Production Anti Diabetes Flour from *Tanjung* Fruit
(*Mimusops elengi* L)

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**Abstract.** Flavonoids are phenol compounds found in various types of vegetables, cereals and fruits. Phenol compounds have activity as antidiabetic substances. *Tanjung* fruit waste, contains flavonoid compounds. The purpose of this study was to extract flavonoid compounds from the fruits and to investigate the effect of temperature and drying time on the quality of the flour produced. The flour products obtained were analysed for the levels of fat, ash, water, protein and carbohydrate content, and the results were compared with standard values. The results of the analysis showed that the best flour was obtained from a process with drying time and temperature conditions of 40 minutes and 100°C, respectively. In this condition, 65% flour is produced from raw materials that met the SNI-01-3751-2006 standard of wheat flour, has a long durability from mold and microbial growth, bright colour and soft texture. Flavonoids obtained from the extraction were 105.01 mg QE / mg extract. Giving flour to white mice with the dosage of more than 1 g/kg body weight showed significant reduction of its blood glucose level.

1. Introduction

Indonesia is a country rich in biodiversity. Indonesia has 30,000 species of plants that live in tropical forests and some of them are medicinal plants with 9600 species. Of the many medicinal plants, only 200 species are newly processed and used for natural herbal medicines. Judging from the quality and side effects, there are still many Indonesians taking herbal medicines because they are considered to be safer, especially after popping up medicinal products that declare back to nature to avoid side effects [1]. *Tanjung* fruits (*Mimusops elengi* L) are a familiar plant because there are many in surrounding environment. *Tanjung* plants are thought to originate in Southeast Asia. Then it spread to Indochina, Sri Rare, Myanmar, Malaysia and most of Indonesia [2].

Flavonoid contained in *Tanjung* fruits makes this fruit has a potential to be processed into food (flour) for diabetics. Flavonoid compounds can bind blood sugar, as blood sugar inhibition. Antioxidants from this fruit has function as anti-diabetes, anti-stroke, anti-cholesterol and prevent blood pressure. Flavonoids are natural phenol compounds that are found in plants. Flavonoid

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compounds and their derivatives which can inhibit blood sugar, are found in many leaves, wood, bark, flowers, pollen, seeds, fruit flesh and roots of plants/herbal plants [3]. Due to human needs, research on usability of flavonoids for food and medicine are increasingly developed. Research on the processing of Tanjung fruits into flour has been done previously by [4] who correlated total phenolics and total flavonoids in the fruits. The general objective of this research is to process Tanjung fruit into flour as food for diabetics. The specific purpose of this study is to look at the effect of temperature and drying time on the quality of flour and flavonoid extracts produced. The quality of flour is determined through analysis of the products and compared with food standards according to SNI.

2. Materials and Method
The tools used in this study were a set of extraction equipment, rotary evaporator, 80 mesh sieve, 250 ml measuring cup, oven dryer, blender, knife, plastic and bucket, porcelain and furnace cups, fat flask, filter paper, desiccator, balance sheet high analytic, a set of test tubes, spatulas, 100, 250 and 500 mL measuring flasks, 1000 ml measuring cups, 10-100 µl micro pipettes, cuvettes and UV-Vis spectrophotometer. The ingredients used were Tanjung fruit, ethanol 96%, hexane solvent, aquadest, 5% NaNO₂, NaOH 4%, quersetin (Sigma Aldrich) and AlCl₃ Reagent 10%.

Tanjung fruits (Mimusops elengi L) were obtained from the area around Syiah Kuala University, Darussalam, Banda Aceh. The fruits were washed thoroughly and peeled. A 500 grams of fruit flesh was dried in an oven dryer at temperature of 40, 60, 80 and 100ºC and the drying time of 20, 40, 60, 80 and 100 minutes. Samples were then blended and sieved with a particle size of 80 mesh. The flour products were analyzed for water content, ash content, and fat content. The best product was then analyzed for its protein and carbohydrate levels. The extraction process was then carried out using 96% ethanol solvent. A total of 150 grams of Tanjung fruit flour was extracted using 500 ml of 96% ethanol solvent. The extraction process was carried out at a temperature and time of 60ºC and 6 hours, respectively. The filtrate obtained was concentrated using a rotary evaporator and then tested for flavonoid levels using a UV-Vis spectrophotometer.

3. Results and Discussion
3.1 Effect of Temperature and Drying Time on Physical Changes of Tanjung Fruit Flour
The effect of drying temperature from 40 to 100 ºC on the physical appearance of the flour with 80 mesh sieve size and information on its physical appearance can be seen in Figure 1.

![Figure 1](image_url)

**Figure 1.** Physical changes (color and texture) of Tanjung fruit flour at various drying temperatures and 60 min drying time.

Drying temperature greatly affects the texture of the acquisition of Tanjung fruit flour. At low temperature (40ºC and 60ºC), the texture of the resulting flour was not soft, easy to stick to the storage and the color of the flour is very dark. This was probably caused by the high water content in the flour. Otherwise, at high drying temperatures (80ºC and 100ºC), the Tanjung fruit flour obtained was...
brighter and the texture of the resulting flour was softer and more durable from the growth of fungi and other microbes. Microbes damage foods and unsafe for consumption. The activity of microbes in low water content food was hampered so as longer the storage time [5]. The effect of drying time from 20 to 100 minutes on the physical changes of the flour can be seen in Figure 2.

![Figure 2. Physical changes (color and texture) of Tanjung fruit flour at various drying time at a temperature of 100°C](image)

Drying time affects the acquisition of the flour. Short drying time resulted in moist flour and dark brown color. In addition, the durability of flour was also low. Brown color resulted from the reaction of oxygen with phenol compounds contained in flour lowering the quality of the flour. The color was also influenced by enzymes contained in the flour [5]. The longer the drying time, the brighter the color of the flour.

3.2 Effect of Temperature and Drying Time on Water Content

Effect of temperature and drying time on water content of the flour is presented in Figure 3.

![Figure 3. Effect of Temperature and Drying Time on water content](image)

Figure 3 shows that the highest water content was 67.15%, resulted from the drying process at 40°C for 20 min. While the lowest water content of 0.48% was obtained from drying process at 100°C for 100 min. The longer the drying time, the lower the water content in the flour. Likewise, the higher the drying temperature, the lower the moisture contained in the material. [5] said that the higher the drying temperature, the faster the rate of water transfer to the environment, thereby reducing the water content in food. This causes the higher temperature and drying time to accelerate the rate of water transfer or the process of evaporation of water in a food material so that the water content of the material reduces. At temperatures below 45°C, microbes and fungi that damage food is still active [6].

From Figure 3, it can be concluded that the water content at the drying temperature (T) of 100°C and the drying time (t) of 40 minutes is the same as the water content at T = 80°C and t = 60 minutes. Based on the SNI for wheat flour (SNI-01-3751-2006) as food ingredients, the water content of flour is a maximum of 14.5%. From the results of the study, it was found that the drying temperature of 80
and 100°C and the drying time of more than 60 minutes produce flour with a moisture content lower than 14.5%, which fulfilled the SNI standards [7].

3.3 Effect of Temperature and Drying Time on ash content

Effect of Temperature and Drying Time on ash content of the flour can be seen in Figure 4.

![Figure 4. Effect of Temperature and Drying Time on ash content](image)

The above figure shows that the higher the temperature and the drying time, the ash content in the material also increases significantly. This is caused by an increase in mineral levels in a food [5]. The higher the mineral content, the higher the ash content in the food. The mineral content in food such as phosphorus, magnesium, potassium, calcium and iron. From the ash content can be determined the nutritional value of a food. The higher the mineral content, the ash content contained in a material is also high, otherwise if the mineral content is low, the ash content contained in the food is also low [6].

From the research results, the highest ash content was obtained at a treatment temperature of 100°C with a drying time of 100 minutes of 0.37%, while the lowest ash content was obtained at 40°C with 20 minutes drying time of 0.12%. The higher the drying temperature, the higher the ash content obtained. This is due to at high drying temperature, water content is low. Therefore, food becomes concentrated so that the minerals left behind in the food material increase. With the high drying temperature, the ash content is not damaged, it is just the reduced water content in the foodstuff [8]. Based on the SNI standard for wheat flour (SNI-01-3751-2006) as a food ingredient, the ash content of flour is set to a maximum of 0.6%. From the research results obtained, Tanjung fruit flour with ash content less than 0.6% for all variations of operating conditions, meet the SNI-01-3751-2006 standard.

3.4 Effects of Temperature and Drying Time on fat content

The Effect of Temperature and Drying Time on fat content is shown in Figure 5.

![Figure 5. Effect of Temperature and Drying Time on fat content](image)
Figure 5 shows that fat content increases with increasing drying time until it reaches 100ºC. This is because the higher the temperature and drying time, the fat content will increase and inversely proportional to the water content in the *Tanjung* fruit flour which decreases as the temperature and drying time increase. This result is in lined with Nuraeni research [6], which stated that when the temperature and duration of drying time are high, the water content decrease, the fat content in the material increase. In this study, the highest fat content of 22.25% was obtained from the treatment at 100ºC drying temperature with 100 minutes drying time, while the lowest fat content of 19.86% was obtained at a treatment temperature of 40ºC drying with 20 minutes drying time. Fat occurs due to the esterification reaction between glycerol and fatty acids. The use of high temperature resulted in the breaking of double bond in fat and break down into fatty acids and glycerol. Too high fat in the ingredients causes rancidity in the storage process [5].

### 3.5 Analysis of Protein and Carbohydrate

The analysis was carried out on samples obtained from the best operating conditions, that was drying time and temperature of 40 minutes and 100 ºC, respectively. The results show that protein and carbohydrate in *Tanjung* fruit flour were 1.69% and 10.24%, within SNI limit for wheat flour of max. of 7.0% and 27.3%, respectively. Table 1 shows the quality of *Tanjung* fruit flour resulted from the process at 100ºC temperature and 40 minutes drying time.

**Table 1.** Quality of *Tanjung* fruit flour at the operating condition of 100ºC temperature and 40 minutes drying time

| No | Parameter         | *Tanjung* fruit flour (Research result) | wheat flour (SNI-01-3751-1994) | Unit | Method Test |
|----|-------------------|---------------------------------------|---------------------------------|------|-------------|
| 1  | Water content     | 9                                     | Maks 14,5                       | %    | -           |
| 2  | Ash content       | 0.27                                  | Maks 0.7                        | %    | -           |
| 3  | Fat content       | 20.24                                 | -                               | %    | Pumpkin fat |
| 4  | Protein content   | 1.69                                  | Maks 7.0                        | %    | Kjeldahl    |
| 5  | Carbohydrate      | 10.24                                 | Maks 27.3                       | %    | Luff Schoorl|

### 3.6 Analysis of Flavonoid Concentration

Flavonoid are phenol compounds that is a lot on the part of stems, roots, wood, skin, flowers, pollen, fruits, seeds and leaves of plants or herbal plants [9]. [10], reported that flavonoid compounds act as anti-diabetes compounds and flavonoid levels can reduce blood sugar. Flavonoid concentrations are expressed in milligrams of Quersetin/gram extract (mg QE/mg extract). The analysis result of flavonoid levels obtained from *Tanjung* fruit flour extracted under various conditions of temperature and drying time is presented in Figure 6.
From Figure 6, it can be seen that at various temperature and drying time the flavonoid levels obtained also vary. Flavonoid levels obtained at drying temperature of more than 60°C decrease with increasing drying time. Whereas at a drying temperature of 40°C the flavonoid levels increase with increasing drying time. High temperatures damage the flavonoids in food. Drying time that is too long also damage the flavonoids in food because exposure to high temperatures during the drying process can interfere the air circulation in food. Also stated that one of the phenolic compounds, flavonoids, are damaged by heat. Phenolic compounds are very sensitive to high temperature and solar radiation [11].

From the variations of drying operating condition, it can be concluded that the optimum levels of flavonoids are taken at a drying temperature of 100°C and a drying time of 40 minutes. This conclusion is also reviewed from various analysis of flour products such as the acquisition of water content, ash content and fat content. Seen on the temperature and drying time variables (100°C and 40 minutes), water and ash content have fulfilled the SNI-01-3751-2006. In this variation flour has a long-lasting resistance to fungal and microbial growth such as mold and has a very bright and soft colour.

3.7 Analysis of glucose blood of mice

Table 2. Result analysis of glucose blood of mice at various conditions

| Mencit   | Glucose Blood Content                  |
|----------|----------------------------------------|
|          | Before Injecting Glucose | After Injecting Glucose | Dosage of Tanjung flour | After 30 min | After 60 min | After 90 min | After 120 min |
| Mice 1   | 96 | 264 | 0,5 g | 206 | 196 | 176 | 166 |
| Mice 2   | 87 | 304 | 1 g | 276 | 201 | 198 | 176 |
| Mice 3   | 99 | 256 | 1,5 g | 152 | 146 | 126 | 96 |
| Mice 4   | 91 | 271 | 2 g | 196 | 186 | 176 | 156 |
| Mice 5   | 89 | 300 | 2,5 g | 222 | 198 | 186 | 147 |

Table 4 shows that injection of glucose with a certain dosage to mice showed positive results, glucose injection with dosage above 1 g/kg body weight showed a significant decrease in blood sugar.
4. Conclusion
The best condition in processing Tanjung Fruit flour with good quality in terms of water, ash, fat, protein and carbohydrate content was temperature 100°C and drying time 40 minutes. The results met the SNI-01-3751-2006 standards for wheat flour. It was resistance to mold growth, has bright colour and soft structure. The maximum flavonoid content at those conditions was 105.01 mg QE/mg extract. Giving flour to white mice with the dosage of more than 1 g/kg body weight showed significant reduction of its blood glucose level.

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