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The Effect of Beans and Baking on Banana Bar Qualities

[Pengaruh Kacang-kacangan dan Proses Pemanggangan terhadap Mutu Banana Bar]

Riyanti Ekafitri[1)]*, Dewi Desnilasari[2)], Rhestu Isworo[3)], Dian Rachmawanti Afandi[2)], and Rohmah Luthfiyanti[4)]

[1)] Research Center for Appropriate Technology, National Research and Innovation Agency, Subang, Indonesia
[2)] Research Center for Applied Microbiology, National Research and Innovation Agency, Cibinong, Indonesia
[3)] Faculty of Agriculture, Universitas Sebelas Maret, Surakarta, Indonesia
[4)] Research Center for Agroindustry, Serpong, Indonesia

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ABSTRACT

Beans are good protein sources for producing banana bars for emergency foods. According to the previous reports, the baking temperatures and times affect the quality of the banana bar. This study aims to evaluate the effect of bean flour types (soybean, mung, and winged bean) as well as the baking temperatures and times on the banana bars chemical characteristics, organoleptic, and microbiological quality. The above three bean flour types were used, and three baking methods were also compared. The baking processes were (1) 40 min at 120°C followed by 10 min at 100°C, (2) 40 min at 125°C and (3) 40 min at 105°C followed by 10 min at 120°C. Additionally, the proximate, total energy, organoleptic, and total bacterial counts were evaluated. The results showed that all banana bars can be classified as high-energy foods based on protein, fat, carbohydrate, and total energy. The organoleptic properties using different baking methods were not significantly different, and the highest score was found in the banana bar added with mung bean flour. In addition, the total bacterial count all products did not exceed the standard.

Keywords: banana bar, beans, emergency food

ABSTRAK

Banana bar adalah salah satu bentuk pangan darurat yang mengandung tepung kacang-kacangan. Kacang-kacangan merupakan sumber protein yang baik untuk produk banana bar. Selain itu, suhu dan waktu pemanggangan memengaruhi kualitas banana bar. Penelitian ini bertujuan untuk mengetahui pengaruh jenis tepung kacang-kacangan (kedelai, kacang hijau, dan kecipir) dan proses pemanggangan (suhu dan lama pemanggangan terhadap kualitas makro-nutrien, organoleptik, dan mikrobiologis banana bar. Tiga jenis tepung kacang yang digunakan dalam penelitian ini adalah tepung kedelai, kacang hijau, dan kecipir. Tiga metode pemanggangan yang dibandingkan antara lain: pemanggangan pertama pada suhu 120°C selama 40 menit dilanjutkan pemanggangan kedua suhu 100°C selama 10 menit; kedua adalah pemanggangan pada suhu 125°C selama 40 menit; ketiga adalah pemanggangan pertama pada suhu 105°C selama 40 menit dilanjutkan pada pemanggangan kedua pada suhu 120°C selama 10 menit. Kandungan proksimat, total energi, organoleptik, dan total bakteri pada produk dianalisis semua banana bar tergolong produk makanan berenergi tinggi berdasarkan kandungan protein, lemak, karbohidrat, dan total energi. Skor organoleptik menunjukkan bahwa seluruh banana bar yang dihasilkan dari metode yang berbeda memiliki nilai yang tidak berbeda signifikan.Tetapi skor organoleptik tertinggi adalah banana bar dengan penambahan tepung kacang hijau. Tidak terdapat perbedaan yang signifikan pada total bakteri.

Kata kunci: *banana bar, kacang-kacangan, pangan darurat*

INTRODUCTION

Indonesia is one of the countries with a high potential for natural disasters due to the demographic, geological, and geographical conditions (Fahlevi *et al.,* 2019). The general population frequently face disasters such as earthquake, landslides, forest fires, floods, and volcano eruptions. In 2018, Indonesia had several earthquakes and tsunamis in Lombok, as well as mountain eruptions in 2019 at Banten (Wekke *et al.,* 2019; International

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*Corresponding Author: E-mail: riyantisyahryan@gmail.com

Federation of Red Cross and Red Crescent Societies, 2019). These conditions make it difficult for the community to fulfill their daily needs, especially for food.

Consequently, there is a need to provide more adequate ready-to-eat food, according to Hermayanti *et al.* (2016), emergency food product (EFP) is designed to fulfill daily energy needs in emergencies and for direct consumption. Emergency conditions include flood, avalanche, earthquake, starvation, fire, and war. EFP is designed to have 2,100 calories containing 35-45% fat, 10-15% protein, and 40-50% carbohydrate (Institute of Medicine, 2002). Moreover, materials of emergency food must be from local ingredients to raise the potential of local products (Aini *et al.,* 2018).

One of the emergency food developed in Indonesia is food bar which is a dry product with low a_w and long selflife. It has a bar shape that is easy, efficient to pack (Ekafitri and Isworo, 2014), and are considered ready-to-eat (Lucas *et al.,* 2019). These foods attract consumers due to their versatility and high sensorial quality (dos Prazeres *et al.,* 2017; Ramírez-jiménez *et al.,* 2018). Several studies have reported high-protein diet bars made from grain added with some functional ingredient (Lucas *et al.,* 2019; Veggi *et al.,* 2018). However, food bars can be prepared using local commodities such as bananas which is an edible fruit that has become the fifth most important commodity globally with increased production in Indonesia (Anyasi *et al.,* 2013). Musita (2012) explained that banana is a nutritious food, while Eriyana *et al.* (2017) added that each variety has a different nutrition value. Banana pulp is a rich source of essential phytonutrients, including phenolics and vitamins such as B3, B6, B12, C, and E, as well as carotenoids, flavonoids, amines, and dietary fiber (DF) (Khoozani *et al.,* 2019). The macronutrients in 100 g banana are 75 g water, 1.2 g protein, 0.20 g fat, 23 g carbohydrate, and 0.6 other substances.

The banana bar has been developed specifically in terms of forms and processing (Ekafitri *et al.,* 2013). The formulation as emergency food must fulfill the 10-15% protein content requirement (Institute of Medicine, 2002). Meanwhile, beans are one of the food materials that are a good source of protein. Nutritionally, they are recognized as a good source of proteins, amounting to 2-3 times that of cereal grains (Siddiq *et al.,* 2010). Soybean, as well as mung and winged beans, have a protein content of 37.58, 23.25, and 41.57% w/w respectively, making them a potential source in food bar development (Ekafitri and Isworo, 2014).

The production of food bars is almost the same as the process of making biscuits, the stability of temperature and baking time significantly affect the cooked food bar. According to Rahman *et al.* (2011), baking at temperatures of 100°C for 40 and 120°C for 20 min produced a hard texture, namely the surface of the product was dry, but the middle part was not well cooked. Therefore, the alternative treatment of temperature and the best baking period is needed to produce better food bars for desired organoleptic criteria.

This study was carried out to examine the effect of beans flour in the form of soybean, mung bean, and winged bean, as well as baking methods comprising temperature and time on the quality of the banana bar. The products were compared based on the protein content, organoleptic, and bacterial total count.

MATERIALS AND METHODS

Materials

The banana bar was formulated with the following ingredients: soybean flour, mung bean flour, winged bean, banana from nangka varieties, sweet potato flour, sugar, and kitchen salt (Kapal, Indonesia). All other chemical reagents used in the analysis were analytical grade.

Banana bar preparation

The ingredients used for making banana bars include soybean, mung, and winged bean flour, as well as purple sweet potato flour, banana cultivar Nangka, margarine, sugar, and salt according to Ekafitri and Isworo (2014) as shown in Table 1. The formulas of banana bars referred to the emergency food standards. The proximate contents of the raw materials were initially analyzed, then the data were used to determine the amount of material needed to make food bars. Additionally, the total energy of the product was calculated using the principle of mass balance with the microsoft excel program. The mass of each material that enters (input) must be equivalent to the amount lost during the process. The basis for calculating product energy per day is 2100 kcal with a target in each product containing 10-15% protein, 35-45% fat, and 40-50% carbohydrates. Banana bars were made in several steps as shown in Figure 1.

All ingredients were weighed and mixed for 20 min with a mixer (Phillips, HARI-1538, Indonesia), then the cultivar Nangka puree was added to the mixture, together with the bean and purple sweet potato flour. The mixture was remixed until the dough was formed. Subsequently, it was flattened and cut into small pieces (10x3x1 cm) which were baked in an oven (Getra, RFL-36, Indonesia) at the specified temperature and period according to the treatment (Table 2).

Chemical, microbiological, and organoleptic analysis of banana bar

The chemical analysis referred to the National Standardization Agency of Indonesia (BSN, 1992), which includes proximate contents comprising moisture, fat, protein, and ash; as well as the total energy. Meanwhile, the microbiological analyses performed were Total Plate Count and Yeast Mold Count (BSN, 1992). Carbohydrate content was calculated using the 'difference' method. The organoleptic assessment was performed by a 7-point hedonic scale in which the samples were given to 30 panelists to be assessed in particular scores within the range of the favorite levels, comprising strongly dislike 1= dislike very much, 2= dislike, 3= dislike slightly, 4= neither like nor dislike, 5= like slightly, 6= like, 7= like very much. The parameters assessed were five quality criteria of color, aroma, taste, sweetness, and overall acceptability.

Statistical analysis

This study was performed in a triplicate of treatment, with a completely randomized design (CRD) used to evaluate the effect of varying bean flour and baking process on the characteristics of banana bar products (Table 2). Variance analysis of each treatment was carried out on a statistical package, SPSS. The significant difference among mean values was analyzed using the one-way analysis of variance (ANOVA) followed by Duncan's test at a significance level of (p<0.05).

RESULTS AND DISCUSSION

The proximate content of the banana bar

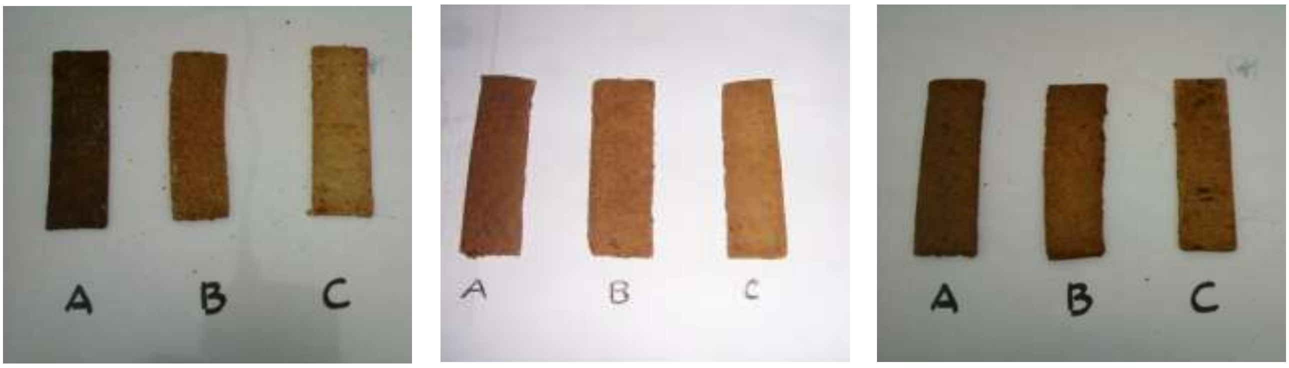
As shown in Figure 1, the type of beans significantly affected the water content of the products as demonstrated by p<0.05 (Table 3-5). Banana bar with soybean, mung, and winged bean flour was significantly different in the moisture content in the range of 3.48-8.57%. This difference is presumably caused by variations in the water content of the dough due to the different formulations used (Ekafitri and Isworo, 2014). The result is lower than the moisture content of the banana bar reported by Megala and Hymavathi (2011).

Table 1. Formulation of banana bar

Ingredient (%w/w)	Banana Bars Soybean	Banana Bars Mung bean	Banana Bars Winged bean
Beans flour	27.50	41.63	25.13
Nangka banana flour	11.00	10.38	11.25
Purple sweet potato flour	0.75	0.75	0.75
Puree Nangka Banana)	28.28	26.50	28.50
Sugar	17.93	3.00	19.63
Margarine	14.29	17.50	14.50
Salt	0.25	0.25	0.25

Table 2. Variation of type of bean flour and baking process of banana bar product

Food Bars	Combination Temperature and Baking		
	120°C for 40 min followed by 100°C for 10 min (A)	125°C for 40 min (B)	105°C for 40 min followed by 120°C for 10 min (C)
Soybean (a)	Aa	Ba	Ca
Mung bean (b)	Ab	Bb	Cb
Winged bean (c)	Ac	Bc	Cc



A B C

Figure 1. Banana bar with addition of soybean flour (A), mungbean flour (B), wingbean flour (C)

The type of beans also significantly affected the ash content with $p<0.05$ in the range of 1.71-3.50% (Table 3). The banana bar with soybean flour and mung beans were significantly different from those made using winged bean. This difference is probably caused by the varying ash content used and the amount of bean flour added. Soybean flour, mung, and winged bean have ash contents of 4.43; 3.02; and 3.36% respectively (Ekafitri and Isworo, 2014). These values are higher than the snack bar developed from spirulina which had values ranging from 1.24-2.00 (Lucas *et al.,* 2019).

The addition of bean flour to the banana bar did not significantly affect protein content ($p>0.05$), even with different protein levels. This is because, in the production of banana bars as emergency food, the formulation must be at equilibrium to get a protein-calorie contribution of 10-15% per total energy needed or 2,100 kcal. The protein content ranged from 10.22-11.74% of the total calories and fulfills the requirements mentioned by the Institute of Medicine (2002). The banana bar had a protein content of 14.22-17.11% which is higher than the snack bar made from rice with 5.73-7.60% (Jauhariah and Ayustaningrum, 2013).

The type of beans significantly affected the fat and carbohydrate content with $p<0.05$. Ekafitri and Isworo (2014) reported that the fat and carbohydrate content of soybean flour, mung, and winged bean respectively were 17.20 and 32.24%; 2.61 and 62.11%; as well as 18.73 and 29.72%. The fat content in this study can only fulfill 36.87-45.45% of the total calories need. For the carbohydrate content, it fulfills 49.00-57.65% of calories, which suits the requirement of emergency food (Institute of Medicine, 2002). The value obtained namely 40.45-54.69% was lower than the carbohydrate content of the banana bar reported by Megala and Hymavathi (2018) which amounted to 78.6-80.3%. However, it has a higher fat content of 22.35-31.88% than the spirulina snack bar (Lucas *et al.,* 2019).

The baking process at 120°C for 40 min followed by 100°C for 10 min (treatment A) produced a significantly different banana bar moisture content than those baked at 125°C for 40 min (treatment B) and 105°C for 40 min followed by 120°C for 10 min (treatment C) with $p<0.05$.

Table 3. The moisture and the ash content of a banana bar

Banana Bar	Moisture Content (% Wet Base)			Ash (% Dry Base)		
	A	B	C	A	B	C
Soybean	$5.65±0.89^{Bb}$	$6.44±0.80^{Ab}$	$4.80±0.94^{Ab}$	$3.11±0.08^{Bb}$	$3.10±0.04^{Ab}$	$3.26±0.02^{Bb}$
Mungbean	$5.01±1.1^{Ba}$	$4.40±0.32^{Aa}$	$3.48±0.59^{Aa}$	$3.33±0.09^{Bb}$	$3.16±0.28^{Ab}$	$3.50±0.03^{Bb}$
Winged bean	$8.57±0.91^{Bc}$	$5.35±0.58^{Ac}$	$6.62±1.01^{Ac}$	$2.75±0.04^{Ba}$	$1.71±0.86^{Aa}$	$2.33±0.09^{Ba}$

Note: The capital letter was read horizontally, and the noncapital letter was read vertically. The different letters after number showed significant difference with $P<0.05$. (A) baking process at 120°C for 40 min followed by 100°C for 10 min, (B) baking process at 125°C for 40 min, and (C) baking processed at 105°C for 40 min followed by 120°C for 10 min

Table 4. The protein and fat content of banana bar

Banana Bar	Protein (% Dry Base)			Fat (% Dry Base)		
	A	B	C	A	B	C
Soybean	$17.11±0.47^{Aa}$	$15.06±1.31^{Aa}$	$15.57±0.71^{Aa}$	$24.88±0.21^{Aa}$	$24.32±0.18^{Ba}$	$24.20±0.27^{Ba}$
Mungbean	$14.61±0.09^{Aa}$	$15.16±0.35^{Aa}$	$14.81±0.17^{Aa}$	$22.35±0.33^{Ab}$	$23.63±0.49^{Bb}$	$23.85±0.07^{Bb}$
Winged bean	$16.34±0.31^{Aa}$	$13.99±0.46^{Aa}$	$14.22±0.12^{Aa}$	$31.88±0.78^{Ac}$	$27.32±0.24^{Bc}$	$27.26±0.26^{Bc}$

Note: The capital letter was read horizontally, and the non capital letter was read vertically. The different letter after number shows significant difference with $p<0.05$. (A) baking process at 120°C for 40 min followed by 100ºC for 10 min, (B) baking process at 125°C for 40 min, and (C) Baking process at 105°C for 40 min followed by 120°C for 10 min

Table 5. The carbohydrate content of banana bar

Banana Bar	Carbohydrate (% Dry Base)		
	A	B	C
Soybean	$49.25±1.15^{Ab}$	$51.07±1.85^{Ab}$	$52.17±0.68^{Ab}$
Mungbean	$54.69±0.77^{Ab}$	$53.65±0.36^{Ab}$	$54.36±0.58^{Ab}$
Winged bean	$40.45±0.18^{Aa}$	$51.63±1.42^{Aa}$	$49.57±0.67^{Aa}$

Note: The capital letter was read horizontally, and the noncapital letter was read vertically. The different letter after number shows significant difference with $p<0.05$. (A) baking process at 120°C for 40 min followed by 100°C for 10 min, (B) baking process at 125°C for 40 min, and (C) Baking processed at 105°C for 40 min followed by 120°C for 10 min

The moisture content ranged from 3.48 to 8.57% and the difference was due to variations in the amount of water that evaporated during the baking process. Water will migrate from the center of the product to the surface and then evaporate quickly (Hazelton *et al.,* 2003). The moisture content of the dough initially ranged from 11-30% but it decreased to 1-5% after baking. Banana bar moisture content in this study is still within the standard range according to BSN (2011), which is above 5%.

The baking process also has a significant effect on the ash content of banana bars with p<0.05%. The ash content in the product processed at 120°C for 40 min and then 100°C for 10 min was significantly different from those processed at 125°C for 40 min. However, no significant difference was found at 105°C for 40 min followed by 120°C for 10 min. According to Hazelton *et al.* (2003), during the baking process, the changes often observed including dimensions, texture, loss of moisture content, color, and flavor, do not significantly influence the ash content which describes the product's mineral content. The difference in ash content was due to the instability of the micronutrients/minerals of the product. Akhtar *et al.* (2010) stated that the baking process led to the formation of insoluble forms of specific minerals which caused the content to disappear in the final products.

The protein and carbohydrate content was not affected by the temperature and baking period with p>0.05. According to Al-Dmoor and El-Qudah (2016), during the baking process, the protein will be denatured and joined with starch followed by gelatinization to form the product's structure. It is suspected that a number of the same proteins undergo denaturation during the baking process, contributing to the formation of the structure, as well as the color of the product. The carbohydrate and protein content were not significantly different. This is presumably caused by the amount of bean flour added according to the mass balance calculation to reach a contribution of 40-50% and 10-15% of the total energy (2100 kcal). This data is according to emergency food standards for carbohydrates and protein, respectively (Institute of Medicine, 2002).

Furthermore, the baking process significantly affected the fat levels as demonstrated by p<0.05%. The fat content produced at 120°C for 40 min followed by 100°C for 10 min was significantly different from those produced at 125°C for 40 minutes, as well as at 105°C for 40 min followed by 120°C for 10 min. In banana bars, fat is sourced from the bean flour used and margarine. The fat content ranged from 22.35-31.88%, this is higher than that of biscuits added with mung bean flour which amounted to 17.94-19.15% (Setyaningsih *et al.,* 2019).

The total energy of the banana bar

The total energy is the number of calories available from food and the complete protein, fat, and carbohydrate present in a product. The type of bean flour as well as the temperature and baking time affected the total calories of banana bars produced as shown in Figure 2. The total calorie in all treatments which ranged from 410.21-473.20 kcal is higher than that of snack bar from rice at 367.89-383.06 kcal (Jauhariah and Ayustaningrum, 2013) and banana snack bar made by Megala and Hymavathi (2011), which amounted to 335.4-340 kcal. Therefore, banana bars produced in this study were classified as high-energy foods (Yang *et al.,* 2018).

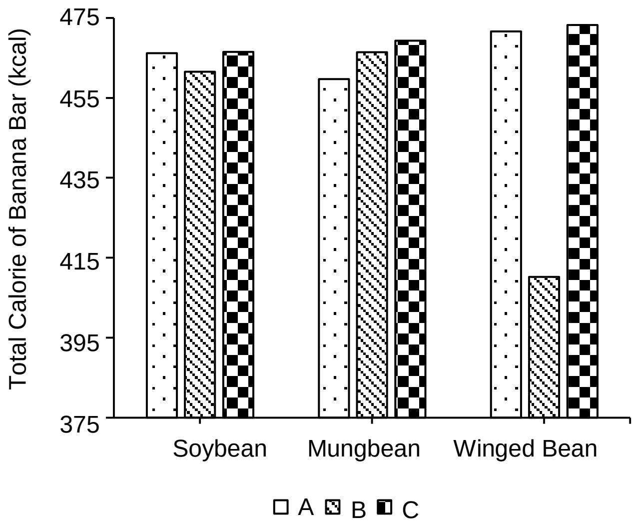


Figure 2. Calorie of banana bar

According to Table 4, the banana bar made with soybean and winged bean flour has the highest protein content and fulfills emergency food requirements. It was processed at 120°C for 40 min, and then 100°C for 10 min with protein contents of 17.11 and 16.34%. These values are higher than those obtained by Ekafitri and Isworo (2014), namely 13.08 and 13.16%. This product also had the highest fat value and is closest to the emergency food standards, hence, it was further subjected to organoleptic and microbiological tests.

Organoleptic analysis of the product

Table 6 shows the score of panelists acceptance for the banana bars, in the color parameters, the products made using winged beans had the best score of 5.17, which is in the like slightly category. The color namely bright brown was obtained from the Maillard reaction between reducing sugars with amino acids and caramelization during heating in the baking process (Pathare *et al.,* 2013). Regarding aroma, the products made with soybean flour, mung, and winged beans, had a score ranging from 4.26-4.77 in the neither like nor dislike to like slightly category. This result showed that legume flour does not produce an unpleasant odor. According to Aziah *et al.* (2012), the unpleasant aroma of bean flour can be reduced by heating treatments such as baking. In the crispness parameter, the banana bar added with mung bean flour had the highest score of 5.10, which implies it is like slightly. This is because mung beans contain high starch which gives a good product texture. According to Dahiya *et al.* (2015), the starch content of mung beans was 47% with 24% amylose. During the baking process, amylose is released and undergoes rapid retrogradation, then after cooling, it produces a porous structure which culminates in high crispiness (Nakamura *et al., 2*010). Furthermore, food bars with soybean and winged bean flour had a better acceptance score of 4.43 and 4.13 compared to those added with mung bean flour. Overall, the banana bar with soybean and winged bean flour is most preferred with a score of 4.47 and 4.10 respectively, but is not significantly different from those made using mung bean flour. According to Aziah *et al.* (2012), cookies with soybean flour have a higher overall sensory acceptance than others made from wheat flour.

Microbiological analysis of the product

Microbiological analysis of the banana bars was conducted to determine the level of safety and suitability for consumption. The total plate count (TPC) and Total Mold Yeast were used (BSN, 1992), and the analysis results are shown in Table 7. The total plate count (TPC) of soybean banana bars was $3x10^1$ CFU/g, mung bean $7x10^1$ CFU/g, and winged bean $3.3x10^3$ CFU/g. According to BSN (2011), the maximum number of TPC in biscuits is $1x10^6$ CFU/g. The total yeast mold count also showed similar results, based on Table 7, no mold or yeast grew in all food bars indicating that the products are safe from fungal microorganisms. Therefore, the three banana bars are safe for consumption because they have a microbial content that is within the specified limit.

CONCLUSIONS

Based on the results, all banana bars can be classified as high-energy foods, the highest organoleptic score was found in the product added with mung bean flour. Furthermore, the organoleptic properties produced using different baking methods were not significantly different, and there was no significant difference in the total bacterial count.

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REFERENCES

Aini N, Prihananto V, Wijonarko G, Sustriawan B, Dinayati M, Aprianti F. 2018. Formulation and characterization of emergency food based on instan corn flour supplemented by instan tempeh (or soybean) flour. Int Food Res J 25: 287–292.

Akhtar S, Anjum FM, Salim-Ur-Rehman, Sheikh MA. 2010. Effect of storage and baking on mineral contents of fortified whole wheat flour. J Food Process Preserv 34: 335-349. https://doi.org/10.1111/j.1745-4549.2009.00405.x

Al-Dmoor HM, El-Qudah JM. 2016. Cake flour chlorination and alternative treatments (Review). Curr Res Nutr Food Sci J 4: 127–134. https://doi.org/10.12944/CRNFSJ.4.2.06

Anyasi TA, Jideani AIO, Mchau GRA. 2013. Functional properties and postharvest utilization of commercial and noncommercial banana cultivars. Compr Rev Food Sci Food Saf 12: 509–522. https://doi.org/10.1111/1541-4337.12025

Table 6. Organoleptic results of banana bar

Banana Bar	Color*	Aroma*	Crispiness*	Taste*	Overall*
Soybean	$4.17±1.53^a$	$4.57±1.22^a$	$3.40±1.67^a$	$4.13±1.46^a$	$4.47±1.53^a$
Mung bean	$4.23±1.57^a$	$4.77±1.30^a$	$5.10±1.37^b$	$3.10±1.27^b$	$3.83±1.26^a$
Winged bean	$5.17±1.12^b$	$4.26±1.34^a$	$3.93±1.53^a$	$4.43±1.50^a$	$4.10±1.47^a$

Table 7. TPC and total mold yeast of banana bar

Parameter	Banana Bar Soybean	Banana Bar Mungbean	Banana Bar Winged bean
Total *plate count* (TPC) (CFU/g)	$3x10^1±2.83$	$7x10^1±1.41$	$3.3x10^3±70.71$
Total mold yeast (colony)	negatif	negatif	negatif

Aziah NAA, Noor MAY, Ho L-H. 2012. Physico-chemical and organoleptic properties of cookies incorporated with legume flour. Int Food Res J 19: 1539-1543.

[BSN] Badan Standardisasi Nasional. 2011. SNI 2973:2011 (Biskuit). Badan Standardisasi Nasional, Jakarta.

[BSN] Badan Standardisasi Nasional. 1992. SNI 01-2891-1992. Cara uji makanan dan minuman. Badan Standardisasi Nasional, Jakarta.

Dahiya PK, Linnemann AR, Van Boekel MAJS, Khetarpaul N, Grewal RB, Nout MJR. 2015. Mung bean : Technological and nutritional potential. Crit Rev Food Sci Nutr 55: 670-688. https://doi.org/10.1080/10408398.2012.671202

dos Prazeres IC, Domingues AFN, Campos APR, Carvalho AV. 2017. Elaboration and characterization of snack bars made with ingredients from the Amazon. Acta Amaz 47: 103-110. http://doi.org/10.1590/1809-4392201602203

Ekafitri R, Isworo R. 2014. Pemanfaatan kacang-kacangan sebagai bahan baku sumber protein untuk pangan darurat. Pangan 23: 134-144.

Ekafitri R, Sarifudin A, Surahman DN. 2013. Pengaruh penggunaan tepung dan puree pisang terhadap karakteristik mutu makanan padat berbasis-pisang. Penelitian Gizi Makanan 36: 127-134.

Eriyana E, Syam H, Jamaluddin. 2017. Mutu dodol pisang berdasarkan substitusi berbagai jenis pisang (*Musa paradisiaca*). J Pendidikan Teknol Pertanian 3: 34–41. https://doi.org/10.26858/jptp.v3i1.5195

Fahlevi H, Indriani M, Oktari RS. 2019. Is the Indonesian disaster response budget correlated with disaster risk? Jàmbá-J Disaster Risk Stud 11: 1-9. https://doi.org/10.4102/jamba.v11i1.759

Hazelton JL, DesRochers JL, Walker CE. 2003. Chemistry of Biscuit Making In: Caballero B, editor. The Encyclopedia of Food Sciences and Nutrition. 533–539. Elsevier Science Ltd, Manhattan USA. https://doi.org/10.1016/B0-12-227055-X/00105-X

Hermayanti ME, Rahmah NL, Wijana S. 2016. Formulasi biskuit sebagai produk alternatif pangan darurat. J Teknol Manajemen Agroind 5: 107-113. https://doi.org/10.21776/ub.industria.2016.005.02.7

Institute of Medicine. 2002. High-Energy, Nutrient-Dense Emergency Relief Food Product, High-Energy, Nutrient-Dense Emergency Relief Food Product. Washington DC: National Academy of Sciences. https://doi.org/10.17226/10347

International Federation of Red Cross and Red Crescent Societies. 2019. Emergency Plan of Action 6-month Update Indonesia: Earthquakes and Tsunamis-Sunda Straits Tsunami. Indonesia.

Jauhariah D, Ayustaningrum F. 2013. Snack bar rendah fosfor dan protein berbasis produk olahan beras. J Nutr Coll 2: 250-261. https://doi.org/10.14710/jnc.v2i2.2750

Khoozani AA, Bekhit AEDA, Birch J. 2019. Effects of different drying conditions on the starch content, thermal properties and some of the physicochemical parameters of whole green banana flour. Int J Biol Macromol 130: 938-946. https://doi.org/10.1016/j.ijbiomac.2019.03.010

Lucas BF, da Rosa APC, de Carvalho LF, de Morais MG, Santos TD, Costa JAV. 2020. Snack bars enriched with *Spirulina* for schoolchildren nutrition. Food Sci Technol Campinas 40: 146-152. https://doi.org/10.15 90/fst.06719

Megala P, Hymavathi T. 2011. Inulin and fructo-oligosaccharides incorporated functional fruit bars. World Acad Sci Eng Technol 59: 393-398. https://doi.org/10.1007/s10971-010-2267-9

Musita N. 2012. Kajian kandungan dan karakteristiknya pati resisten dari berbagai varietas pisang. J Dinamika Penelitian Industri 23: 57-65.

Nakamura K, Taniguchi Y, Taira M, Ito H. 2010. Prediction of specific japanese sponge cake volume using pasting properties of flour. Cereal Chem 87: 505–510. https://doi.org/10.1094/CCHEM-05-10-0080

Pathare PB, Opara UL, Al-Said FA-J. 2013. Colour measurement and analysis in fresh and processed foods-a review. Food Bioproc Tech 6: 36–60. https://doi.org/10.1007/s11947-0120867-9

Rahman T, Luthfiyanti R, Ekafitri R. 2011. Opti-masi Proses Pembuatan Food Bar Berbasis Pisang. Prosiding Seminar Nasional Penelitian dan Pengabdian pada Masyarakat (Prosiding SNaPP 2011) Sains, Teknologi, dan Kesehatan 2: 295-302, Universitas Islam Bandung, Bandung

Ramírez-jiménez AK, Gaytán-martínez M, Mo-rales-sánchez E, Loarca-Piñaa G. 2018. Functional properties and sensory value of snack bars added with common bean flour as a source of bioactive compounds. LWT-Food Sci Technol 89: 674-680. https://doi.org/10.1016/j.lwt.2017.11.043

Setyaningsih DN, Fathonah S, Putri RDA, Auda AK, Solekah N. 2019. The influence of baking duration on the sensory quality and the nutrient content of mung bean biscuits. Food Res 3: 777-782. https://doi.org/10.26656/fr.2017.3(6).089

Siddiq M, Ravi R, Harte JB, Dolan KD. 2010. Physical and functional characteristics of selected dry bean (*Phaseolus vulgaris* L.) flours. LWT-Food Sci Technol 43: 232-237. https://doi.org/10.1016/j.lwt.2009.07.009

Veggi N, Voltarelli FA, Pereira JMN, Silva WC, Navalta JW, Cavenaghi DFL de C, de Barros WM. 2018. Quality of high-protein diet bar plus chia (*Salvia hispanica* L.) grain evaluated sensorially by untrained tasters. Food Sci Technol 38: 306-312. https://doi.org/10.1590/fst.22317

Wekke IS, Sabara Z, Samad MA, Yani A, Abbas T, Umam R. 2019. Earthquake, Tsunami, and Society Cooperation: Early Findings in Palu Post of Indonesia Disaster. Int Conf Challenges Oppor Sustain Environ Dev (ICCOSED) 1-11. Universitas Prof. Dr. Moestopo (Beragama), Jakrata, Indonesia, 11-13 January 2019. https://doi.org/10.31227/osf.io/xmcyn

Yang YX, Wang XL, Leong PM, Zhang HM, Yang XG, Kong LZ, Zhai FY, Cheng YY, Guo JS, Su YX. 2018. New Chinese dietary guidelines: Healthy eating patterns and food-based dietary recommendations. Asia Pac J Clin Nutr 27: 908-913. https://doi.org/10.6133/apjcn.072018.03