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PORANG FLOUR (AMORPHOPHALLUS ONCHOPHYLLUS) BLEACHING PROCESS USING NATRIUM METABISULFIT AND ASCORBIC ACID

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Abstract-- Iles-iles flour contains a lot of glucomannan. Glucomannan is a polysaccharide in the mannan family which has many benefits especially as gelling agent. The use of iles-iles flour in the food industry is still limited because the flour colour is brown. The purposes of this research are to study the effect of soaking time, ethanol concentration, and type bleaching agents to increase flour whiteness and glucomannan content .On the other hand the research will evaluate the residu of bleaching agent in the flour. The result showed that the best treatment was soaking using 0,125 % sodium metabisulfite as bleaching agent with 40 % ethanol for 60 minutes. For suggestions, after iles-iles is peeled, it should be immediately processed to avoid browning reaction

Keywords— Porang flour, glucomannan, bleaching, Na2S2O5, asorbic acid

I. INTRODUCTION

Porang (Amorphopallus onchophyllus) is one of the plants which grown in Indonesia has high content of glucomannan [1]. Glucomannan is polysaccharide of the mannan family. The main chain of glucomannan consists of D-glucose and D-mannose connected by ß-D-1,4 bonds with ratio of mannosa and glucose 1.6: 1[17].

Glucomannan of porang has properties as thickening agents, texture-formers, gelling agents, emulsifiers, stabilizers, and water-binding properties Shah[16] In particular, porang are used as gelling agents in the food industry. However, the use of porang flour in the food industry is still limited due to the color of the flour that is not atrrative (brown). Browning on porang flour is caused by a browning reaction during processing. Therefore, it needs a bleaching process on the flour to increase the selling value of flour Sulfite compounds are widely used in the bleaching process of flour. Based on research conducted by Mulyono [12] the one for bleaching process is sodium metabisulfite ($Na_2S_2O_5$). Sodium metabisulphite prevents browning reactions in the porang flour by inhibiting reactions producing melanoidin pigment. Another bleaching process agent is asorbic acid. one of the important properties of ascorbic acid is its ability as a reducing agent (electron donor). Ascorbic acid leaves no harmful residue when compared to other inorganic bleaching.[13].

Ethanol is non solvent to glucomannan. Glucomannan can dissolve into water during immersion so that the levels in the resulting flour may be reduced. Therefore, it should be treated to prevent the reduction of glucomannan levels during processing. In this research we will study the effect of addition of sodium metabisulphite and ascorbic acid as bleaching agent in various time of soaking, after that the best bleaching agent will be tested in various concentration. In addition, it will also examine the effect ethanol concentration on the bleaching process. Thus, appropriate methods and bleaching materials can be obtained for bleaching of porang flour.

II. METHOD

A.Materials

The porang tubers (Amorphopallus oncophyllus sp.) were collected from Darupono Village, West Kaliwungu District, Kendal District. Ethanol 96% as non solvent for glukomanan from PT Brataco Chemika. Sodium Metabisulphite (Na2S2O5) from Indrasari Chemicals Store and Ascorbic Acid (C6H8O6) from PT Brataco Chemika.

B. Preparation Porang Flour from Fresh Tubers

The porang tubers was weighed, washed, with its epidermis removed and sliced into pieces, 5–6 mm in thickness. The slices were then immersed in bleaching solution for various times. The bleaching solution consist of water, ethanol, sodium metabisulphite or ascorbic acid for various concentration, after that followed by oven-drying at 120 ◦C for 40 min. The drying process was continued at 60 ◦C until a constant weight was obtained. The dried slices were subsequently ground with coffee mill to pass through 100 mesh.

C. Determination Glucomannan Content

One gram of porang flour are weighed and put into the erlenmeyer, added with 50 ml of 2% HCl. The solutin boiled for three hours in erlenmeyer equipped with cooler reflux and filtered. The filtrate is neutralized with NaOH and added with activated carbon, then filtered again. The filtrate is distilled to a volume of 10 ml. To the filtrate were added 0.4 grams of phenylhydrazine hydrochloride and 0.65 grams of Na-acetate in 5 ml of aquadest. The mixture is stored in the refrigerator for 24 hours. The phenylhydrazine mannose crystals are strained and weighed. Glucomannan content was calculated by the following formula:

Glucomannan content (%) = (2/3 x a) / (weight of b-sample) x 100%

Information:

2/3 = conversion factor mannosa phenylhidrazone to total mannosa
a = crystal weight of mannosa phenylhidrazone
b = water weight in porang flour

D.White Degree Test

Color analysis was performed using the Minolta CR 300 Chromameter. The principle is measuring the color difference through light reflection by the sample surface.

E. Determination Sulfite Residue

The sulfite residue test refers to Ranganna [15]. Sulfur dioxide (SO_2) added in the foodstuff may be the acid of undissociated sulfur, free sulfite ions, free bisulfite ions, or as combined SO_2 in the form of hydroxy sulphonate. Free SO2 can be titrated directly with iodine. As for the total SO_2 measure, combined SO_2 can be liberated first with excess alkali at room terminals, then acidified to prevent recombination, and then titrated with iodine. At first weighing 5 grams of ingredients, put into 250 ml pumpkin flask and then added aquades until the mark. Filtered and then taken 50 ml of filtrate, then added 5 ml NaOH 5 N, left for 20 minutes. Added 7 ml of HCl 5 N, whipped then titrated with iodine 0,02 N after added indicator of starch 1 ml. The titration endpoint is blue. This titration is referred to as the titration C. To determine a non-sulfite reducing compound, the 50 ml of the filtrate, added with 5 ml of 5 N NaOH, left for 20 min.

After that it was acidified with 7 ml of HCl 5 N. Added 10 ml of formaldehyde (36-40%) and left to 10 minutes. Added starch indicator and then immediately titrated to blue. The blue color is maintained for at least 15 seconds (titration D). The volume of iodine used by the total SO_2 present in the material is C-D.

1 ml of 0.02 N iodine = 0.64 mg SO_2

Calculation of total SO_2 in ppm:

SO_2 (ppm) = (Iodine volume (ml) × 0.64 × 1000) / (Weight Samples (gr))

III.RESULTS AND DISCUSSION

A. Effects Soaking Time on Glucomannan Content

The soaking time affect glucomannan content. Glucomannan content in sodium metabisulfte solution were higher than in the ascorbic acid .This can be seen in Figure 1.

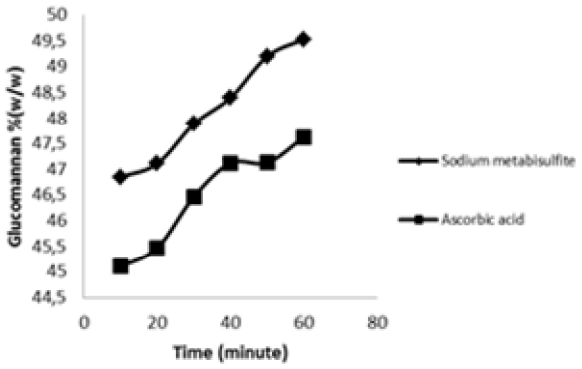

Figure 1. Effects Soaking Time on Glucomannan Content

In sodium metabisulphite solution, the longer the soaking time of chips the glucomannan content increases. This is because sodium metabisulphite has the ability to break up disulfide ions in proteins with the help of hydrogen sulphite anion (HSO_3-) known as sulfitolysis [4]Gonzales and Damodaran, 1990).

$$RS\text{-}SR + HSO_3^- \rightarrow RS\text{-}SO_3^- + RSH$$

The sulfitolysis reaction causes decrease the protein content [2] . Hildayati [6] also reported that sulfite ions can break the disulphide bond. The presence of sulfite ions will denature the enzyme protein. So the longer the soaking time, the protein content will decrease resulting in increased glucomannan levels. In ascorbic acid solution, the soaking time has no effect on glucomannan content. Ascorbic ac id acts only in preventing browning reactions. Ascorbic acid inhibits the browning reaction by reducing orthoquinones to phenol compounds before undergoing to form a brown pigment [10] .In addition, ascobicc acid also inhibit polyphenol oxidase that cause browning reaction[7] . In a study conducted by Lee [11] also showed that asorbic acid has a strong effect to inhibit the work of PPO enzymes. So the longer the immersion time, the more orthoquinones are reduced to phenol and the blocked PPO that results in a browning reaction can be prevented but glucomannan content do not change significantly.

B. Effects Soaking time on White Degree

The soaking time has an effect on white degree of flour. Figure 2 shows that the longer the soaking time, there is an increase in the degree of white on the bleaching process with sodium metabisulfite. However, the increase in white degree is not significant.

According Purwanto et al.[14] , the longer the immersion time causes more sodium metabisulphite to be absorbed by the material, making it more effective in preventing browning reactions and producing bright white flour.

In the Hildayati [6] study, it was also found that the longer the immersion treatment with sodium metabisulphite would be the increasingly white color of the flour. The longer the immersion, sodium metabisulphite will be more effective in disabling PPO enzymes and forming bonds with quinine compounds so that the formation of melanoidin pigment can be inhibited. According to Laurila et al[10] and Widiyowati[18] sulphite compounds can also prevent non-enzymatic browning reactions. In addition, sodium metabisulfite is also reported to damage or bind melanoidin compounds that cause brown color[14] .

So the longer the immersion, the more effective sodium metabisulfite works in the bleaching process. Differences in the degree of white on the flour of the treatment with ascorbic aid is very small. Therefore it is concluded that the duration of the immersion process did not affect the degree of white in the treatment with ascorbic acid.

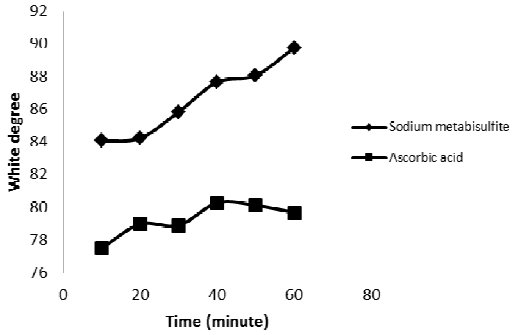

Figure 2. Effets Soaking time on White Degree

According to Vamos-Vigyazo quoted in Evans et al. [3], oxidized by ascorbic acid can actually form a brownish color on flour. This is what can cause a white drop in the 60th minute. Since sodium metabisulphite gives the best flour, the test is added for the 10th, 30th, and 50th minutes.

C. Effects Bleaching Agent on Glucomannan Content

The glucomannan content which obtained on the treatment with sodium metabisulphite is always higher than in the treatment with ascobic acid. Due to sodium metabisulphte will breakdown disulfide ions in proteins that cause the protein to dissolve readily in water.

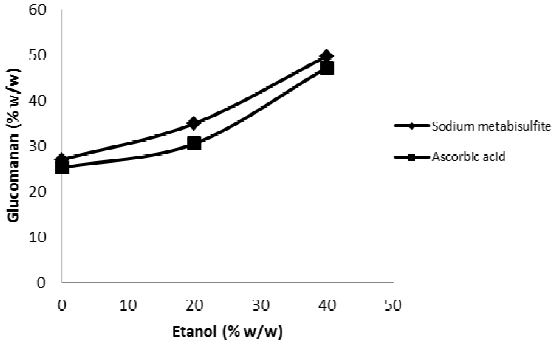

Figure 3. Effect of Bleaching Agent on Glucomannan Content

The reaction of the disulfide ion breakdown in the protein with the aid of the hydrogen sulfite anion (HSO3-) is known as sulfitolysis, which occurs as follows [4] :

$$RS\text{-}SR + HSO_3\text{-} \rightarrow RS\text{-}SO_3\text{-} + RSH$$

The hydrogen sulfite anion is derived from sodium bisulfite which is the product of the reaction between sodium metabisulfite and water[6] (Hildayati, 2005):

$$Na_2S_2O_5 + H_2O \rightarrow 2NaHSO_3$$

Sulfitolysis reactions cause protein levels to decrease resulting in increased glucomannan in porang flour, therefor glucomannan levels in the treatment with sodium metabisulfite greater than the treatment with ascorbic acid that only works as PPO enzyme inhibitors and reducers for quinone compounds.

D. Effects Bleaching Agent on White Degree

This type of bleaching agent affects the resulting degree of whitenes. Figures 2 and 4 show that the treatment with sodium metabisulphite always results higher in degree of whitenes than treatment with ascorbic acid . According to Embs and Markakis in Evans et al. [3], sodium metabisulphite is capable of forming a quinone-sulfite complex thus preventing polymerization of quinone compounds to forming brown melainoidin pigment. Voleroet in Evans et al.[3] also reported that sulfahydryl compounds such as sodium metabisulphite are also thought to bind copper metal to the active site of the PPO enzyme. In addition, according to Laurila et al. [11] and Widiyowati [18] sulfite compounds can prevent non-enzymatic browning reactions. The browning reaction occurs because of the reaction between the reducing sugar and the amine-free group of amino acids [9](Kusnandar, 2011). Research conducted by Krishnan et al.[9] show that immersion in sodium metabisulphite can be reduce reducing sugar levels in the material. Another sodium metabisulfite effect that can serve as a bleaching agent reducer. Bleaching agent can destroy chromophor or dyestuff .

Purwanto [14] , reported that sodium metabisulphite can interact with carbonyl groups, the result of which can bind to melanoidin, thus prevent to occurrence of brown color. According to Ioannou & Ghoul [7], ascorbic acid act as a reducing agent or antioxidant . According to McEvily in Guerrero-Beltran et al. [5], ascorbic acid can reduce the reactin of quinone to diphenol to prevent enzymatic browning reaction. Ascorbic acid also can inhibit the working of PPO enzymes. In a study conducted by Lee [11]shown that ascorbic acid has a strong effect to inhibit the work of PPO enzymes.

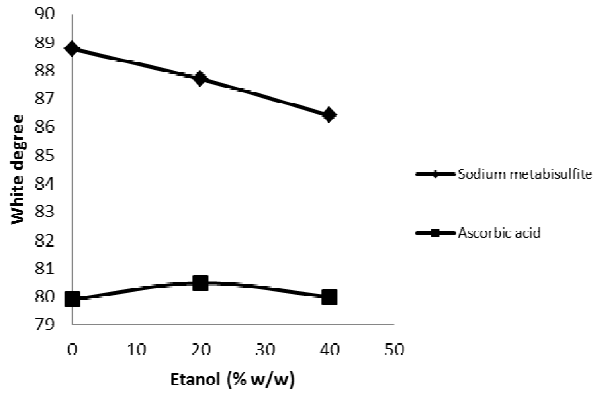

Figure 4. Effects Bleaching Agent on White Degree

Each type of whitening agent has its own effect on the whitening process. However, sodium metabisulfite was better in prevention browning compared to ascorbic acid. It was seen from the result which sodium metabisulphite treatment always produce more white flour than ascorbic acid.

E. Effects Bleaching Agent Concentration on Glucomannan Content

The concentration bleaching agent affect the glucomannan content produced. From Figure 6 it can be seen that the more concentration of sodium metabisulfite, the higher the glucomannan content, but it can be seen that the effect is not significant.

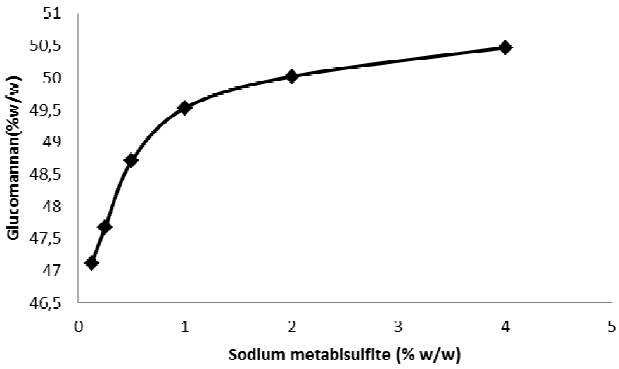

Figure 5. Effects Bleaching agent on Glucomannan Content

From the experiment, the effect is directly proportional, this is because sodium metabisulfite can break up disulfide ions in proteins that cause the protein soluble in water. The reaction of disulfide ion breakdown in proteins with the help of hydrogen sulfite anion (HSO_3-) is known as sulfitolysis[4]. Sulfitolysis reactions cause protein levels of 0.92 wt% to decrease resulting in increased glucomannan in porang flour[2]. However, the increase in glucomannan levels is not proportional to the magnitude of the increase in the concentration of sodium metabisulfite whose difference is a multiple of the previous concentration. So it can be said that the rise in glucomannan levels that occur is not too significant.

F.Effects Bleaching Agent Concentration on White Degree

The concentration of bleaching agent affect the degree of white. This is shown in Figure 7. The greater the concentration of sodium metabisulfite, the higher the white degree of the flour. In this experiment obtained the result that the effect of sodium metabisulfite concentration is directly proportional to the value of white degree of flour produced. The same is also shown in Purwanto et al.[14] , the greater the concentration of sodium metabisulfite used will be produced flour with an increasingly white color.

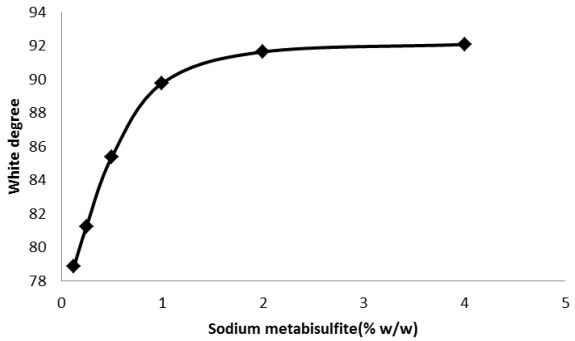

Figure 6. Effects Bleaching Agent Concentration on White Degree

This is because the more sodium metabisulphite concentration is added the more effective the sodium metabisulphite prevents both enzymatic and non enzymatic browning.

G.Effects Bleaching Agent Concentration on Sulfite Residues

In the bleaching process, the concentration of bleach affects the sulfite residue. Figure 7 shows that the greater the concentration of added sodium metabisulfite, the higher the sulphite residue produced. From the experiment, it was found that the concentration of sodium metabisulfite was directly proportional to the sulphite residue.

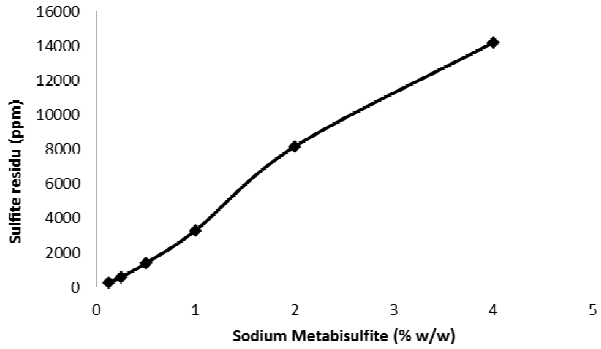

Figure 7. Effects of Bleaching Concentration on Sulfite Residues

One criterion of iles-iles flour according to USA standards is to have SO2 residues of ≤ 500 ppm [12]. So from this experiment, the flour which sulfite residue still meets the standard is the flour with treatment using sodium metabisulfite as much as 0.125%. With the addition of 0.125% also can be obtained flour with a high degree of white, which is equal to 78.842. The sulphite residue present in porang flour also can be reduced by ethanol extraction treatment. In the extraction experiments of flour from the addition of 1% sodium metabisulfite, the residual sulfite was reduced to 1177.6 ppm. Simple extraction experiments, by immersion in 50% ethanol and stirring for 4 hours, are then filtered and dried. If the extraction is carried out in a more developed manner or with more sophisticated tools, for example as in Mulyono's study [12], it is possible to decrease the residual sulphite residue even more.

IV. CONCLUSION

Ethanol 40%(w/w) concentration gives the highest glucomannan content in porang flour which soaked with sodium metabisulfite but ascorbic acid does not affect the degree of whitenes. The longer the immersion time with sodium metabisulphite bleach, the higher glucomannan and white degree are produced. However, in ascorbic acid bleach, the duration of immersion did not affect the glucomannan level and the resulting white degree. At the 60th minute ascorbic acid started to be oxidized theefore will decrease the degree of white. The glucomannan content and the white degree of porang flour obtained on the treatment with sodium metabisulphite are always higher than in the treatment with asorbi aid. The more concentration of sodium metabisulfite added, the higher the glucomannan level, the degree of white, and the resulting sulphite residue .

V. ACKNOWLWDGMENT

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