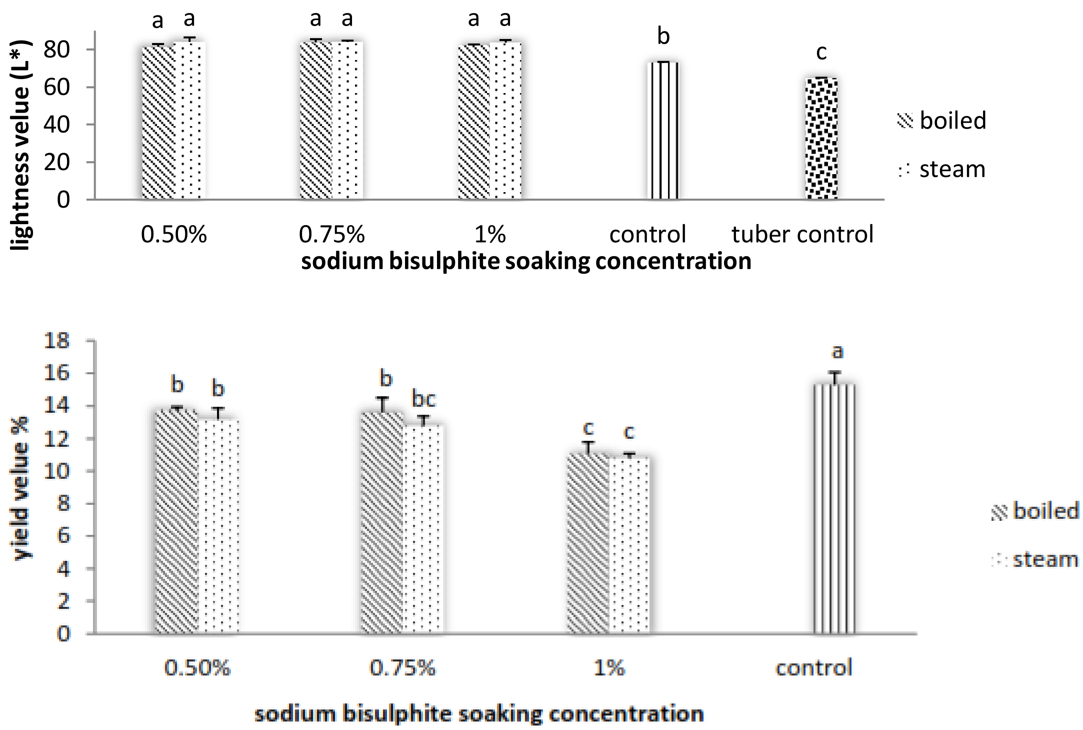

Figure 3 : figure of Effect of Blanching and Soaking Method with Sodium Bisulfite on Colour L* of Porang Flour

Color a* (redness)

Figure 4 shows that the blanching and soaking methods with sodium bisulfite have a significant effect on the redness value. The redness value (a*) in the blanching and soaking treatments with sodium bisulfite has a low average value, which ranges from 0.72-2.46. The red color is a color that is naturally found in porang tubers (Kurniawati & Bambang Widjanarko, 2010). The red color produced tends to increase along with the addition of sodium bisulfite concentration in the manufacture of porang flour. The addition of soaking concentration the higher the red color produced. This is due to the carotenoid content in the material that can be maintained along with the increase in sodium bisulfite soaking concentration. The presence of sodium bisulfite can prevent the oxidation process of beta-carotene due to heating during drying (Prabasini et al., 2013).

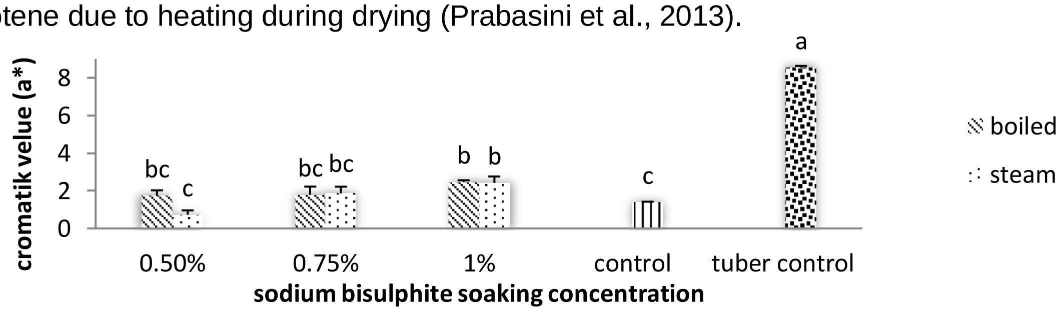

Figure 4 : figure of Effect of Blanching and Soaking Method with SodiumBisulfite on Colour a* of Porang Flour

Color b* (yellowness)

Figure 5 shows that the method of blanching and soaking with sodium bisulfite has a significant effect on the yellowness value (b*) of the porang flour produced. The b* colour produced in the blanching and soaking treatments with sodium bisulfite ranged from 20.12 to 22.01. The control treatment had a value of 13.57 and the tuber control had a higher value compared to all treatments and controls at 33.73. The b* color value produced is quite high

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because fresh porang tubers contain carotene, polyphenol oxidase, and tannin which are high enough to produce a reddish -yellow color (Amyranti & Maftukhah, 2021). This study can be seen that the average b* value in the blanching and sodium bisulfite immersion treatments is higher than the value in the control but the b* color is lower than the tuber control. This shows that the blanching and sodium bisulfite soaking methods are effective in preventing the browning process because color changes occur due to the material experiencing a browning reaction (Syepty et al., 2018).

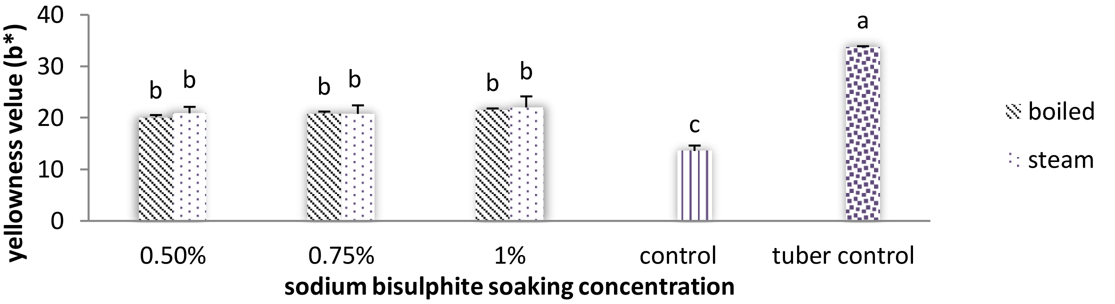
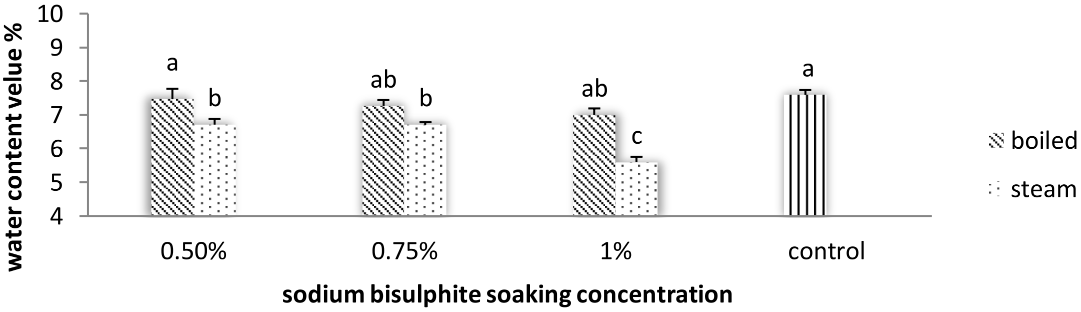


Figure 5: Graph of Effect of Blanching and Soaking Method with Sodium Bisulfite on Colour Intensity b* of Porang Flour

A. Chemical Property of Porang Flour

Water content

In Figure 6 blanching treatment and soaking with sodium bisulfite have a significant effect on the value of water content produced. boiled blanching method, the average value of water content produced is higher than steamed. This is because in the boiling process the material is in direct contact with water which causes more water to be absorbed in the material compared to the steamed blanching method. According to Daulyah, (Daulyah 2017) the boiling process will cause the development of a cavity structure in the material and easily absorb water but easily release water during the drying process. Sodium bisulfite soaking also affects the water content value of the porang flour produced, the higher the concentration of sodium bisulfite soaking decreases the water content of the flour produced. This is because sodium bisulfite is a salt and the salt is hygroscopic, that is, the salt will be ionized and the ions will attract several water molecules around it (Saputrayadi and Marianah 2018). The moisture content produced in the table ranged from 5.59%-7.59% which has met the Indonesian National Standard with a maximum limit of 15%.



Gambar 6: Figure Effect of Blanching and Soaking Method with Sodium Bisulfite on Water Content of Porang Flour

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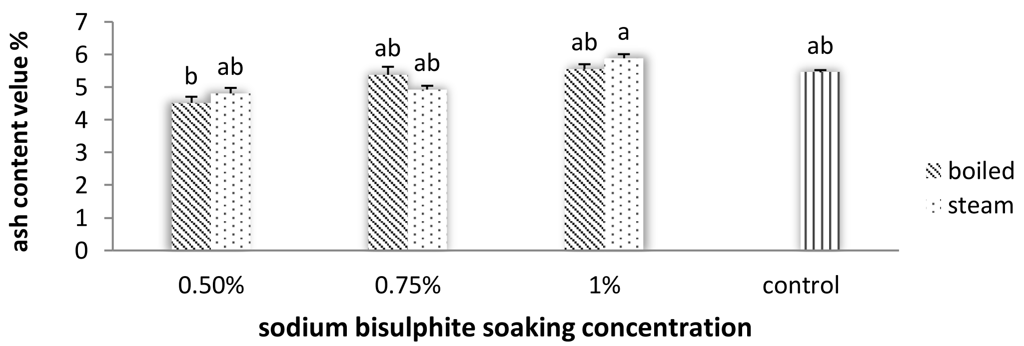
Ash content

The amount of ash in a material indicates its mineral content; the more minerals a material contains, the more ash it contains. With an average ash content value of 4.52%–5.88%, Figure 7 demonstrates the significant effects of the blanching technique and the concentration of soaking with sodium bisulfite on the ash content of porang flour. Compared to the boiling blanching procedure, the steam blanching method yields a higher average ash content value. this is due to the fact that there are more dissolved mineral components when using the boiling blanching procedure. Ultimately, the substance is in direct contact with boiling water. Because some of the ingredients' water-soluble mineral content will be lost during the blanching process, this can have an impact on the nutritional quality, color, and sensory appeal of the components (Muntikah and Razak).

Figure 8 shows that the higher the sodium bisulfite soaking concentration, the higher the ash content. This is because the addition of sodium bisulfite can reduce the value of water content in the material so that the resulting ash content increases. According to (Erni, Kadirman, and Fadilah 2018), the greater the amount of water content that evaporates, the higher the ash content. The highest ash content value was found in the blanching treatment (steamed) with a 1% soaking concentration with a value of 5.88%. The ash content of porang flour produced has met the Indonesian National Standard SNI, which is a maximum of 6.5%.



Gambar 7: Figure Effect of Blanching Method and Soaking with Sodium Bisulfite on Ash Content of Porang Flour

Glucomannan

Glucomannan is a polysaccharide composed of D-glucose and D-mannose units that have water-soluble properties, and high viscosity values, and can form gels and adhere strongly in water. The test results of glucomannan content in Table 2 obtained the highest average value of glucomannan content in the steamed blanching treatment and soaking with 1% sodium bisulfite, namely 41.09%. This is due to the nature of glucomannan which can dissolve in water so that the average produced in the steamed blanching method is higher than in boiled blanching. From the results of this study, the glucomannan content value obtained has met the SNI 7938: 2022 standard for porang flakes and entered quality I of I ≥ 35%. The blanching method followed by sodium bisulfite soaking increases glucomannan content along with the addition of sodium bisulfite concentration, this is because soaking with sodium bisulfite can reduce impurities. According to Ni'maturohmah (2019), the increase in glucomannan to a certain point is caused by a decrease in non-glucomannan levels, such as calcium oxalate. In line with the opinion (Widjanarko and Megawati 2015) oxalate content in the material can affect the quality of glucomannan.

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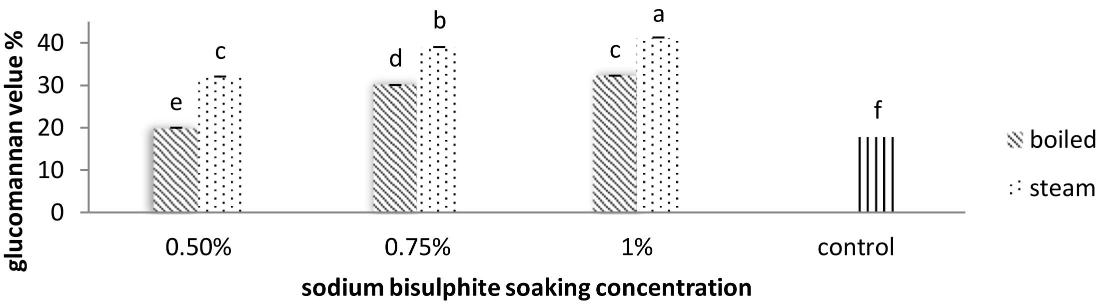

Gambar 8: Figure Effect of Blanching Method and Soaking with Sodium Bisulfite on Glucomannan Content of Porang Flour.

Calcium oxalate

Oxalate compounds in tubers are stored in plant cell fluids either in the form of oxalic acid or calcium oxalate. calcium oxalate can cause itching due to puncture by needles of calcium oxalate crystals encased in a transparent capsule filled with a liquid called rapid. Table 2 shows that the blanching method and sodium bisulfite soaking had a significant effect on the average calcium oxalate value ranging from 104.58 mg/100 g – to 245.34 mg/100 g. The resulting calcium oxalate value is still relatively high so it is not suitable for consumption. According to SNI 7939: 2020, the oxalate content in porang flour is a maximum of 50 mg/100 g. In Figure 9, the higher the soaking concentration can reduce the oxalate content contained but the use of sodium bisulfite which is required to be used based on BPOM Regulation No. 37 of 2019, the maximum limit for the use of BTP sulfite in starch and flour products is 70 mg/kg.

In this study, the blanching and sodium bisulfite soaking methods were less than optimal in reducing the calcium oxalate contained in porang tubers. calcium oxalate compounds are oxalate salts that are most difficult to dissolve in water so it is necessary to use strong acid solutions. According to Kusuma, (Wardani and Handrianto 2017) calcium oxalate can dissolve in dilute acids, either by soaking or washing. As in Chotimah's research (Chotimah, Siti; Fajarini 2013) boiling treatment with 6% NaCl at 80 oC for 30 minutes can reduce calcium oxalate content by 60%. Boiling with NaCl can reduce calcium oxalate because NaCl in water will ionize into Na + ions which will bind to oxalate which will form a sodium oxalate compound while Cl- ions can form calcium dichloride precipitates which will dissolve in water (Widari and Rasmito 2018).

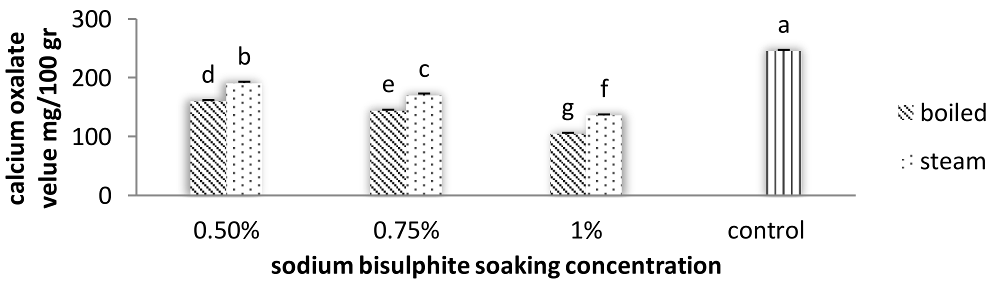

Figure 9: Figure Effect of Blanching and Soaking Method with Sodium Bisulfite on Calcium Oxalate of Porang Flour

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CONCLUSION

The physical and chemical properties of the porang flour produced were significantly impacted by the blanching and sodium bisulfite soaking processes. The calcium oxalate test still yields high levels even when the glucomannan value has reached the established SNI requirements. The resulting porang flour has a yellowish-white tint. With a yield of 10.80%, water content of 5.59%, ash content of 5.8%, water absorption capacity of 7.64 ml.g-1.bk, glucomannan content of 41.09%, and a calcium oxalate content of 135.81 mg/100g, the steamed blanching method and soaking with 1% sodium bisulfite is the best treatment. It is recommended that more research be conducted in light of the findings of the current study that has been carried out, it can be suggested that further research using other methods can reduce the very low calcium oxalate content in order to porang flour that is suitable for consumption.

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