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Formulation of Gude Bean Flour (Cajanus cajan), with Kratok Bean (Phaseolus lunatus) and Red Bean (Phaseolus vulgaris) in Making of Functional Snack Bar

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***Abstract*---*Snack bar is a snack that is consumed between meals. Snack bars are usually made from nuts, cereals, and dried fruit. Snack bars are made to meet nutritional intake and overcome hunger amid busy activities. Snack bar products made from local raw materials need to be developed considering the many sources of food that have functional benefits. Samples were tested for carbohydrate, protein, fat, moisture content, and ash content. The results obtained were then statistically analyzed using a completely randomized design analysis. The study used 7 treatments and 3 replications so that the researcher had 21 experimental units. The comparison treatment of gude bean flour with red beans and kratok beans on snack bar products has a carbohydrate content of 41.826 – 45.310%, protein 13,234 – 33,869%, fat 10.046 – 10.796%, ash content 0.704 – 1.343%, and water content 6.344 – 6.819%.*
Keywords*---*gude bean flour (Cajanus cajan), kratok bean (Phaseolus lunatus), red bean (Phaseolus vulgaris), snack bar

Introduction

The diet of modern society changes in the fulfillment process. Modern society tends to choose to consume practical and ready-to-eat foods to meet their nutritional needs. This tendency is influenced by the mobility and activities of modern society which is dense. The density of activity and mobility of modern society often results in them consuming snacks or commonly referred to as snack bars during their activities. The snack bar is a snack that is consumed between meals. Snack bars are usually made from nuts, cereals, dried fruit and are shaped like bars so they are called bars. Snack bars are made to meet nutritional intake and overcome hunger (Indrastati & Anjani 2016).

Snack bars circulating in the market generally use imported ingredients or insufficient domestic production such as soybeans, almonds, pistachios, wheat, and granola causes the price of snack bars to be quite high. It is very important to make food products using basic ingredients that can thrive in all parts of Indonesia, can grow all year round, are easy to cultivate, affordable, and prices tend to be stable in the market, so there is no need to import raw materials. Several types of raw materials that can be used as raw materials for making functional snack bars are Gude beans (Cajanus cajan), Kratok beans (Phaseolus lunatus), and Red beans (Phaseolus vulgaris).

Gude beans can be processed into flour which has a protein content of 24.32%, fat 2.94%, carbohydrates 65.64%, fiber 3.21% (Augustyn et al., 2017). These beans have properties that are easy to adapt to various environmental conditions, can grow on land with low fertility and low rainfall, so they have the potential to be developed as raw material for soybean substitution (Nurhasanah et al., 2020). Nutrient content contained in nuts consists of protein, carbohydrates, fat, fiber, thiamin, riboflavin, niacin, minerals such as sulfur, iron, potassium, and manganese (Saxena et al., 2010). In gude beans, there are anthocyanin compounds of 208.307 mg/100gram which act as antioxidant compounds (Roosmarinto & Rahayu, 2016).

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In this study, the snack bar product was made using gude bean flour and added kratok beans and red beans to enrich the nutritional content and functional benefits of the product using a comparison of the composition of the ingredients. The ratios are 1:1, 1:4, 1:6, 1:8, 4:1, 6:1, 8:1 and 1:1. As an initial stage, the product will be analyzed for carbohydrates, protein, fat, ash content, and water content. It is hoped that using a combination of local ingredients can produce snack bar products that have nutritional content and provide good functional benefits for the body. People need to be accustomed to consuming various kinds of food, so as not to depend on only one type of material. The use of local raw materials also supports the national food security and self-reliance program (Purnama et al., 2020; Benítez et al., 2021).

Methods

Gude Nut Flour is made by drying the Gude Beans at a temperature of 50 oC for 12 hours then milled and sieved using an 80 mesh sieve. Snack Bar is made by combining gude peanut flour with kratok beans and red beans that have been roasted at a temperature of 50 oC. Snack bars are made according to a predetermined combination, then baked. Furthermore, the samples were analyzed for carbohydrates, protein, fat, water content, and ash content. The research design used was a randomized block design (Mwasaru et al., 1999; Eyaru et al., 2009). The research design consisted of 7 comparative treatments between the use of gude bean flour versus the use of red beans and kratok beans. The ratios are 1:4, 1:6, 1:8, 4:1, 6:1, 8:1, and 1:1. This study used 3 replications to obtain 21 experimental units.

Results

Carbohydrates

ANOVA test showed that the comparison treatment of gude bean flour with red beans and kratok in the manufacture of snack bars had a very significant effect (P>0.01) on the parameters of carbohydrate content. The interaction between treatments had a significant effect (P>0.05) on carbohydrate parameters. Carbohydrates have an important role in food products. Carbohydrates are a source of energy. Determination of carbohydrate content in snack bar samples using the By-difference analysis method by reducing the water content, ash content, protein content, and fat content. The results of carbohydrate analysis can be seen in Table 1.

Table 1
Average value of carbohydrate snack bar (%)

Treatment	% Carbohydrate
1:4	43.733
1:6	42.350
1:8	41.826
1:1	45.310
4:1	42.300
6:1	43.610
8:1	41.336

Table 1. shows the combination of 1:1 treatment based on the By difference method. Carbohydrate analysis using the By difference method is strongly influenced by other proximate aspects. Because By difference analysis has a formula for subtracting 100% from the value of water content, ash content, protein, and fat. Carbohydrate content in functional snack bar products in 1:1 treatment produced the highest carbohydrate with 45.310% while the analysis results in 1:8 treatment produced the lowest carbohydrate with 41.826%. Comparison of other ingredients that have carbohydrate content in a row is 1:4 (43.733%); 1:6 (42.350%), 4:1 (42.300%), 6:1 (43.610%), 8:1 (41.336).

In the 1:1 treatment, the composition of nuts as a snack bar constituent was made balanced. The results of the analysis of carbohydrates in this snack bar product are not much different from the research of Siregar et al. (2017), on snack bar products based on red bean flour and salak padang, which have a carbohydrate content of around 45.23 – 47.74%. In snack bar products based on red bean flour and sago flour, the carbohydrate content is around 55.62 –

61.56% (Soeparyo et al., 2019). The 1:8 treatment had the lowest carbohydrate content. The carbohydrate components of kidney beans are starch, pentose, galactose, cellulose, and oligosaccharides. The low carbohydrate content in the 1:18 treatment was caused by the pretreatment, namely the soaking process. The soaking process is carried out to remove anti-nutritional content in red beans such as phytic acid and minimize the content of oligosaccharides (Le Berre-Anton et al., 1997).

Oligosaccharides are anti-nutritional substances found in red beans (Pangastuti et al., 2013). The decrease in carbohydrate content in red beans also occurred in snack bar products based on red beans and poor apples. The carbohydrate content obtained is around 27.43-35% (Wibowo, 2013). The use of gude bean flour in the product also influences the carbohydrate content of the snack bar product. Carbohydrate content in gude bean flour with pretreatment is around 64.92 – 68.42%. The carbohydrate content of kratok beans on a dry basis is 53-71% (Bin Sayeed & Ameen, 2015).

Protein

The results of the ANOVA test showed that the comparison treatment of gude bean flour with the use of red beans and kratok had a very significant effect (P>0.01) on protein parameters. In the 4:1 and 8:1 treatments, the interaction between treatments had no significant effect (P>0.05), while the other treatment interactions had a significant effect (P>0.05). Proteins play an important role in various biological processes. Protein functions to regulate metabolic processes in the form of enzymes, hormones, and as a body defense mechanism to fight foreign infections into the body, as well as maintain cells and body tissues (Winarno, 2008). Based on the results of protein analysis using the Kjeldahl method, the highest protein content was found in the 1:8 treatment of 33,869%. The lowest protein content was found in the 8:1 treatment of 13.234%. The protein content of snack bar products is presented in Table 2.

Table 2
Average value of protein snack bar (%)

Treatment	% Protein
1:4	30.867
1:6	31.654
1:8	33.869
1:1	20.849
4:1	13.117
6:1	13.990
8:1	13.234a

The other compositional comparison treatments, respectively, are as follows, 1:4 (30.8676), 1:6 (31.654), 1:1 (20.849), 4:1 (13.117), and 6:1 treatment (13.990) . The protein standard set by USDA (2019) for snack bar products is 9.38%, while the results of protein analysis for the lowest content in the 8:1 treatment are still higher than the standard. The source of protein from this snack bar comes from the use of red beans, kratok beans, and gude beans. Red beans themselves have a protein content of 24.37%, koro kratok beans have a protein content of 21-26% and gude beans have a protein content of 22.87%. Protein content in food products that receive pre-treatment in the form of soaking or boiling may lose protein. This happens because of the diffusion of dissolved nitrogen substances into the soaking water or boiling water, but the decrease has no significant effect (Pangastuti et al., 2013). In snack bar products based on red bean and salak padang, the protein content of the product ranges from 12.51 to 15.67%, the protein content tends to increase with the addition of red bean flour concentration and decrease in the content of salak fruit. This is also due to the higher protein content of red beans, which is 19.0% (Siregar et al., 2017). Products with the addition of gude bean flour have a protein content ranging from 21.48 to 24.32% (Agustyn et al., 2017). In the research of Ekafitri & Isworo (2014), blinding food bars using kratok koro beans have a protein content of 13.40%.

Fat

The results showed that the comparison treatment of gude bean flour with the use of red beans and kratok had a very significant effect (P>0.01) on fat parameters. The interaction between treatments had no significant effect (P>0.05) in the 1:4 and 1:1 treatments, while the other treatments gave a significant interaction (P>0.05) (Ryland et al., 2010; Sun-Waterhouse et al., 2010). with red beans and kratok beans produced the highest fat content in the 1:1 comparison treatment of 10.796% bk while the lowest fat content was obtained from the 6:1 treatment of 10.046%, but the results of the fat test in all treatments were not significantly different. The results of fat analysis in other treatments were 1:4 (10.096%), 1:6 (10.135%), 1:8 (10.625%), 4:1 (10.250%), and 8:1 (10.268) . The fat content of the snack bar is presented in Table 3.

Table 3
Average value of fat snack bar (%)

Treatment	% Fat
1:4	10.096
1:6	10.135
1:8	10.625
1:1	10.796
4:1	10.250
6:1	10.046
8:1	10.268

The fat content in the peanut gude snack bar with the addition of red beans and kratok beans ranges from 10.046-10.796%bk but the fat content is still below the standard for commercial snackbar products which have an average fat content standard of 32% (Pangastuti et al., 2013). The fat content produced in snackbar products when compared to SNI already meets SNI standards (Indonesian National Standard). SNI requires a minimum fat content of a product of at least 9.5% dry weight (SNI 01-2973-1992). The fat content of snackbars with the composition of gude bean flour with red beans and kratok beans is still below the fat content of snack bar products with a mixture of sago flour and red bean flour containing 14.05-16.50% fat content (Soeparyo et al., 2019).

In the snackbar study with the composition of tofu dregs and bogor beans, the fat content of the product was 15.69%. In a study by Wibowo (2013), a snack bar based on red beans and poor apples has a fat content of 22.81 - 29.66%. In the process of processing food products, fat functions to provide a soft, smooth, and layered texture. In the manufacture of snack bars, the fat content is supplied from nuts (Ekafitri & Isworo, 2014). Kratok beans have a fat content of 0.32 – 2% Kratok beans contain a lot of linoleic, linolenic and palmitic fatty acids. In the study, Marimuthu et al. (2014), detected the 19 largest fatty acid content in kratok nuts using the GC-MS method, with a high oleic fatty acid content. Oleic fatty acids are known to have good abilities for wound healing, cancer, and autoimmune (Sales-Campos et al., 2013). Fat content that is too high in foodstuffs needs to be considered because it is prone to oxidation processes that cause the product to become rancid (Luthfiyanti et al., 2011).

Ash content

The results of the ANOVA test showed that the comparison treatment of gude bean flour with the use of red beans and kratok had a very significant effect (P>0.01) on the ash content parameter. The interaction between treatments had a significant effect (P>0.05). The highest ash content was found in the 1:8 treatment of 1.343% while the lowest ash content was found in the 6:1 treatment of 0.704%. The ash content of all treatments can be seen in Table 4. SNI sets the ash content of the product to a maximum of 1.5%, when compared to the SNI standard (Indonesian National Standard), the ash content produced in this study is lower than the provisions of SNI (SNI 01-2973-1992). In the study of cookies with the addition of soybean and banana composition, the resulting ash content was 2.18% (NURHAYATI et al., 2018).

Table 4
Average value of ash content snack bar(%)

Treatment	% Ash Content
1:4	1.023
1:6	1.073
1:8	1.343
1:1	1.071
4:1	0.874
6:1	0.704
8:1	0.837

A snack bar with tofu dregs composition with the addition of Bogor beans resulted in 1.11% ash content. In the study, snack bars with the composition of salak fruit and the use of red bean flour had a significant effect on the ash content of the resulting snack bars. The resulting ash content ranges from 1.54 to 2.95% (Siregar et al., 2017). Foodstuffs generally consist of 96% organic matter and water while the rest is inorganic and mineral materials. The organic matter in the material will burn during the combustion process while the inorganic material will not because it is referred to as ash content can be used as an indicator of the total minerals contained in foodstuffs (Gunawan, 2018). The mineral content of the material also affects the ash content of the product. Determination of ash content is carried out to determine the quality, quality, purity, and cleanliness of the product as a parameter value in food products.

Water content

The results of the ANOVA test showed that the comparison treatment of gude bean flour with the use of red beans and kratok had a very significant effect (P>0.01) on the water content parameter. The interaction between treatments had no significant effect (P>0.05) on the comparison treatment of gude bean flour with red beans and kratok beans (1:1) and (8:1) (Pinto et al., 2017; Wahyuni et al., 2016). The water content of snack bar products with the ratio of gude bean flour with red beans and kratok beans is shown in Table 5. The highest moisture content in the comparison treatment of gude bean flour with red beans and kratok beans was obtained at 1:8 treatment of 6.819% and the lowest water content was obtained at 6.344% at a ratio of 1:1

Table 5
Average value of water content snack bar (%)

Treatment	% Water Content
1:4	6.736
1:6	6.793
1:8	6.819
1:1	6.344
4:1	6.442
6:1	6.646
8:1	6.347

The results of the water content test on snack bar products with a ratio of gude bean flour and red beans and kratok beans are higher than the SNI standard (SNI 01-2973-1992) which sets the standard for the moisture content of the product in the form of cookies a maximum of 5%. The snack bar with the composition of tofu dregs with the addition of Bogor beans has a water content of 11.62% (Purnama, 2019). The snack bar product with the composition of sago flour with red beans has a water content of 7.23 – 12.11% (Soeparyo et al., 2019). The water content of the snack bar research with the comparison treatment of gude bean flour with red beans and kratok beans was lower.

The water content of a food product is influenced by the water content of the ingredients, the shape, size of the thickness that is not homogeneous, the time and temperature of roasting. Moisture content is an important component in determining the shelf life of a product, appearance of texture, and taste in food products. High water content makes it easy for bacteria, mold, and yeast to breed. The water content of a material is determined by free and bound water. Factors of temperature and drying time affect the water content of the product (Bartoli et al., 2009; Ramírez-Jiménez et al., 2018). The higher the drying temperature and the longer the material is in direct contact with heat, the lower the moisture content.

Conclusion

The comparison treatment of gude bean flour with red beans and kratok beans on snack bar products has a carbohydrate content of 41.826 – 45.310%, protein 13.234 – 33.869%, fat 10.046 – 10.796%, ash content 0.704 – 1.343%, and water content 6.344 – 6.819%.

References

Augustyn, G. H., Moniharapon, E., & Resimere, S. (2017). Analisa Kandungan Gizi Tepung Kacang Gude Hitam (Cajanus Cajan) dengan Beberapa Perlakuan Pendahuluan. *AGRITEKNO: Jurnal Teknologi Pertanian*, *6*(1), 27-32.

Bartoli, C. G., Tambussi, E. A., Diego, F., & Foyer, C. H. (2009). Control of ascorbic acid synthesis and accumulation and glutathione by the incident light red/far red ratio in Phaseolus vulgaris leaves. *FEBS letters*, *583*(1), 118-122. https://doi.org/10.1016/j.febslet.2008.11.034

Benítez, R. B., Tabares, W. F. E., Velásquez, L. A. L., Sánchez, C. I. H., & Cruel, O. A. S. (2021). Enzymatic hydrolysis as a tool to improve total digestibility and techno-functional properties of pigeon pea (Cajanus cajan) starch. *Heliyon*, *7*(8), e07817. https://doi.org/10.1016/j.heliyon.2021.e07817

Bin Sayeed, M. S., & Ameen, S. S. (2015). Beta-sitosterol: a promising but orphan nutraceutical to fight against cancer. *Nutrition and cancer*, *67*(8), 1216-1222.

Ekafitri, R., & Isworo, R. (2014). Pemanfaatan Kacang-Kacangan sebagai Bahan Baku Sumber Protein Untuk Pangan Darurat The Utilization of Beans as Protein Source for Emergency Food. *Jurnal Pangan*, *23*(2), 134-145.

Eyaru, R., Shrestha, A. K., & Arcot, J. (2009). Effect of various processing techniques on digestibility of starch in Red kidney bean (Phaseolus vulgaris) and two varieties of peas (Pisum sativum). *Food Research International*, *42*(8), 956-962. https://doi.org/10.1016/j.foodres.2009.06.007

Gunawan, A. (2018). Characteristics of the physical and chemical quality of snack bar products with the addition of mixed flour (head and meat) of African catfish [Thesis]. Juanda University. Bogor.

Indrastati, N., & Anjani, G. (2016). Snack Bar Kacang Merah Dan Tepung Umbi Garut Sebagai Alternatif Makanan Selingan Dengan Indeks Glikemik Rendah. *Journal of Nutrition College*, *5*(4), 546-554.

Keller, C., Markert, F., & Bucher, T. (2015). Nudging product choices: The effect of position change on snack bar choice. *Food Quality and Preference*, *41*, 41-43. https://doi.org/10.1016/j.foodqual.2014.11.005

Le Berre-Anton, V., Bompard-Gilles, C., Payan, F., & Rougé, P. (1997). Characterization and functional properties of the α-amylase inhibitor (α-AI) from kidney bean (Phaseolus vulgaris) seeds. *Biochimica et Biophysica Acta (BBA)-Protein Structure and Molecular Enzymology*, *1343*(1), 31-40. https://doi.org/10.1016/S0167-4838(97)00100-3

Luthfiyanti, R., Riyanti, E. F., & Dewi, D. (2011). Pengaruh perbandingan tepung dan pure pisang nangka pada proses pembuatan food bar berbasis pisang sebagai pangan darurat. *Dalam Prosiding Konferensi SNaPP*, 239-246.

Marimuthu, K., Nagaraj, N., & Ravi, D. (2014). GC-MS analysis of phytochemicals, fatty acids and antimicrobial potency of dry Christmas lima beans. *Int. J. Pharm. Sci. Rev. Res*, *27*(2), 63-66.

Mwasaru, M. A., Muhammad, K., Bakar, J., & Man, Y. B. C. (1999). Effects of isolation technique and conditions on the extractability, physicochemical and functional properties of pigeonpea (Cajanus cajan)

Nurhasanah, S., Rumperiai, M. G., Angin, R. Z. P., Arasti, A., Rianinsih, D., Palupi, G., & Purwanti, E. (2020, July). Dolichos lablab (Anatomi, Fisiologi, dan Etnobotani). In *Prosiding Seminar Nasional Pendidikan Biologi*.

NURHAYATI, N., MARYANTO, M., & GANDANINGRUM, L. (2018). Sensory and Chemical Characteristics of Bar Cookies Made from Mung Bean Flour and Ripe Plantain var Raja as Emergency Food.

Pangastuti, H. A., Affandi, D. R., & Ishartani, D. (2013). Karakterisasi sifat fisik dan kimia tepung kacang merah (Phaseolus vulgaris L.) dengan beberapa perlakuan pendahuluan. *Jurnal Teknosains Pangan*, *2*(1).

Pinto, V. R. A., de Oliveira Freitas, T. B., de Souza Dantas, M. I., Della Lucia, S. M., Melo, L. F., Minim, V. P. R., & Bressan, J. (2017). Influence of package and health-related claims on perception and sensory acceptability of snack bars. *Food Research International*, *101*, 103-113. https://doi.org/10.1016/j.foodres.2017.08.062

Purnama, H., Hutami, R., & Novidahlia, N. (2020). Karakteristik Fisikokimia Dan Sensori Snack Bar Ampas Tahu Dengan Penambahan Kacang Bogor. *Jurnal Ilmiah Pangan Halal*, *1*(2), 75-82.

Ramírez-Jiménez, A. K., Gaytán-Martínez, M., Morales-Sánchez, E., & Loarca-Piña, G. (2018). Functional properties and sensory value of snack bars added with common bean flour as a source of bioactive compounds. *LWT*, *89*, 674-680. https://doi.org/10.1016/j.lwt.2017.11.043

Roosmarinto, R., & Rahayu, M. (2016). Kajian Aktivitas Antioksidan Kacang Gude (Cajanus cajan) dan Pengaruhnya Terhadap Aktivitas Enzim Hati Tikus Yang diinduksi Karbon Tetraklorida. *Jurnal Teknologi Kesehatan (Journal of Health Technology)*, *12*(2), 71-76.

Ryland, D., Vaisey-Genser, M., Arntfield, S. D., & Malcolmson, L. J. (2010). Development of a nutritious acceptable snack bar using micronized flaked lentils. *Food Research International*, *43*(2), 642-649. https://doi.org/10.1016/j.foodres.2009.07.032

Sales-Campos, H., Reis de Souza, P., Crema Peghini, B., Santana da Silva, J., & Ribeiro Cardoso, C. (2013). An overview of the modulatory effects of oleic acid in health and disease. *Mini reviews in medicinal chemistry*, *13*(2), 201-210.

Saxena, K. B., Kumar, R. V., & Gowda, C. L. L. (2010). Vegetable pigeonpea–a review. *Journal of Food Legumes*, *23*(2), 91-98.

Siregar, L. N. S., Harun, N., & Rahmayuni, R. (2017). *Pemanfaatan Tepung Kacang Merah Dan Salak Padang Sidimpuan (Salacca Sumatrana R.) Dalam Pembuatan Snack Bar* (Doctoral dissertation, Riau University).

Soeparyo, M. K., Rawung, D., & Assa, J. R. (2019). Pengaruh Perbandingan Tepung Sagu (Metroxylon sp.) dan Tepung Kacang Merah (Phaseolus vulgaris L.) Terhadap Sifat Fisikokimia dan Organoleptik Food Bar. *Jurnal Teknologi Pertanian (Agricultural Technology Journal*, *9*(2).

Sun-Waterhouse, D., Teoh, A., Massarotto, C., Wibisono, R., & Wadhwa, S. (2010). Comparative analysis of fruit-based functional snack bars. *Food Chemistry*, *119*(4), 1369-1379. https://doi.org/10.1016/j.foodchem.2009.09.016

Wahyuni, I., Hemon, A. F., & Kisman, K. (2016). Growth and Production of Genotypes of Peanuts in Double Stress: Drought and Shade. *International Research Journal of Engineering, IT and Scientific Research*, *2*(11), 29-40. and cowpea (Vigna unguiculata) protein isolates. I. Physicochemical properties. *Food chemistry*, *67*(4), 435-443. https://doi.org/10.1016/S0308-8146(99)00150-8

Wibowo, O. A. (2013). Optimization of Formulation for Making Malang Red Bean-Apple SnackBbar Using Linear Programming. Article. Department of Food Technology, Faculty of Engineering, University of Pasundan. Bandung

Winarno, F. G. (2008). Kimia Pangan dan Gizi: Edisi Terbaru. *Jakarta. Gramedia Pustaka Utama*, *31*.