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Sensory and Chemical Characteristics of Bar Cookies Made from Mung Bean Flour and Ripe Plantain var Raja as Emergency Food

Nurhayati[1,2]*, Maryanto[1] and Larasati Gandaningarum[1]

[1]Department of Agricultural Product Technology, Faculty of Agricultural Technology, University of Jember, East-Java, 68121, Indonesia
[2]Center for Development of Advanced Science and Technology, University of Jember, Jember, East-Java, 68121, Indonesia

ABSTRACT

Bar cookies are generally consumed as snacks. This product is considered as emergency food that is easy to consume, provides sufficient calories and adequate nutrients. This study evaluates the quality of bar cookies based on their sensory and chemical characteristics. The cookies made from mung bean flour and ripe plantain var. Raja. There were four ratios of formulation i.e. 10 % mung bean flour with 90 % ripe plantain puree (P1), 20 % mung bean flour with 80 ripe plantain puree (P2), 30% mung bean flour with 70 % ripe plantain puree (P3) and 40 % mung bean flour with 60 % ripe plantain puree (P4). The cookie bars were evaluated based on their sensory attributes by using preference test. Chemical characteristics were based on the proximate analysis (water, ash, protein, lipid and carbohydrate content). The preferred formula of the bar cookies was 20 % mung bean flour with 80 ripe plantain puree (P2). Sensory characteristics of the preferred bar cookies were 3.29 colour; 2.93 aroma; 3.39 flavour; 2.89 texture; and 3.29 overall with the scale dislike (1) to like (5). Chemical characteristics of preferred bar cookies (P2) were 36.53 % water, 2.60 % db ash, 10.86 % db fat, 11.69 % db protein, 36.06 % db carbohydrate. The proximate composition for formulation of the bar cookies is significant.

Keywords: Bar cookies, emergency food, mung bean flour, plantain

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E-mail addresses:
nurhayati.ftp@unej.ac.id (Nurhayati)
maryanto.ftp@unej.ac.id (Maryanto)
larasatiganingarum@gmail.com (Larasati Gandaningarum)
* Corresponding author

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INTRODUCTION

Bar cookies are a food product that is commonly made from soy flour with the addition of fruits and food additives, such as syrup, caramel and chocolate (Sarifudin, Ekafitri, Surahman, & Putri, 2015). Marketable bar cookies are made from soy flour mixed dry fruits and generally consumed as snacks in the bars form (Setyaningtyas, 2008). The bar cookies do not require a high gluten flour (Marissa, 2010). Nowadays, consumers are wiser and they aim for good quality food which is also affordable, nutritious and tasty (Adriani & Bambang, 2012). Ladamay and Yuwono (2013) found bar cookies can be made using mung bean flour which are high in nutrition and taste good.

Mung beans (*Phaseolusradiatus*, L) are widely cultivated in Indonesia. Mung beans contain 62.5% carbohydrate (Kusharto, 2006), 22.2% protein (Setyaningtyas, 2008) and 1.3% fat (Rukmana, 1997). Mung beans are used as composite flour or hunkue.

Musa sp was classified into two groups: plantain and banana. Plantain belongs to a cooking banana subgroup (AAB, ABB, or BBB) while banana belongs to dessert banana subgroup. Plantains are longer, have a thicker skin, and contains more starch than bananas. Dessert banana cultivars in the world are AA or AAA, this last group includes almost all the cultivars for the export market (Aurore, Parfait, & Fahrasmane, 2009; Ploetz, Kepler, Daniells, & Nelson, 2007).

Banana and plantain are important staple foods in many developing countries, especially in Indonesia. *Musa* are rich in vitamin C, B6, minerals, and dietary fibre. They are also a rich energy source, with carbohydrates accounting for 22% and 32% of fruit weight for banana and plantain, respectively. People consume 28kg of banana and plantain per capita, or 155kg per year, or almost half kg per day (Robinson & Sauco, 2010).

Unripe plantain contains a high proportion of indigestible compounds, such as resistant starch and non-starch polysaccharides (Nurhayati, Jenie, & Kusumaningrum, 2014), included in the dietary fibre content (Juarez-Garcia, Agama-Acevedo, Sáyago-Ayerdi, Rodriguez-Ambriz, & Bello-Perez, 2006). Ripe banana chips can stimulate probiotics in the colon resulting in short chain fatty acids especially butyric acid which as anti-colon cancer properties (Nurhayati & Rahmanto, 2017). This study evaluates the sensory and chemical characteristics of bar cookies made from mung bean flour and ripe plantain var. Raja as emergency food.

MATERIALS AND METHODS

Materials

Materials for making bar cookies were mung bean flour and plantain (cooking banana) var Raja with maturity level at 5 - 6. Complementary materials were eggs, sugar, salt, margarine, skim milk and flour.

Preparation of Bar Cookies

The mung beans were soaked for 7 hours and its water replaced every 3 hours. They were later dried in the sun and crushed and sieved using an 80-mesh sieve. Sarifudin et al.'s (2015) method was used to make the bar cookies.

There were four ratios of formulation: 10 % mung bean flour with 90% ripe plantain puree (P1), 20% mung bean flour with 80 ripe plantain puree (P2), 30 % mung bean flour with 70% ripe plantain puree (P3) and 40% mung bean flour with 60% ripe plantain puree (P4). Complementary materials were eggs 10%, wheat 20%, sugar 10%, salt 0.25%, and margarine 10% and 5% skim milk. The first step is to mix eggs, margarine and sugar until the dough is consistent and creamy and after that flour, skim milk, salt and plantain puree are added to the dough. The dough is based on 100 g per treatment of flour and plantain.

Analysis of Bar Cookies Characteristic

The sensory characteristics of bar cookies were determined based on a preference test (Meilgaard, Civille, & Thomas, 1999). The chemical characteristics of bar cookies were water content (Association of Official Analytical Chemists International [AOAC], 2005), ash (AOAC, 2005), and total protein and fat content was measured using Kjehdahl and soxhlet methods respectively (AOAC, 2005). Data was analysed using Effectiveness Index (De Garmo, Sullevan, & Canana, 1984) based on the proximate and sensory values.

Statistical Analysis

Results were expressed as the mean ± standard error of three separate determinations. The statistical significance of the generated data was further analysedd by employing one-way analysis of variance (ANOVA) along with the least significant difference (LSD) test. The level of significance of the mean values was assigned at $P < 0.05$.

RESULTS AND DISCUSSION

Sensory Characteristic of Bar Cookies

The sensory characteristic of bar cookies formulation, such as colour, flavour, taste, texture and preference, were evaluated by 28 panellists.

Figure 1 shows the preferred bar cookies was based P2 formula. It had a yellow-brownish colour. The high addition of ripe plantain causes the bar cookies to have darker shade. The cooking banana (plantain) contains phenolic compounds susceptible to enzymatic browning reactions (Sarifudin et al., 2015). Stripping and cutting up of the banana can accelerate the oxidation reaction, either by oxygen and polyphenol oxidase to produce a brown colour. The brown colour on the bar cookies can also be affected by the reaction of reducing sugars with primary amine group during the baking process to form a melanoidin compound (brown colour) in cookies.

Flavour is an important determinant of quality associated with the smell sense. Meilgaard et al. (1999) described flavour in the food industry as important because it

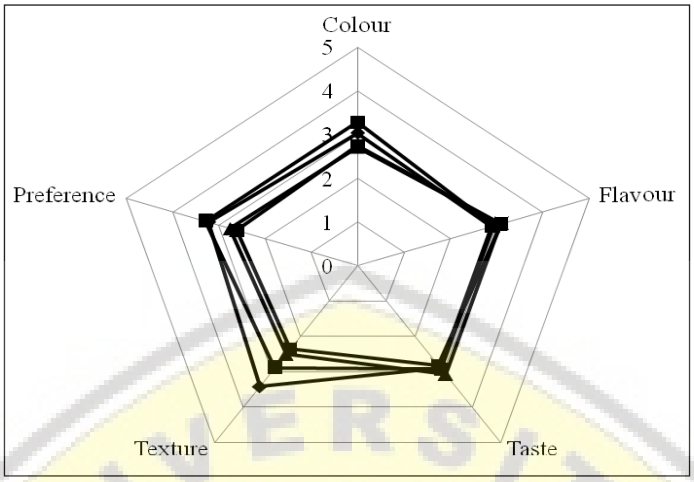

Figure 1. Sensory characteristics of *bar cookies* made from: 10% mung bean flour and 90% plantain puree (P1--■--), 20% mung bean flour and 80% plantain puree (P2--●--), 30% mung bean flour and 70% plantain puree (P3--▲--), 40% mung bean flour and 60% plantain puree (P4--×--).

could influence consumer acceptance of the product. Flavour is caused by the volatile substances.

The flavour values of bar cookies ranged between 2.89 and 3.11. The preferred flavour of bar cookies was the P4 formula (3.11) consisting of 40% mung bean flour and 60% plantain puree. The P1 formula resulted in the lowest flavour (2.89) consisting of 10% mung bean flour and 90% plantain puree. Sidabutar, Rona and Ridwansyah (2013) explained that mung beans contained essential amino acids i.e. leucine, arginine, isoleucine, valine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. The amino acids caused the Maillard reaction with the sugar component that was supported by the heating process.

The taste value of bar cookies ranged from 2.82 to 3.43. The higher taste value was P1 formula (3.43), while the lowest taste value was P4 (2.82). Ferawati (2009) explained the banana var Raja had a distinctive sweet taste as a result of the starch degradation to reduce sugars during the ripening process of bananas. According to Soltani, Alimardani and Omid (2010), the sugar content in the unripe bananas was between 1-2% and 15-29% if the fruit is ripe.

Texture is an important determinant of bar cookies quality associated with the touch sense. Tan, Kanyarat and Azhar (2012) reported that the texture determined consumer acceptance of the product. The texture value of bar cookies ranged between 2.36 and 3.43. The preferred texture of bar cookies was P1 formula (3.43) consisting of 10% mung bean flour and 90% plantain puree, while P4 formula (2.36) consisted of a 40% mung bean flour and 60% plantain puree.

Adding plantain puree softens the texture and increases its moisture content. The texture of cookies bars is influenced by the starch content, especially amylose component of mung beans. Akubor (2003) explained that the amylose content of the mung bean flour results in firmer and harder texture of cookies. Therefore, increasing the proportion of green bean flour leads to increased hardness of the texture of bar cookies.

The preference value of bar cookies ranged from 2.61 to 3.29. The most preferred value was P2 formula (3.29) consisting of 20% mung bean flour and 80% plantain puree; P4 formula resulted in the lowest value of preference. Increasing the proportion of mung bean flour decreased the preference value of bar cookies. Ripe plantain puree improves texture of cookies to become softer and sweeter while increasing the proportion of mung bean flour hardens the texture.

Chemical Characteristics of Bar Cookies

Water Content of Bar Cookies. Water content of bar cookies (Figure 2) was 40.97% for P1 db (10% mung bean flour and 90% ripe plantain puree), 36.62% db to P2 (20% mung bean flour and 80% ripe plantain puree), 34.18% db for P3 (30% mung bean flour and 70% ripe plantain puree) and 26.52% db for P4 (40% mung bean flour and 60% ripe plantain puree). Statistical analysis showed the main materials (mung bean flour and ripe plantain puree) affected the moisture content of bar cookies. Higher proportion of plantain puree can increase the water content of bar cookie.

Nio (2012) reported the water content of ripe bananas was high, about 66.0% and which could affect texture of the dough. Akubor (2003) stated that the amylose content of mung beans was about 33%, higher than wheat (28%). Amylose was easier to absorb than amylopectin which

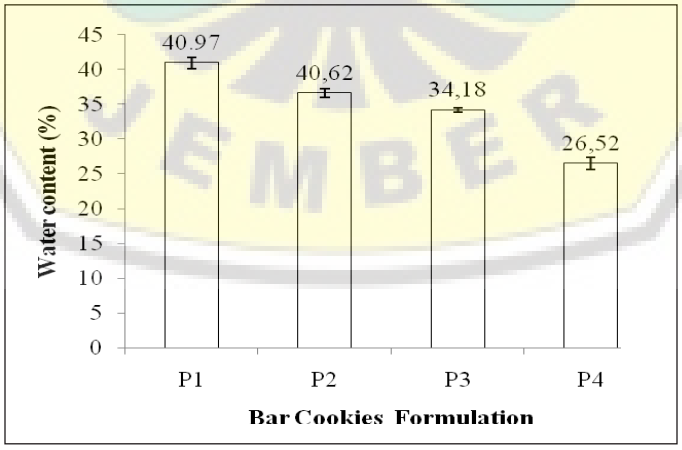

Figure 2. Water content of bar cookies made from:10% mung bean flour and 90% plantain puree (P1), 20% mung bean flour and 80% plantain puree (P2), 30% mung bean flour and 70% plantain puree(P3), 40% mung bean flour and 60% plantain puree (P4).

affects the evaporation of water during baking process. The egg addition on the dough also affects the water content of the snack bar. It causes the lecithin content of egg yolk to absorb water in the dough.

Ash Content of Bar Cookies. The ash content is the amount of inorganic compounds remaining after the combustion process l in the form of ash, while the organic material is burned into water (H_2O) and carbon dioxide (CO_2).

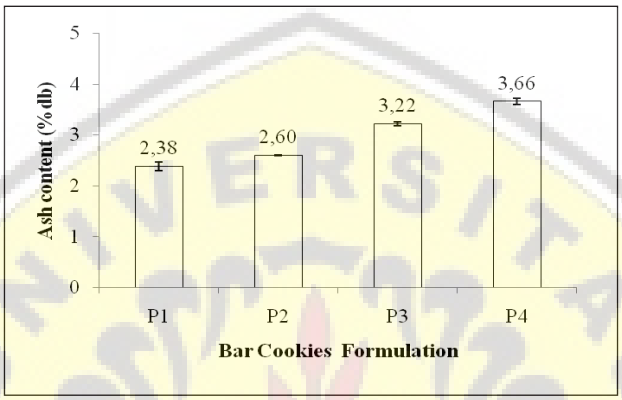

Figure 3. Ash content of *bar cookies* made from:10% mung bean flour and 90% plantain puree (P1), 20% mung bean flour and 80% plantain puree(P2), 30% mung bean flour and 70% plantain puree(P3), 40% mung bean flour and 60% plantain puree (P4).

The ash content of bar cookies (Figure 3) ranged from 2.38% -3.66% db; and 2.38% db for formula P1; 2.60% db for formula P2; 3,22% db for P3 formula; and 3.66% db for formula P4. The composition of the main materials (mung beans flour and ripe plantain puree) causes a significant difference in the ash content of the bar cookies.

The ash content can be influenced by the mineral content in mung bean flour. The higher proportion of mung bean flour leads to higher level of ash content in the bar cookies. Ratnasari, Yunianta and Maligan (2015) reported that adding of mung bean flour into biscuits increased its ash content while Soebito (1988) found the ash content of mung beans was higher (3.7%) than ripe plantain (1.0%).

Fat Content of Bar Cookies. The fat content of bar cookies (Figure 4) was 10.65% db for formula P1; 10.86% db for formula P2; 12.08% db for P3 formula; and 12.56% db for formula P4. The fat content of bar cookies was significantly different as they were made from different composition of the main flour. Kusnandar (2010) reported that mung bean flour contained 3.9% of fat content while banana puree contains 1.2% fat content.

Fat content can improve the texture of cookies. Eggs and margarine are rich in essential fatty acids and are the main ingredients in bread making to improve its physical properties and enhance the nutritional value of bread. Egg yolk contains high fat (31.9%).

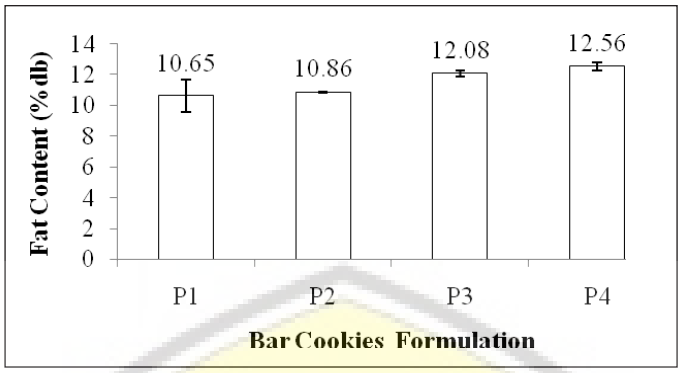

Figure 4. Fat content of bar cookies made from: 10% mung bean flour and 90% plantain puree (P1), 20% mung bean flour and 80% plantain puree(P2), 30% mung bean flour and 70% plantain puree(P3), 40% mung bean flour and 60% plantain puree (P4).

Protein Content of Bar Cookies. The protein content of bar cookies (Figure 5) ranged from 8.51% -20.64% db. The protein content of bar cookies was 8.51% db for formula P1; 1.69% db for formula P2; 14.15% db for P3 formula; and 20.64% db for formula P4. The composition of the main ingredients (mung beans flour and ripe plantain puree) affected the protein content of bar cookies. Increasing mung bean flour increased the protein content of bar cookies. Ladamay and Yuwono (2013) reported that the addition of mung bean flour could increase the protein content in barfood.

The addition of mung bean flour into food bars aims to increase the protein in solid foods that cannot be substituted with tapioca flour. Setyaningtyas (2008) explained the protein content of mung beans was 22.2% and 1.2% for ripe plantains. The mung beans are rich in essential amino acids, among others, the amino acid

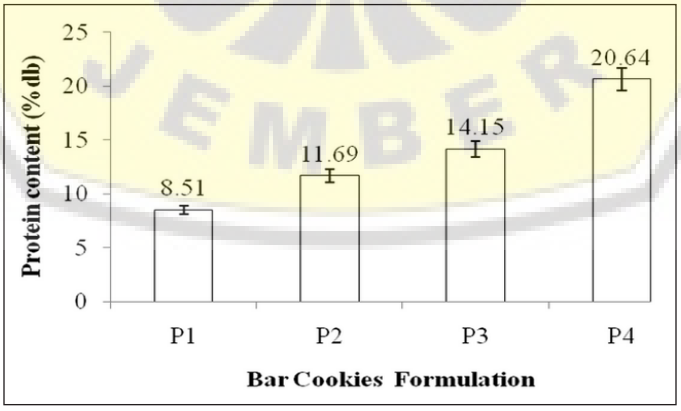

Figure 5. Protein content of bar cookies made from:10% mung bean flour and 90% plantain puree (P1), 20% mung bean flour and 80% plantain puree(P2), 30% mung bean flour and 70% plantain puree(P3), 40% mung bean flour and 60% plantain puree (P4).

leucine, arginine, isoleucine, valine, lysine, methionine, phenylalanine, threonine, tryptophan and valine.

Carbohydrate content of Bar Cookies. Carbohydrate content of bar cookies (Figure 6) ranged between 36.06% (db) and 38.11% (db). Carbohydrate content of bar cookies was 36.06% db for formula P1; 36.53% (db) for formula P2; 37.81% db for P3 formula; and 38.11% db for formula P4. Increasing the proportion of mung bean flour increased the carbohydrate content of bar cookies. Lumiar (2010) reported the carbohydrate content of mung beans was 62.5%, composed of starch, sugar and fibre. Mung bean starch consists of 28.8% amylose and 71.2% amylopectin.

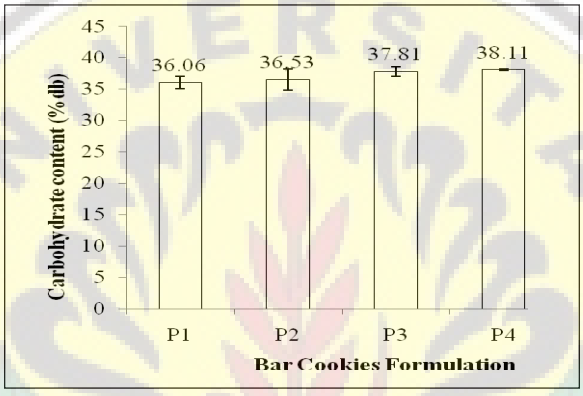

Figure 6. Carbohydrate content of *bar cookies* made from: 10% mung bean flour and 90% plantain puree (P1), 20% mung bean flour and 80% plantain puree(P2), 30% mung bean flour and 70% plantain puree(P3), 40% mung bean flour and 60% plantain puree (P4).

Effectiveness Value of Cookies Bars. The best treatment can be determined by assigning weight to some parameters that have been tested, such as water content, ash content, fat content, protein content, carbohydrate content, and sensory values. The effectiveness value of the bar cookies are shown in Table 1. It can be seen the best formulation of bar cookie is P2 made from 20% mung bean flour and 80% ripe plantain puree. The P4 formulation resulting in the bar cookies being bright in colour and having a good aroma, tastier and softer texture. The P2 bar cookies had a 40.97% of water content, ash content 2.60%, fat content 10.86%, protein content 11.69% and carbohydrate 36.53%.

Table 1
The Effectiveness value of bar cookies formulation

Formulation	Effectiveness Value
P1 (10% green bean flour, 90% ripe plantain puree)	0.45
P2 (20% green bean flour, 80% ripe plantain puree)	0.55
P3 (30% green bean flour, 70% ripe plantain puree)	0.51
P4 (40% green bean flour, 60% ripe plantain puree)	0.49

CONCLUSION

Sensory properties of preferred bar cookies include their colour, aroma, flavour and texture at 3.29; 2.93; 3.39; 2.89 respectively; and 3.29 on the scale range values really dislike (1) to like (5). Formulation of the bar cookies has a significant effect on their chemical characteristics. The preferred formulation of bar cookies was P2 made from main ingredient i.e. 20% mung bean flour and 80% ripe plantain puree. Chemical characteristics of preferred bar cookies (P2) were 40.62 % water, 2.60 % db ash, 10.86 % db fat, 11.69 % db protein, 36.53 % db carbohydrate.

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REFERENCES

Adriani, M., & Bambang, W. (2012). *Pengantar gizi masyarakat* [Introduction to community nutrition]. Jakarta, Indonesia: Kharisma Putra Utama.

Akubor, P. I. (2003). Functional properties and performance of cowpea/plantain/wheat flour blends in biscuits. *Plant Foods for Human Nutrition*, *58*(3), 1–8.

Association of Official Analytical Chemists International. (2005). Official method of analysis (18th ed.). Maryland, USA: AOAC.

Aurore, G., Parfait, B., & Fahrasmane, L. (2009). Bananas, raw materials for making processed food products. *Trends in Food Science & Technology*, *20*(2), 78–91.

De Garmo, E. P., Sullevan, W. E., & Canana, C. R. (1984). Engineering economy (7th ed.). New York, NY: Macmilland Publisher.

Ferawati. (2009). *Formulasi dan pembuatan banana bars berbahan dasar tepung kedelai, terigu, singkong dan pisang sebagai altenatif pangan darurat* [Formulation and manufacture of banana bars based on soybean flour, wheat flour, cassava and banana as alterative emergency food] (Undergraduate thesis), Bogor Agricultural University, Indonesia.

Juarez-Garcia, E., Agama-Acevedo, E., Sáyago-Ayerdi, S. G., Rodriguez-Ambriz, S. L., & Bello-Perez, L. A. (2006). Composition, digestibility and application in breadmaking of banana flour. *Plant Foods for Human Nutrition*, *61*(3), 131–137.

Kusharto, C. M. (2006). Serat makanan dan perannya bagi kesehatan [Dietary fibre and its role for health]. *Jurnal Gizi dan Pangan*, *1*(2), 45–54.

Kusnandar, F. (2010). *Kimia pangan komponen makro* [Macro component of food chemicals]. Jakarta, Indonesia: Dian Rakyat.

Ladamay, N. A., & Yuwono, S. S. (2013). Pemanfaatan bahan lokal dalam pembuatan foodbars (kajian rasio tapioka: tepung kacang hijau dan proporsi CMC) [Utilization of local materials in the making of foodbars (tapioca ratio study: green bean flour and proportion of CMC)]. *Jurnal Pangan dan Agroindustri*, *2*(1), 67–78.

Lumiar, G. (2010). *Analisis sifat fisik dan ekonomi makanan padat (food bars) berbasis tepung komoditas lokal* [Analysis of physical properties and food-based economics (food bars) based on local commodities flour] (Undergraduate thesis), Bogor Agricultural University, Indonesia.

Marissa, D. (2010). *Formulasi foodbars jagung dan pendugaan umur simpan produk dengan pendekatan kadar air kritis* [Foodbars corn formulation and age assumption store products with critical water content approach] (Undergraduate thesis), Bogor Agricultural University, Indonesia.

Meilgaard, M., Civille, G. V., & Thomas, B. (1999). *Sensory Evaluation Techniques*. Florida, USA: CRC Press LLC.

Nio, O. K. (2012). *Daftar Analisis Bahan Makanan* [List of foodstuffs analysis]. Jakarta, Indonesia: University of Indonesia.

Nurhayati, N., Jenie, B. S. L., & Kusumaningrum, H. D. (2014). Komposisi kimia dan kristalinitas tepung pisang termodifikasi secara fermentasi spontan dan siklus pemanasan bertekanan-pendinginan [Chemical composition and crystallinity of modified banana flour by spontaneous fermentation and autoclaving-cooling cycle]. *Jurnal Agritech Fakultas Teknologi Pertanian UGM*, *34*(02), 146–150.

Nurhayati, N., & Rahmanto, D. E. (2017). Banana and plantain as medicinal food. *Proceeding of International Conference on Medicine and Health Sciences 2016* (pp. 87–91). Kyoto, Japan: UNEJ e-Proceeding.

Ploetz, R. C., Kepler, A. K., Daniells, J., & Nelson, S. C. (2007). Banana and plantain—an overview with emphasis on Pacific island cultivars. *Species Profiles for Pacific Island Agroforestry*, 21–32.

Ratnasari, D., Yunianta, Y., & Maligan, J. M. (2015). Pengaruh tepung kacang hijau, tepung labu kuning, margarin terhadap fisikokima dan organoleptik biskuit [Effect of green bean flour, pumpkin flour, margarine on physicokoto and organoleptic biscuits]. *Jurnal Pangan dan Agroindustri*, *3*(4), 1652–1661.

Robinson, J. C., & Saúco, V. G. (2010). *Bananas and Plantains* (2nd ed., Vol. 19). Cambridge, MA: CAB International (Cabi).

Rukmana, R. (1997). *Ubi jalar budidaya dan pascapanen* [Sweet potato cultivation and postharvest.]. Yogyakarta, Indonesia: Kasinius.

Sarifudin, A., Ekafitri, R., Surahman, D. N., & Putri, S. K. D. F. A. (2015). Pengaruh penambahan telur pada kandungan proksimat, karakteristik aktivitas air bebas (aw) dan tekstural snack bar berbasis pisang (*Musa paradisiaca*) [Effect of egg concentration on proximate, water activity (aw) and textural properties of banana (*Musa paradisiaca*) Snack Bar]. *Agritech*, *35*(01), 1–8.

Setyaningtyas, A. G. (2008). *Formulasi produk pangan darurat berbasis tepung ubi jalar, tepung pisang, dan tepung kacang hijau menggunakan teknologi intermediate moisture food (IMF)*. [Emergency food product formulation based on sweet potato flour, banana flour, and green pea flour using intermediate moisture food technology (IMF)] (Undergraduate thesis), Bogor Agricultural University, Indonesia.

Sidabutar, W. D. R., Rona, J. N., & Ridwansyah (2013). *Kajian penambahan tepung talas dan tepung kacang hijau terhadap mutu cookies* [Review of addition of wheat flour and green pea flour to the quality of cookies] (Undergraduate thesis), University of North Sumatra, Indonesia.

Soebito, S. (1988). *Analisis Farmasi* [Pharmaceutical analysis]. Yogyakarta, Indonesia: UGM Press.

Soltani, M., Alimardani, R., & Omid, M. (2010). Prediction of banana quality during ripening stage using capacitance sensing system. *Australian Journal of Crop Science*, *4*(6), 443–447.

Tan, T. C., Kanyarat, K., & Azhar, M. E. (2012). Evaluation of functional properties of egg white obtained from pasteurized shell egg as ingredient in angel food cake. *International Food Research Journal*, *19*(1), 303–308.