Effects of boiling time and baking soda concentration on the physical chemistry of saga seed flour

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Abstract. Saga tree is a plant that grows in Indonesia and produce seed production very much. However, utilization is still very little saga seeds when seeds saga has a very high nutritional content, especially protein and fat. Saga seeds can be processed into various products such as being a high-protein flour. This study aims to determine the effect of long boiling and baking soda concentration on the physicochemical properties of flour biji saga. The research design uses completely randomized design (CRD) factorial with two factors, namely the long boiling (40, 50, 60 minutes) and baking soda concentration (3; 4; and 5%). The results showed that the interaction between boiling time and concentration of baking soda had highly significant effect to water and fat content, had significant effect to protein content and had no significant effect to ash content and flavour of saga seed flour. The best saga seed flour was T1K3 that is boiled for 40 minutes and dipped in the 5% baking soda solution.

1. Introduction

Saga trees (Adenanthera pavonina L.) is a crop of trees that grow in Indonesia, particularly in Sumatra. This plant is a leguminous plant species that contain high protein and safe enough for human consumption. High protein content in the seeds of this saga, can be used as a source of vegetable protein [1]. Seeds saga has almost the same size with soy, flattened round shape, skin is red and hard seeds [2]. Agricultural Hall of research results Ciawi, Bogor, West Java, showed that the saga tree seeds have a protein content of 48.2%, 22.6% fat, 10% carbohydrate, and 9.1% water [1]. In this study, saga seed is processed into semi-finished products, namely flour with boiling treatment with long time and baking soda in a certain concentration. The purpose of this study was to determine the physicochemical characteristics of seed flour saga.

2. Methods

The research was conducted at Analisa Kimia Bahan Pangan laboratory, University Sumatera Utara. Saga seeds obtained from Taman Saga University Sumatera Utara, Medan. Saga seeds sorted and cleaned. Furthermore, in accordance with the treatment long boiled boiling time (T1 = 40 min, T2 = 50 min, T3 = 60 minutes). Then, the seeds soaked saga with additions accordance with the treatment of baking soda (K1 = 3% = K2, K3 = 5%) for 24 hours. Then the saga seeds are separated from their husks and cleaned. Furthermore, saga seeds are drained and put into a baking sheet and then put in the
oven with a temperature of 60 °C for 12 hours. Then, the saga seeds are mashed using a disc mill and sieved using 60 mesh sieve.

Analysing the flour saga included the water content with the oven method [3], ash content by dry methods [4], protein content by Kjeldahl method [3], the fat content by using soxhlet [3], and flavour with organoleptic test of the 15 panellists. Data analysis using randomized design were analysed using SPSS version 22 for windows. The data reported in all Tables are the average of triplicate observation subjected to one-way analysis of variance (ANOVA). Difference among the ranges of the properties were determinate using the method of Least Significant Difference (LSD) tests at 95% confidence level (P<0.01). De Garmo was used in determining the best treatment method.

3. Results and discussion

3.1. Water content

Saga seed flour with the treatment of boiling time (60 minutes) and soaking with the lowest concentration of baking soda (3%) has a high water content. The longer the boiling time and the higher the concentration of baking soda used in immersion resulted in water content decreases. This is because the longer boiling, the more water will evaporate from the material. This is supported by the statement which states that the longer the cooking time the water level will decrease due to evaporation of more water so that the water content in the material gets smaller. Evaporation is also caused due to the difference between water vapour pressure on the material with water vapour in the air [5].

Higher concentration of baking soda used for soaking the moisture content decreases. This is because the amount of water released from the starch granules burst upon drying so that the amount of water evaporated more. The use of baking soda can damage the cell walls so that the absorption of water will become larger and starch which will be the more gelatinized [6]. When starch gelatinized perfect, then the amount of water coming out is large enough so it will form large cavities when done drying [7]. Interaction between boiling time and concentration of baking soda on water content are shown in Figure 1.

![Figure 1](image)

**Figure 1.** Interaction between boiling time and concentration of baking soda on water content

3.2. Ash content

Based on the results, interaction between boiling time and concentration of baking soda had no significant effect to ash content of the saga seed flour. Chemical and physical treatment in the flour making did not affected significantly the ash content of the flour [8].
3.3. Protein content
Saga seed flour with the treatment of the lowest boiling time (40 minutes) and soaking with the lowest concentration of baking soda (3%) had a highest protein content. The longer the boiling time and the higher the concentration of baking soda added during immersion produces lower levels of the protein. This is because the longer boiling, the more denatured protein material due to heating. The protein is very sensitive to heat and will change the chemical structure (denaturation) due to heating [9].

Decreased levels of protein along with increased concentrations of baking soda added while soaking will result in the increasing number of proteins that are dissolved in the water because the compounds baking soda can dissolve the cell walls so that the absorption of water will become larger and cause protein components in the dissolved substance in water, Soaking with lye would cause the loss of protein and fat as a result of the dissolution of the cell wall material [10]. Interaction between boiling time and concentration of baking soda on water content are shown in Figure 2.

![Figure 2](image)

**Figure 2.** Interaction between boiling time and concentration of baking soda on protein content

3.4. Fat content
Saga seed flour with the treatment of the lowest boiling time (40 minutes) and soaking in the lowest the higher concentration of the baking soda added, the lower the fat content of the saga seed flour. This is due to a long boiling time caused the higher heat received by the material and the higher heat broke the fat highly. The higher temperatures are used, the more intense the breakdown of fat [8].

The higher the concentration of baking soda is used it will decrease the fat content. Soaking with lye will cause the fat in the ingredients are absorbed by the added alkali [11]. Additionally, soaking with lye would cause the loss of protein and fat as a result of the dissolution of the cell wall material [10]. Interaction between boiling time and concentration of baking soda on water content are shown in Figure 3.
3.5. Flavour

Based on the results, interaction between boiling time and concentration of baking soda had no significant effect to flavour of the saga seed flour. Organoleptic impression panellists are influenced by various factors and these factors should be cause full acceptance by the panellists [12].

4. Conclusion

Interaction between boiling time and concentration of baking soda had highly significant effect to water and fat content, had significant effect to protein content and had no significant effect to ash content and flavour of the saga seed flour. Based on the result test, the best saga seed flour was T1K3 that is boiled for 40 minutes and dipped in the 5% baking soda solution.

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