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Effect of Drying Time and Temperature on Water Content of Klutuk Banana (*Musa balbisiana* Colla) Flour

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Abstract

The optimization of drying parameters leads to the increased production rate of dried products. The present study was conducted to investigate the effect of drying time and temperature on water content of klutuk banana flour. The drying process of klutuk banana was conducted by using a validated oven. The optimization of drying time and temperature was conducted until water content meets the requirement. Determination of water content was done by oven. Drying temperature and time of simplisia that qualify the water content of klutuk banana was 50 ºC for 20, 24, and 40 h. The secondary metabolites of the simplisia and flour were analyzed using standard method. The results of the phytochemical analysis revealed varying constituents of these extracts, as follows: flavonoids, polyphenols, tannins, monoterpenoids, sesquiterpenoids, Quinones and saponins. Our results demonstrated that drying time and temperature of Klutuk banana fruits simplisia would decreased water content of banana flour, but did not gave different effect on the presence of secondary metabolites target.

Keywords: drying, temperature, time, Klutuk, water content

Introduction

Empirically, banana fruit is one of the traditional medicine that can cure dysentery. Klutuk banana fruit contains secondary metabolites such as flavonoids, polyphenols, tannins, quinones, saponins, monoterpenoids and sesquiterpenoids that can play a role in inhibiting bacterial growth. This is interesting because so far the utilization of banana klutuk not optimal because of its seeds, its thick skin, and its fruit can not be used in fresh form [1]. However, bananas have a perishable nature that must be done further processing in the form of other products, such as banana flour.

The benefits of banana processing into banana flour is to increase the length of storage, can be used as flexible raw materials, improve the security of distribution, and become a practical material to be processed [2]. Banana flour can be made from young bananas and unripe old bananas. In addition to more durable, banana flour is also known to contain some of the nutrients for the body needs, such as starch (84%), protein

(6.8%), fat (0.3%), ash (0.5%) and food fiber (7.6 %) [3].

Banana flour obtained must have good quality. Flour is made by drying the banana with sunlight or drying tool, then milled and sieved using a mesh of 100 [4]. Drying process was done to lower the water content so that enzymes can not work and microorganisms can not grow. The aim of drying is to preserve food [5]. Factors affecting the success of drying are surface area, heating temperature, air flow velocity, and air pressure [6]. Therefore, in this research, the optimization of temperature and the long time of drying simplisia of banana klutuk fruit to obtain banana flour with moisture content below 10%, were evaluated.

Materials and Methods

Material

The chemical materials used in this study are aquadestilata, amyl alcohol (Merck), chloride acid 2N (PT. Brataco), concentrated sulfuric acid (Merck), dimethyl sulfoxide (DMSO - Merck), chloroform (Merck), ether (Merck), Mayer reagent (Merck), Dragendorff reagent (Merck), gelatin solution 1% (CV. Medilabs), ferric chloride reagent (Merck), magnesium powder (CV. Agung Menara Abadi), chloride acid 1N (Merck), Liebermann Bouchard reagent, concentrated sulfuric acid 10% in ethanol, vanilin in concentrated sulfuric acid, dan sodium hydroxide (PT. Brataco).

Plant Material

Plant samples used in this study are Klutuk banana fruits (*Musa balbisiana* Colla). The age of Klutuk banana fruits was approximately 3 months, The banana was obtained from Cimincrang Village, District Gedebage, Bandung, West Java, Indonesia. Plant sample was identified in Plant Taxonomy Laboratory of Biology Major, Faculty of Mathematics and Natural Science Padjadjaran University.

Methods

Oven Validation

The calibrated thermometer was placed in the corners of the empty oven about 50 mm from the walls. And another calibrated thermometer was placed in the geometric center of the oven. After that, the oven was closed and the temperature was set. The oven temperature was allowed to get stabil. After the oven has stabilized, the oven was opened and the temperatures on thermometer were recorded. The oven was closed and allowed it to stabilize. After the oven has stabilized, recorded the oven temperature. If the oven temperature is not at the required value, reset the controls and repeat the procedure [7].

Preparation of Flour Production

Klutuk banana were cleaned and air dried at ambient temperature [8] then peeled and separated between skins and fruits. The fruits of Klutuk banana were cut into small pieces with 2-3 cm long, 2-3 cm width, and ± 1mm thick. Then the slices of fruit arranged on the alumunium foil before drying process [9].

Optimization of Drying Time and Temperature

The slices of fruit on the alumunium foil were dried with oven at various temperature (30, 40, and 50° C) and time (15, 20, 24 and 40 h). After drying process, its water content of dried fruits were measured using loss and drying method.

Loss on Drying Analysis

Loss on drying analysis was conducted to find out the drying temperature and time that produce the slice of dried fruit with the qualified of water content. Loss on drying test was conducted by weighing 1-2 g of dried fruits in bottle which had been heated on the setting temperature. After that, dried fruits were flattened in bottle by shaking the bottle, to get a layer 5-10 mm thick. Bottles that contained dried fruits were placed into the oven in an open state. Dried fruits were dried at the setting temperature until the weight fixed [10]. The dried fruits that have qualified water content, then milled using a blender and sieved using a 100 mesh thus obtained the flour of Klutuk banana fruit [11].

Phytochemical Screening of Secondary Metabolites

Phytochemical screening of secondary metabolites was using a standard method to determine the contains alkaloids, flavonoids, tannins, quinones, saponins, steroids, and triterpenoids, in both simplisia and flour of Klutuk Banana Fruits.

Results and Discussion

Validation Oven Results

The oven should be validated by placing the thermometer into an empty oven where temperature has stabilized. After that, checked the temperature of thermometer after ± 45 min in the oven. Based on the data in Table 1, the difference temperature of validated oven was ranging between 0.5 – 1.5º C. For getting stable temperature, the oven need 40-45 min. Thus the oven was used has been validated where the temperature difference indicated by the oven is not more than ± 5ºC [7].

Table 1: Validation Oven Results

Test Temperature Oven (ºC)	Thermometer Temperature (ºC)	Time Temperature Stability (min)
30	30,5	40
40	41,5	45
50	51,5	45

Optimization Result

The drying process was the most important activity in the processing of medicinal plants as it affects the quality of the products to be produced [12]. Method of drying was selected using an oven in order to provide a better product that the direct rays drying method. Drying with oven was considered more advantageous because there will be a reduction in the levels of water in

large quantities in a short time [13]. The weight of Klutuk Banana Fruit before and after drying was calculated so it would be get the percentage of lost weight. Percentage of lost weight in Klutuk banana fruit can be seen in Table 2 and Figure 1.

Table 2: Percentage of Lost Weight in Klutuk Banana Fruit

Temperature (ºC)	Drying Time (h)	Initial Weight (g)	Final Weight (g)	Lost Weight (g)	Lost Weight (%)
30	15	25,05	21,07	3,98	15,89
	20	25,06	19,06	5,99	23,93
	24	26,32	16,31	10,01	38,03
	40	25,16	9,88	15,28	60,74
40	15	26,58	17,47	9,11	32,27
	20	26,41	12,91	13,50	51,13
	24	26,96	9,23	17,74	65,77
	40	26,98	2,62	24,36	90,29
50	15	25,43	8,54	16,88	66,40
	20	25,37	2,62	22,74	89,65
	24	25,68	2,91	22,77	88,65
	40	25,88	3,53	22,35	86,35

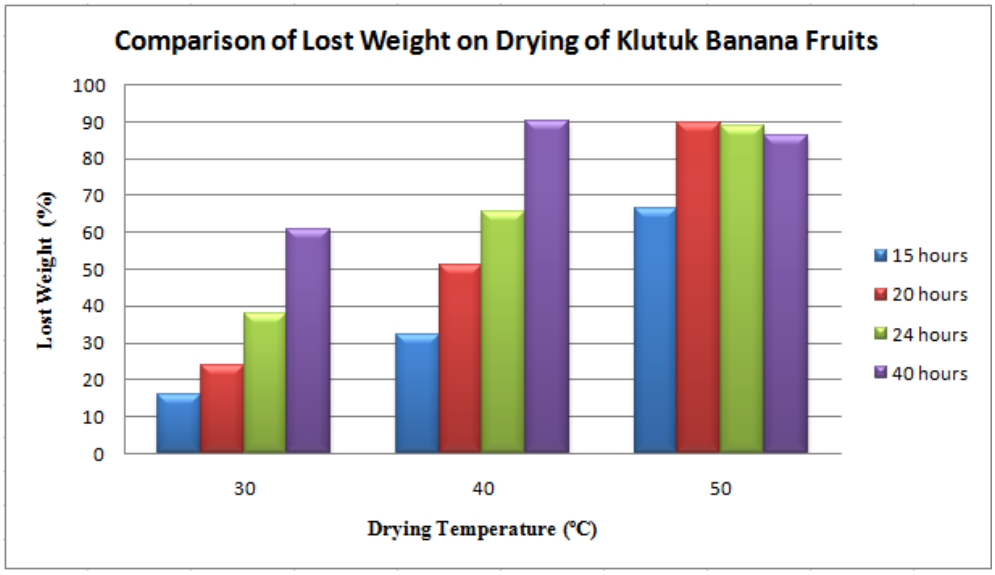

Figure 1: Comparison of Lost Weight on Drying of Klutuk Banana Fruit

Based on these data, the percentage of lost weight was directly proportional to increase the drying temperature and time. The greater drying temperature and the longer drying time was also increased the percentage of lost weight due to the drying process. However, at some particular drying temperature and time, the percentage of lost weight was inversely proportional to the drying temperature and time. This can be happened because the lack composition of Klutuk banana fruits in the alumunium foil causing the drying process was not running perfectly and made the percentage of lost weight smaller.

Loss On Drying Test Results

Loss on drying test was conducted to find out the water content of Klutuk banana fruits. In addition, loss on drying test was also conducted to control quality of dried Klutuk banana fruits [14]. The result of loss on drying test of Klutuk banana fruit can be seen in Table 3.

Table 3: The Result of Loss on Drying Test of Klutuk Banana Fruit

Temperature (ºC)	Drying Time (h)	Initial Weight (g)	Final Weight (g)	LOD Value (%)
30	15	1,97	0,14	92,64
	20	1,96	0,20	89,90
	24	1,97	0,26	86,91
	40	1,98	0,47	76,47
40	15	1,85	0,23	87,73
	20	1,87	0,32	82.83
	24	1,89	0,48	74,73
	40	1,87	1,66	10,92
50	15	1,71	0,65	62,01
	20	1,79	1,63	8,79
	24	1,80	1,69	6,21
	40	1,89	1,79	5,42

Simplisia with good quality had a water content of less than 10 with the characteristics of simplisia is easy to break, not moldy, and smells like fresh materials [14]. Based on the data in Table 3, the fruits of Klutuk banana that meets the requirements of simplisia water content was flour with drying temperature of 50ºC and various of drying time (20, 24, 40 h).

Phytochemical Screening Result

The results of the phytochemical analysis revealed varying constituents of these extracts, as follows: flavonoids, polyphenols, tannins, monoterpenoids, sesquiterpenoids, quinones and saponins**.** The result of phytochemical screening can be seen in Table 4.

Based on the data in Table 4., simplisia and banana flour did not have differences in secondary metabolites. This proves that the drying temperature and time was used in this study did not gave effect presence of secondary metabolites. But the levels of each secondary metabolite in flour may affect the antidisentery activity of this banana flour [15]. The results of literature studies suggested that secondary metabolite compounds such polyfenols, flavonoids, tannins, saponins has the activity of

antibacteria with various working mechanism. Flavonoids act as antibacterial by forming complex compounds against extracellular proteins that interfere with integrity of baterial cell membranes [16]. Tannins have antibacterial activity by destroying components of cell membranes, cell walls, enzymes, genetic material, and other protein components [17]. The lipophilic terpenoids has antibacterial activity by destroying the bacterial cell membrane, it will react with the active side of the membrane, dissolving the lipid constituent and increasing permeability [18]. Saponins can increase the permeability of bacterial membranes so as to alter membrane structure and function, causing membrane protein denaturation so that cell membranes will be damaged and lysis [16].

Table 4: Phytochemical Screening Result

Secondary metabolites	Results	
	Simplisia	Flour
Alkaloids	-	-
Quinones	+	+
Polyphenols	+	+
monoterpenoids	+	+
sesquiterpenoids	+	+
Tannins	+	+
Flavonoids	+	+
Steroid & Triterpenoid	-	-
Saponins	+	+

Note: (+) presence; (-) absence

Conclusion

Our results demonstrated that drying time and temperature of Klutuk banana fruits simplisia would decreased water content of banana flour, but did not gave effect on the presence of secondary metabolite target.

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