

Exsperimental Physic-Chemical Modification on Sorghum Flour as Substitute Wheat Flour

Azafilmi Hakiim¹⁾, Faresti Sistihapsari²⁾, DessyAgustina Sari³⁾

^{1,3)} UNSIKA, Karawang, Indonesia

E-mail: aza252116@gmail.com

²⁾UNDIP, Semarang, Indonesia

E-mail: faresti.sistihapsari@gmail.com

Abstract. Physic-chemical modification on sorghum flour through the process of HMT and acetylated reaction. The research's aim is to learn the influence of reaction time and temperature with additional of material to swelling power and % solubility of sorghum in order to get modified with characteristics similiar to wheat. The result of this study shows that the swelling power and % solubility, when the reaction time and temperature initial increased. The swelling power and solubility characteristics of near-modified sorghum flour obtained at a temperature 100 °C, over 14 hours in the HMT and the temperature 80 °C, concentration of 15%V acetic acid in acetylated process.

Keywords: sorghum, heat moisture treatment, acetylated, %solubility, swelling power.

I. INTRODUCTION

Wheat is one of the foodstuffs imported by Indonesia, because it does not allow to be cultivated in tropical countries. The increasing demand and import of wheat in Indonesia, resulting an effort to produce flour from local resource while has functional properties and nutrition value equal with wheat. The food diversification program by empowering local potential has not shown satisfactory results. Alternative solutions is to import wheat and substitute with sorghum as a local potential produce that cheap but the quality is not much different from the wheat. But until now the use of sorghum as a food ingredient in Indonesia is still very limited due to the composition of sorghum flour for wheat flour substitute so far only reached the level of 20% of the sorghum flour. Substitution of sorghum were more than 20% will change the value of the taste, texture, color and aroma that lowering interest of consumers to consume processed sorghum flour [1]. This is because sorghum lacks of physicochemical properties owned by grain. It required modification in order to maximize the potential of sorghum as an alternative food to be reckoned. Modifications here is intended as a change from the molecular structure that can be done by chemical, physic or enzymatic. Modifications in sorghum by swelling power, solubility in sorghum. Modifications made with sorghum flour physic modification and chemical modification. Physic modifications through Heat Moisture Treatment (HMT) with the addition of some materials that have high protein content and heating. Chemical modification is done through the acetylated reaction. This study aimed to characterize the properties of sorghum include swelling power and % solubility, modification of sorghum flour with Heat Moisture Treatment (HMT) and Acetylated characterization of modifications, knowing the condition of the modification (addition of ingredients, time of operation, the operating temperature, the addition of % concentration acetic acid) which generating a character similar to wheat flour.

II. MATERIAL AND METHOD

A. Material

Materials used in the modification Heat Moisture Treatment (HMT) is sorghum, green beans, soybeans, and distilled water.

B. Method

HMT process is adding flour 30 grams (sorghum, sorghum + soybean, sorghum + green beans) to the 25% moisture content then stored at a temperature of 4-5°C overnight. Afterwards, oven the flour at a temperature corresponding variable (100°C; 110°C; 120°C) and the corresponding variable drying time (14 hours; 15 hours; 16 hours), and then let it cool. Acetylated modification of the materials used are sorghum, acetic acid, distillate water. Acetylated is done by soaking the sorghum flour 30 grams of water with a ratio of 1: 3, then added acetic acid at a concentration corresponding variable (10%V; 15%V; 20%V; 25%V) and temperature corresponding variables (60°C; 70°C; 80°C) for 30 minutes. The reaction product was filtered, then the precipitate is washed until pH neutral (7). The precipitate obtained the oven at a temperature of 45°C to constant levels.

C. Analytical Method

Then the products were analyzed of its swelling power, and %solubility. Swelling power analysis using the method of Leach [2], % solubility using Kainuma [3].

III. RESULTS AND DISCUSSION

A. Research Physical Modification

HMT modification, expected swelling power of sorghum (11) may increased toward wheat flour (12.84). The time and temperature heating operation on HMT modification causes a change in starch granules that affect the value of swelling power. Analysis of the level of swelling power of a material, made by the method of Leach. The results of this research are as follows: Figure 1. shows that % swelling power on starch content decreased a long with time at different variable temperatur. At longer reaction time in temperatur 120°C.

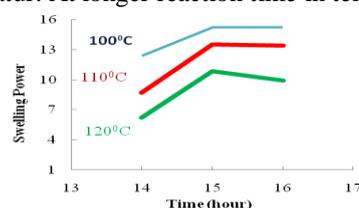


Fig. 1 The effect of time and % swelling power at variable temperature in sorghum.

In Figure 2 and Figure 3 swelling power increases with along increasing temperature. Figure 1, 2, 3 show that sorghum has the highest swelling power and swelling sorghum + soybean has the lowest power. Swelling power rate differences on various materials due to differences in the composition contain the material. Fat and protein in soybeans is greater than sorghum. Water absorption is affected by carbohydrate, protein and other components that are hydrophilic. Fat content and high protein can reduce swelling power because of its hydrophobic inhibiting the binding of water by the granule thus reducing the power of swelled [4].

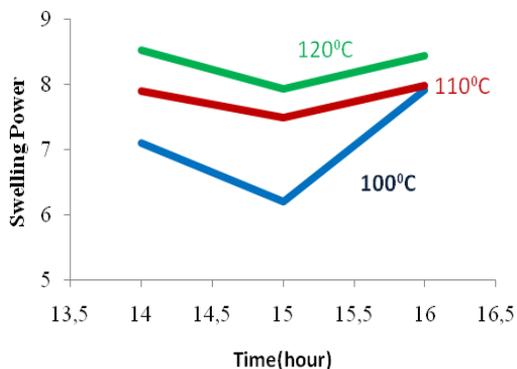


Fig. 2 The effect of time and % Swelling power at all varian temperature in sorghum+soybeans starch

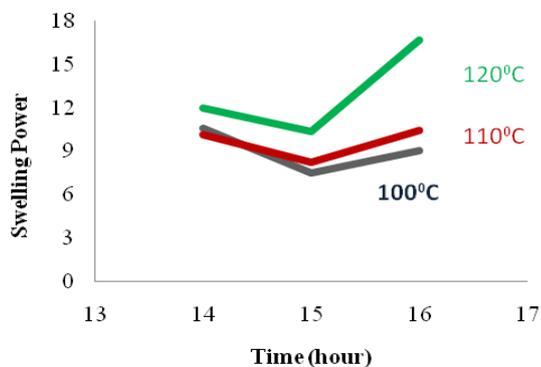


Fig. 3 The effect of time and % Swelling power at variable temperature in sorghum+green beans

Figure 4. it can be seen that the solubility in sorghum operating time of 14 hours to 15 hours to increase, but after passing operating time of 15 hours solubility begins to decline.

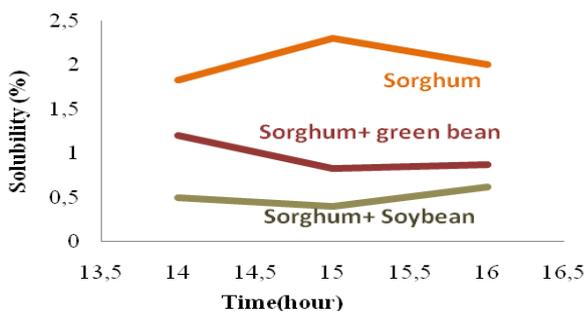


Fig. 4 The effect of time and % solubility at variable composition starch addition.

In sorghum + soybean and sorghum + green beans has decreased to 15 hours of operating time, after passing within 15 hours the solubility begins to increase until it reaches its maximum point. The relationship between the swelling power of the percent solubility in a wide range of starch almost drawn a straight line that shows how close the relationship between these properties [5]. Temperature is one factor that determines the value of solubility, where the higher the temperature, the solubility will increase [6].

B. Research Chemical Modification

In our study, the process of chemical modification used are acetylated starch polymer was ester with an acetyl group. With acetylated modification, the expected level of swelling power and solubility of sorghum flour swelling power and solubility approaching wheat flour. The concentration of acetic acid which affects the amount of acetyl group substitution of the hydroxyl group. Modification of the sorghum flour by adding acetic acid in various concentrations (10% V, 15% V, 20% V, 25% V) at a temperature of 70°C.

Figure 5 and Figure 6, the more the concentration of acetic acid is added to the process of acetylated, swelling power and solubility values higher. At a concentration of 15%V addition of acetic acid, achieved value maximum swelling power and solubility. Value swelling power in acetylated modification addition of 15%V acetic acid is 12.31, the value of swelling power in this modification approaches the swelling power of wheat (12.84). The addition of acetic acid concentration of more than 15 %V will decrease the swelling power and solubility values.

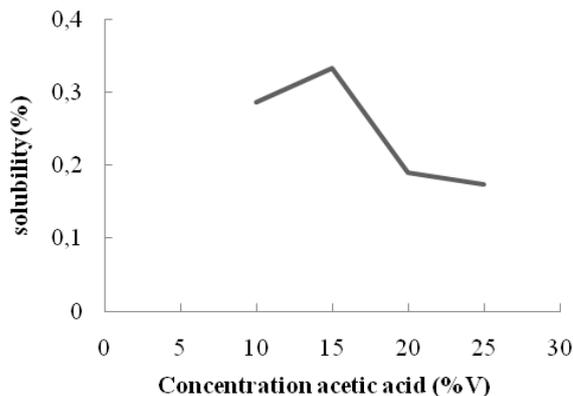


Fig. 5. The effect of concentration acetic acid and solubility on sorghum starch

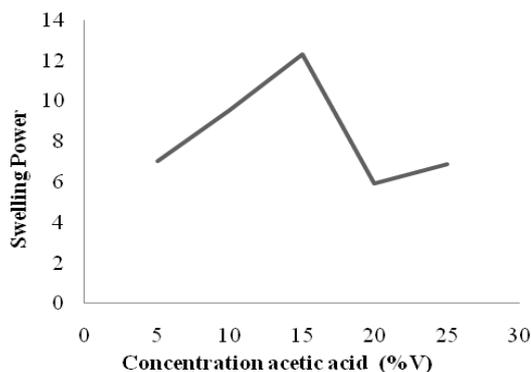


Fig. 6. The effect of concentration acetic acid and swelling power on sorghum

Figure 7 and Figure 8, along with the increased in temperature, swelling power and solubility increased due to increased acetylated reaction speed. With the increase in the acetylated reaction speed, the more the acetyl group is substituted carboxyl group.

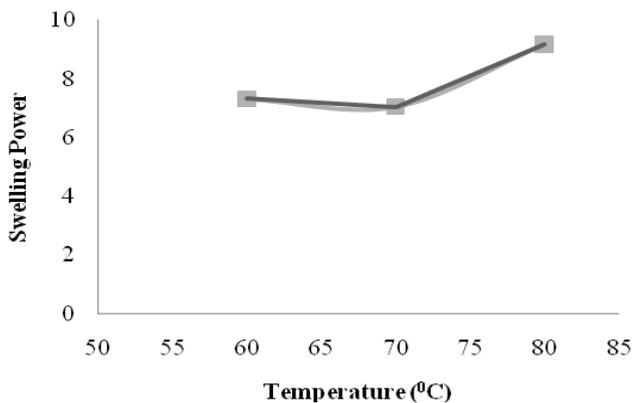


Fig. 7. The effect of temperature and % swelling power at sorghum starch

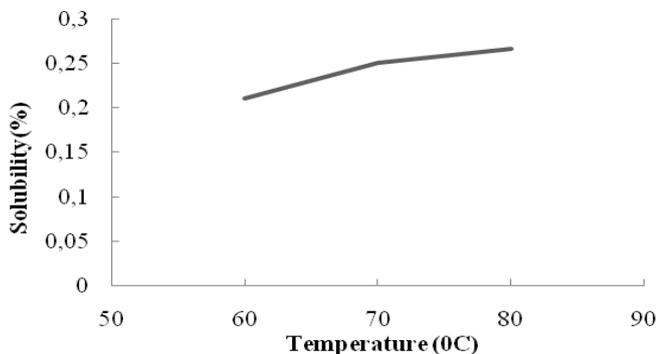


Fig. 8. The effect of temperature and % solubility at sorghum starch

This condition makes the acetylated starch has a weaker hydrogen bonds, thereby increasing the value of swelling power and solubility.

IV. CONCLUSIONS

The overall results suggested that the results were obtained the longer reaction times and higher temperatures lead to increased swelling power and % solubility enhancement. In HMT process operating conditions that produce grain sorghum with the characterization approaches are best at a temperature of 100°C and 14 hours, while in the process of acetylated obtained the best conditions on the addition of 15% V.

ACKNOWLEDGMENT

We would like to thank Prof. Dr. rer. nat. Heru Susanto MT, for financial support to conduct this research.

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