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OPTIMIZING THE UTILIZATION OF CANDI BANANA AS FUNCTIONAL FOOD AND IMPORT SUBSTITUTION OF INDUSTRIAL RAW MATERIALS THROUGH THE APPLICATION OF APPROPRIATE TECHNOLOGY

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Keyword

Candi Banana, Functional Food, Industrial Raw Materials, TTG, Institutional Strengthening.

Abstract

Indonesia is one of the countries known as the world's banana (Musa Paradisiaca) producer, where 50% of Asian banana production comes from Indonesia. Bananas are one of the sources of prebiotics that fight free radicals that trigger oxidative stress, especially for people with hypercholesterolemia, Alzheimer's Disease, and Autism. There is a type of Pisang Candi (Musa Paradisiaca Fa. Corniculata) that is gluten free and is the largest commodity in Malang Regency, especially Sidodadi village. The research aims to process bananas into various forms of functional food through the use of appropriate technology and test their physiochemical content. The method of activity was carried out through technological engineering and proximate testing through a research & development approach. The results showed that 100 grams of banana flour contained 3.297% protein, 82.966% carbohydrate, 0.573% fat, 2.384% ash/mineral, and 10.780% water. For the banana to have a long shelf life and not easily experience browning due to its polyphenol content, it is dried and made into flour. The benefits of the research and development are increased capacity of farmers, increased quality and added value of temple banana products, and the availability of import substitution of industrial raw materials, which has implications for increasing their income.

INTRODUCTION

Indonesia is one of the world's leading banana producers and is highly competitive. Indonesia has produced as much as 6.20% of world production, whereas 50% of Asian banana production comes from Indonesia [Soesilowati. E, 2016] [Satuhu, 2008]. Banana is the second most exported fruit with total production reaching 7, 26 tons. Of course, national banana production is supported by banana production in the regions. Based on data obtained from BPS in 2020, East Java occupies the first position as the largest banana producer in Indonesia.

Banana Temple is an energy source that is rich in carbohydrates amounting to 22-32% of the weight of the fruit flesh. In addition, banana flesh is rich in vitamins A, B6, and C as well as minerals, especially potassium, magnesium, phosphorus, and folate [Adebayo-Oyetoro, et.al, 2016]. Nutritional components contained in bananas include potassium 373 mg, and vitamin A

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amounting to 250-335 g in every 100 gr. Candi banana has a higher starch content in the form of amylose compared to other conventional sources such as potatoes, corn, and tubers [Soesilowati. E, 2018].

Banana is a prospective intermediate product as a local and functional food that is rich in carbohydrates (17.2- 38%) (https://validnews.id/ekonomi/bps-januarinovember-impor-gandum-indonesia-843-juta-ton). Functional food can strengthen the body's defense mechanism, and reduce the risk of a disease [Legi. et.al, 2021]. Bananas, apart from containing carbohydrate vitamins and minerals, are also a source of prebiotics needed to maintain a healthy body, especially for people with hypercholesterolemia and Alzheimer's Disease.

Alzheimer's disease (AD) is a neurodegenerative disease and the most common cause of dementia [Kurniawan, Fajar, 2009], better known to the general public as senility disease where there is a complex and progressive decline in brain nerve function, even in advanced stages the patient is unable to take care of himself [R. S. Wilson, E. et.al, 2012]. It is estimated that 35.6 million people are living with dementia worldwide and this will increase to 65.7 million by 2030 [W.W. Barker. et.al, 2002] and by 2050 reach 106.8 million, with most of the increase occurring in developing countries, therefore this disease is a concern with a major socioeconomic burden [D'Agostino G., et.al, 2012]. The risk of AD incidence varies from 12% to 19% for women over the age of 65 years and 6% to 10% for men and increases exponentially to 47% in individuals over the age of 80 years [R. Brookmeyer, et.al, 2007]. Symptoms in patients rarely occur before the age of 50 years, the incidence of the disease increases with age and the prevalence approximately doubles every 5 years, starting from a level of 1% for the population aged 60 to 64 years and can reach 40% or more for the population aged 85 to 89 years [S. Seshadri, et.al, 1997].

On the other hand, the variety of wheat-based processed products causes the demand for wheat to increase in proportion to the level of public consumption and the rate of population growth. Aptindo Executive Director Ratna Sari Loppies explained that wheat flour consumption in the first nine months of 2023 reached 5.01 million tons. This figure is equivalent to 6.43 million tons of wheat. The countries of origin of Indonesia's largest wheat imports are Australia, Canada, Brazil, Argentina and Ukraine. It is feared that Indonesia's dependence on wheat flour, which is entirely made from imported wheat, will gradually shift the consumption of local foodstuffs other than rice.

One of the areas with the largest banana production in East Java is Sidodadi Village, Gedhangan District, Malang Regency. Banana products in this village are diverse, including fruit, kepok, awak king, and temple bananas. This indicates that Sidodadi Village has local potential that should be utilized to increase the economic value of bananas. The production of candy bananas in Sidodadi Village, Gedangan Subdistrict, Malang Regency during the harvest season is very abundant.

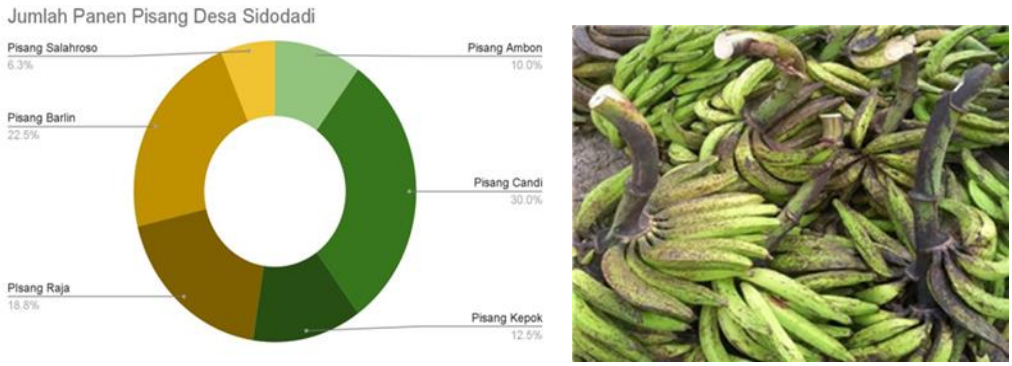

Figure 1 Banana Products in Sidodadi Village Gedangan Sub-district, Malang district

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Optimizing the utilization of candi banana as an industrial raw material is needed to increase the added value of candi banana to increase farmers' income as well as in the long term to substitute wheat imports.

METHOD

The research "Optimizing the Utilization of Candi Banana as Functional Food and Import Substitution of Industrial Raw Materials through the Application of Appropriate Technology" is a specific and holistic study. Specific means that the object of research is the banana fruit. Holistic means that the study in this research concerns not only the technical aspects of production but also the nutritional aspects. The research used a Research and Development approach. The researcher and the subject under study are interactive. The research location was Sidodadi Village, Gedangan District, Malang Regency, where most of the population are banana farmers.

The aspects studied were production technology and the physiochemical content of banana flour products. Samples of Candi banana were made into flour by using engineering technology of drying (cabinet dryer), flouring machine and 80 mesh sieve.

Type	DRY P1-180
Diskripsi	Pengering 1 Pintu
Temperatur kerja	30 °C – 75 °C
Bahan Bakar	LPG
Power (W)	40
Konsumsi LPG (Kg/jam)	0.05
Dimensi (P x L x T) (Cm)	700 x 550 x 1800
Jumlah rak (Unit)	15
Dimensi Rak (P x L x T) (Cm)	350x350x50
Bahan Rak	Stainless Steel 304
Timer	Omron H3CR
Thermocontroler	Omron E5CWL
Kapasitas Max (Kg)	8

Figure 2 Proptotype Drying Machine

Mesin Penepung
Specifications:
-type : ffc 15
-material: stainless
-frame material: tomorrow's elbow
-drive: 5.5 HP petrol motor

Figure 3 Prototype Flouring Machine

For proximate tests, gooch crates/weighing bottles, analytical scales, ovens, desiccators; protein levels using analytical scales, a set of 30 m kjeldahl flask equipment; fat levels using analytical scales, filter paper, ovens, a set of soxhlet extraction equipment; and determination of ash content using a stove, gooch crates, furnaces, analytical scales.

Chemicals used for the determination of protein content are HCl 0.001 N or 0.002N, K2SO4, HgO, H2SO4, water, H3BO3, indicators (a mixture of 2 parts of red metal 0.2% in alcohol and 1 part of methylene blue 0.2% in alcohol), NaOH-Na2S2O3, HCl 0.02 N, Blanko (aquadest). The material used for the determination of fat content is diethyl meter solvent or petroleum ther. Supporting materials needed are acetic acid for chemical modification (acid modification) and a-amylase enzyme for enzymatic modification.

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The product proximate analysis method refers to the American Association of Cereal Methods (AACC, 2024) and the method found in (AOAC) [AOAC, 2005]. Moisture content using the oven method (AACC Method 44-15A). Samples (3 g) were placed in a laboratory dryer and dried at 103◦C ± 1◦C until constant weight. After cooling in an exicator, the samples were weighed and the moisture content was calculated. Ash content using the AACC 08-01 method. The sample was measured to an ash plate at 3 g. Then the sample was put into a muffle furnace at 5500C. The samples were burned until they were light gray or a constant weight was obtained (7 hours). After cooling, the samples were weighed and the ash content was calculated. To determine the total protein content, the Kjeldahl method (AACC Method 46-08) and using Kjeltec 2300 equipment (FOSS, Höganäs, Sweden). Protein content was calculated from total nitrogen content using a conversion factor. Fat content used the Soxlet method. SoxtecTM8000 on AN 310 apparatus (FOSS, Höganäs, Sweden) and using hexane as solvent. Carbohydrate content using the by differences method [AOAC, 2005].

The data obtained were analyzed using ANOVA at the 5% significance level, if there was a significant difference then further tests were carried out with DMRT at the 5% significance level.

RESULTS

Banana is a horticultural product that rapidly deteriorates due to physiological fruit processes. Increasing the shelf life and usability of banana fruit requires processing with drying and flouring technologies. With drying techniques, banana flour can last up to 6 months. According to Kurniawan (2009), extending shelf life, providing ease of storage and transportation of materials, are benefits of banana flour processing that can be felt by farmers.

In addition, banana flour can also be used as a flour substitute in various processed products (Nurhayati & Andayani, 2014). Flouring will produce a variety of foods that will automatically grow the food industry and improve what has been existing (Suryana et al., 2004). One of the creative forms of banana flour processing is as a substitute for making snacks such as dried sponge cake (Pratomo, 2013); crackers (Wahyuningtyas, et al., 2014); snack bars (Ekafitri, et al., 2013); and even baby porridge (Nurhayati, et al., 2015). However, it should be underlined that the different types of banana raw materials greatly affect the nutritional content, physical and organoleptic properties of the banana flour produced (Nurhayati et al., 2015; Palupi, 2012).

Figure 4 Banana Candi-based Cake Products

The wide use of banana flour makes banana flour one of the local products that has the potential to be developed. In addition to the type of banana, the age of banana harvest also determines the banana flour produced (Radiena, 2016). According to Hidayat (2010), this is because at the optimal level of fruit maturity, starch formation has reached the highest level. At this stage, the sweet and sour flavors are in a balanced condition, as most of the tannins have been decomposed. Almost all types of bananas can be made into banana flour. Each type of banana will

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produce flour with different characteristics (Yani, Wylis Arief, & Mulyanti, 2013; Anggraeni & Saputra, 2018).

DISCUSSION

The proximate content / nutritional composition in 100 g of banana flour is listed in table 1:

Tabel 1 Observation Data of Candi Banana Flour Samples

Protein					
Sample	ul	m smpl (g)	Titrasi (ml)	Protein (%)	
Banana Flour	1	2,006	7,6	3,317	
	2	2,004	7,5	3,277	
				3,297	
Fat					
Sample	ul	m gls (g)	m sampel (g)	final m (g)	Lemak (%)
Banana Flour	1	102,463	2,005	102,475	0,599
	2	98,688	2,007	98,699	0,548
					0,573
Air					
Sample	ul	m btl (g)	m sampel (g)	final m (g)	Air (%)
Banana Flour	1	42,163	1,005	43,061	10,647
	2	29,846	1,008	30,744	10,913
					10,780
Abu					
Sample	ul	m cwn (g)	m sampel (g)	final m (g)	Abu (%)
Banana Flour	1	108,469	1,005	108,492	2,289
	2	104,366	1,008	104,391	2,480
					2,384
Carbohydrate					
Sample	ul	Karbohidrat (%)			
Banana Flour	1	83,149			
	2	82,782			
		82,966			

Based on the results of the proximate test, candi banana has a carbohydrate content of 82.966%; ash of 2.384%; water 10.780%; fat 0.573%; and protein 3.297%. Meanwhile, the banana flour has a bright white color with a value of : L* = 91,935. According to Astawan (2005) and Bappenas (2000) bananas (Musa paradisiaca) can be classified into 4 groups: (1) Musa paradisiacal var. sapientum (banana), which are bananas that can be eaten immediately after ripening or table fruit bananas, for example, Pisang susu, hijau, mas, raja, ambon kuning, ambon, barangan, etc.; (2) Musa paradisiacal forma typical (plantain) which is a banana that can be eaten after being processed first, for example, Pisang tank, Uli, bangkahulu, tapas; (3) Bananas that can be eaten after ripening or processing, for example, Banana kepok and raja and; (4) Musa brachycarpa is a type of banana with seeds that can be eaten while still raw, such as banana batu or also called banana klutuk or banana seeds. Each of these banana groups has different functions and characteristics. All types of bananas can be made into flour from both banana and plantain. The better type of banana to make flour is from the plantain type. Plantain bananas have higher starch content and lower sugar content than banana (Palupi, 2012). Temple banana is a type of plantain.

Banana has many useful secondary metabolite compounds. The fruit is known to contain saponins, glycosides, tannins, alkaloids, and flavonoids (Ajani et al, 2010). Besides being rich in secondary metabolites, banana fruit is also rich in potassium content which is good for hypertension (Fatmawati et al, 2017). Those who have positive hypertension experience a decrease in blood pressure after consuming bananas for five days because bananas have activity

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as an Angiotensin Converting Enzyme (ACE)-Inhibitor in the body so that it can inhibit the formation of angiotensin and reduce blood pressure (Sutrya and Insani, 2017). The average blood pressure reduction ranged from 11.70 mmHg for systolic and 3.45 mmHg for diastolic (Dayanand et al, 2015). In addition, other studies also provide the same results where the administration of 3 bananas every day for a week can reduce systolic blood pressure by 9.54 mmHg and 9.091 mmHg for diastolic (Tangkilisan et al, 2013).

CONCLUSION

Research has shown that banana fruits can have a long shelf life if dried and extracted into flour. Flour not only has properties as a functional food but can also be utilized as a raw material for the food industry.

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