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THE EFFECT OF ADDING TOFU PULP FLOUR ON THE FIBER CONTENT OF SNACK BARS AS A HEALTHY SNACK ALTERNATIVE FOR TEENAGERS

Pengaruh Penambahan Tepung Ampas Tahu Terhadap Kadar Serat Pada Produk Snack Bar

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ABSTRACT

Tofu residue flour is a by-product of the tofu production process that is rich in dietary fiber, but its use as a functional food ingredient is still limited in society. The purpose of this study was to utilize tofu production by-products to create a snack bar product as an alternative high-fiber snack. The parameters observed were chemical tests of tofu residue flour, the optimal snack bar formula, and dietary fiber content. The experimental design used was a completely randomized design with four treatment factors: F0 (100% wheat flour) as the control, F1 (60%), F2 (70%), and F3 (80%). Consumer acceptance testing was conducted on 50 untrained panelists to evaluate their preference for the snack bars based on indicators such as color, aroma, texture, taste, and overall. The results showed that the best snack bar was F1 (60%). Then then normality test and the Kruskal-Wallis follow-up test at a significance level of α = 0.05 indicated that the addition of tofu residue flour was associated with an increase in dietary fiber content in the produced snack bars, and there were significant differences in aroma and taste indicators. The proximate analysis and dietary fiber results for the best product per 100 g were as follows: total energy 435.85 kcal, ash content 2.035%, moisture content 15.49%, carbohydrates 47.125 g, total fat 21.19 g, protein 14.16 g, and dietary fiber 16.755 g.

Keyword : *dietary fiber; snack bar; tofu pulp flour*

ABSTRAK

Tepung ampas tahu merupakan hasil samping proses produksi tahu yang kaya akan serat pangan, namun pemanfaatannya sebagai bahan pangan fungsional masih terbatas di masyarakat. Tujuan penelitian ini adalah memanfaatkan ampas tahu untuk menghasilkan produk snack bar sebagai alternatif snack tinggi serat. Parameter yang diamati meliputi uji kimia tepung ampas tahu, formula snack bar optimal, dan kadar serat pangan. Rancangan percobaan yang digunakan adalah rancangan acak lengkap dengan empat faktor perlakuan, yaitu F0 (100% tepung terigu) sebagai kontrol, F1 (60%), F2 (70%), dan F3 (80%). Uji penerimaan konsumen dilakukan terhadap 50 panelis tidak terlatih untuk menilai kesukaan terhadap snack bar berdasarkan indikator warna, aroma, tekstur, rasa, dan keseluruhan. Hasil penelitian menunjukkan bahwa snack bar terbaik adalah F1 (60%). Kemudian uji normalitas dan uji lanjutan Kruskal-Wallis pada taraf signifikansi α = 0,05 menunjukkan bahwa penambahan tepung ampas tahu berhubungan dengan peningkatan kadar serat pangan pada snack bar yang dihasilkan, serta terdapat perbedaan yang signifikan pada indikator aroma dan rasa. Hasil analisis proksimat dan serat pangan untuk produk terbaik per 100 g adalah sebagai berikut: energi total 435,85 kkal, kadar abu 2,035%, kadar air 15,49%, karbohidrat 47,125 g, lemak

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total 21,19 g, protein 14,16 g, dan serat pangan 16,755 g. Kata kunci: serat pangan, snack bar, tepung ampas tahu.

Kata Kunci: serat pangan; *snack bar*; tepung ampas tahu

INTRODUCTION

Adequate dietary fiber intake is very important for maintaining a healthy body. According to the Dietary Reference Intake (DRI) from the National Institutes of Health (2011), the recommended daily fiber requirement is around 29 grams per day. Meanwhile, the World Health Organization (WHO, 2012) recommends a fiber intake of 25 grams per day. However, in reality, global fiber consumption is still below this standard. In Indonesia, according to the 2013 Nutrient Adequacy Rate (AKG), the recommended fiber intake is 30 grams/person/day. However, in reality, adolescents are still far from this figure. The fiber intake of the general population is only around 10.5 grams/day (Rahmah et al., 2017; Paruntu, 2019), and the condition is even lower in adolescents, especially adolescent girls, ranging from 3.88 to 4.9 grams/day (Musfira, 2024). This low fiber intake contributes to an increased risk of non-communicable diseases (NCDs) in the future, such as cardiovascular disease, type 2 diabetes, and cancer. In fact, dietary fiber is known to help control weight, reduce calorie intake, and maintain digestive health (Nicola et al., 2018; Fairudz, 2015).

Snack bars are practical, nutritious snacks that are popular among various groups, especially people with fast-paced lifestyles who still pay attention to their nutritional intake. This product has the potential to be a healthy snack alternative that can help increase daily fiber consumption. In addition, the development of high-fiber snack bars is also a strategy for food diversification, both in terms of raw materials and processed forms, to enrich the selection of functional foods available to the public. Snack bars are generally made with flour as the main ingredient (Wijaya, 2010), but this can be substituted with other foods that can increase their nutritional value.

Soybeans, as the main ingredient in tofu production, contain 2.9 grams of fiber per 100 grams (TKPI, 2017). Tofu pulp, which is a by-product of the soybean extraction process, actually has a higher dietary fiber content, namely around 58.27–58.60 grams per 100 grams, consisting of insoluble fiber and soluble fiber (Santos,

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2019; Lu et al., 2013), because the extraction process in tofu production separates the soluble fraction (protein and fat) into tofu, while insoluble fiber is concentrated in the residue as a by-product, so that this filtering process effectively increases the proportion of fiber in tofu residue. Unfortunately, the utilization of tofu residue is still not optimal. Many tofu producers discard this waste due to a lack of knowledge about its nutritional potential and economic value. Although a small portion is used as animal feed or fertilizer (Kasim, 2018), the potential of tofu pulp as a functional food ingredient is still enormous. Through a drying process, tofu pulp can be processed into flour and used as a fiber-rich food additive.

Seeing the low fiber consumption in Indonesia and the high fiber potential in tofu pulp, this study aims to develop snack bars with added tofu pulp flour as a fiber-rich snack. This effort is expected to not only increase the nutritional value of food, but also provide a solution for utilizing food waste that is both economically valuable and environmentally friendly. In addition, the development of this product is expected to provide a healthy and practical food alternative for the community.

METHOD

Ingredients

The ingredient used to make tofu pulp flour was 1 kg of tofu pulp obtained from Jakarta. The ingredients used to make snack bars were tofu pulp flour, wheat flour, chicken eggs, powdered milk, granulated sugar, and butter margarine obtained from a baking supply store in the South Tambun area. The materials used for organoleptic testing were control snack bars and snack bars that had undergone tofu pulp flour substitution (F1, F2, F3) and mineral water. The materials used for chemical testing were snack bars selected from the results of hedonic and hedonic quality tests.

Preparation of Tofu Pulp Flour

The production of tofu pulp flour begins with the selection of high-quality tofu pulp. Tofu pulp is selected based on its color, aroma, and physical appearance. It should have a natural color that is not too pale or dark brown, a strong aroma without any rancid smell, and a fresh, not dull physical appearance. The selected tofu pulp is washed and filtered using a clean cloth, then steamed for 30 minutes to preserve it and prevent it from becoming smelly, and then cooled.

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After that, the tofu pulp is roasted to reduce its water content.

Tofu Pulp Flour Processing Method

The tofu pulp flour processing method in this study uses a blender. The tofu pulp produced from the roasting process is ground using a blender, which is then sieved using a 60-mesh sieve to make the flour texture smoother.

Snack Bar Ingredient Preparation

To make snack bars, prepare blue triangle flour, tofu pulp flour, chicken eggs, powdered milk, granulated sugar, and margarine butter. The initial stage of dough preparation involves mixing 35 g of granulated sugar, 10 g of powdered milk, and 35 g of margarine butter in a container using a low-speed mixer until the sugar dissolves, then adding 55 g of chicken eggs. Next, add wheat flour and/or tofu pulp flour according to the substitution formula and powdered milk. Pour the well-mixed dough into a mold that has been greased with margarine.

Snack Bar Processing Method

The snack bar processing method is done by baking in an oven for 45 minutes at 120ºC. The molded snack bars are 10 cm long, 3 cm wide, and 2 cm thick.

Tofu Pulp Flour Substitution Formulations

There were four formulations used in this study, namely F0 as the control (100 g wheat flour), F1 with 60% substitution (40 g wheat flour and 60 g tofu pulp flour), F2 with 70% substitution (30 g wheat flour and 70 g tofu pulp flour), and F3 with 80% substitution (20 g wheat flour and 80 g tofu pulp flour).

Statistical Analysis

The selection of products was determined using a weighting method based on their importance value. The data will be processed and analyzed using Microsoft Excel. The analysis of the effect of tofu pulp flour substitution on snack bar products is carried out by testing its normality using Shapiro Wilk for hedonic test results and hedonic quality data. If it is normally distributed, the effect of the treatment will be analyzed using the ANOVA test. If there is a significant difference, a follow-up Duncan Multiple Range Test will be carried out. If the data is not normally distributed, it will be

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analyzed using the Kruskal-Wallis test, and if there is a significant difference, a Mann Whitney follow-up test will be conducted. To determine the effect of snack bar substitution using tofu pulp flour, IBM SPSS software will be used. The results of the nutritional content in the form of fiber in all products will be tested in a food laboratory and the results of the test will be included.

RESULTS AND DISCUSSION

Yield of Tofu Pulp Flour

The yield of tofu pulp flour obtained based on the ratio between the weight of flour produced and the weight of tofu pulp after selection is expressed as a percentage (%). The calculation of tofu pulp flour yield aims to determine the amount of flour produced from the raw materials used. The following is the calculation of tofu pulp flour yield.

$$\% \text{ Yield} = \frac{464}{1000}\ x\ 100\% == 46{,}4\ \%$$

Based on the above calculations, 1,000 grams of tofu pulp can produce 464 grams of tofu pulp flour, resulting in a tofu pulp flour yield of 46.4%. This occurs because there is a decrease in the water content in the fresh tofu pulp that is dried, resulting in a reduction in the weight of the tofu pulp to flour.

Organoleptic Test

The organoleptic test consists of a hedonic test and a hedonic quality test conducted by panelists. The data obtained is processed using SPSS and Microsoft Excel software. The data is statistically tested using Kruskal Wallis, and if there is a significant difference (p-value <0.05), a Mann Whitney follow-up test is conducted with a significance level of 5%.

Table 1. Organoleptic Test Results for Tofu Waste Flour Snack Bars

Indicator	F0 (0%)	F1 (60%)	F2 (70%)	F3 (80%)	*P-value*
Hedonic Test					
Color	3,82 ± 1,004[a]	3,80 ± 0,808[a]	3,74 ± 0,751[a]	3,68 ± 0,913[a]	0,723
Aroma	4,08 ± 0,877[a]	3,88 ± 0,773[ab]	3,64 ± 0,663[bc]	3,50 ± 0,763[c]	0,000
Texture	3,06 ± 0,843[a]	3,28 ± 1,031[a]	3,34 ± 0,658[a]	3,20 ± 0,904[a]	0,496
Taste	3,82 ± 0,896[a]	3,40 ± 0,948[a]	3,36 ± 0,827[a]	3,30 ± 0,886[a]	0,006
Overall	3,82 ± 0,748 [a]	3,66 ± 0,872 [a]	3,60 ± 0,700 [a]	3,46 ± 0,813 [a]	0,114
Hedonic Quality Test					

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Indicator	F0 (0%)	F1 (60%)	F2 (70%)	F3 (80%)	*P-value*
Brown Color	1,68 ± 0,935	3,08 ± 0,724[a]	3,10 ± 0,544[a]	3,48 ± 0,707	0,000
Tofu Aroma	4,16 ± 0,817	3,86 ± 0,756[ab]	3,84 ± 0,710[ac]	3,62 ± 0,805[bc]	0,001
Dense Texture	3,22 ± 1,112[a]	3,56 ± 0,787[abc]	3,60 ± 0,728[bd]	3,72 ± 0,809[cd]	0,036
Bitter Taste	4,56 ± 0,501[a]	4,36 ± 0,631[ab]	4,28 ± 0,607[bc]	4,04 ± 0,755[c]	0,002

a,b = Similar letter notation means there is no significant difference at the Mann Whitney test level has a value of 5%.
Hedonic test = 1 (strongly dislike), 2 (dislike), 3 (slightly like), 4 (like), 5 (strongly like)
Hedonic color quality test = 1 (very not brown), 2 (not brown), 3 (slightly brown), 4 (brown), 5 (very brown)
Hedonic aroma quality test = 1 (very beany), 2 (beany), 3 (slightly beany), 4 (not beany), 5 (very not beany)
Hedonic texture quality test = 1 (very not dense), 2 (not dense), 3 (slightly dense), 4 (dense), 5 (very dense)
Hedonic taste quality taste = 1 (very bitter), 2 (slightly bitter), 3 (bitter), 4 (not bitter), 5 (very not bitter)

Color

The color appearance of snack bars generally varies depending on the ingredients, temperature, baking time, and the flavor to be highlighted. Based on Table 1, the hedonic test results show that the panelists preferred F_0 (0% tofu pulp flour) in terms of color. F_0 has a golden yellow color. Further testing using the Kruskal-Wallis test showed no significant difference in preference for the color indicator between the control formula and the substitution formula shown (sig 0.723) at a 5% significance level. The average preference score of the panelists for color was 3, which means “slightly like.” This indicates that the color of the product is still within the panelists' acceptance limits even though there was no significant increase in preference value.

Based on Table 1, the color of the product affects the quality of the snack bar (sig 0.000) with a significance level of 5%. To see which groups were different, a Mann-Whitney test was conducted, which showed that the color quality of snack bars with tofu pulp flour substitution was significantly different ($P<0.05$) in F_0 and F_1, F_0 and F_2, F_0 and F_3, F_1 and F_3, and F_2 and F_3. The hedonic quality test showed that the higher the percentage of tofu pulp flour, the more brownish the color of the snack bar, as in a study on making gapit cakes (Komariyah,

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2019), tofu pulp flour substitution affects the color quality of the product. Color changes in food products generally occur due to the Maillard reaction, which is a non-enzymatic browning reaction between amino acids and reducing sugars that occurs during the heating process and produces brown compounds (Yudasri, 2017). The intensity of this browning can increase with the high protein content in the ingredients, because protein accelerates the Maillard reaction, causing the product color to become darker (Roifah et al., 2013). In addition, the presence of sugars and carbohydrates in ingredients such as bran flour also triggers the Maillard reaction during heating, which ultimately affects the final color of the food product produced (Hilman et al., 2019).

Aroma

The aroma assessment of snack bars aims to determine the panelists' level of acceptance of the smell or fragrance produced by the product, whether it comes from the main ingredients, substitute ingredients, or the processing, as well as to determine whether the aroma is liked or disliked. Based on Table 1, the hedonic test results show that the panelists preferred the aroma of snack bar F0 (0% tofu pulp flour). Further testing using Kruskal-Wallis showed a significant difference in the aroma indicator between the control formula and the substitution formula shown (sig 0.000) with a significance level of 5%. To see which groups were different, a Mann-Whitney test was conducted, which showed that the level of preference for the aroma of snack bars with tofu pulp flour substitution was significantly different ($P<0.05$) in F_0 and F_2, F_0 and F_3, and F_1 and F_3.

Based on Table 1, the aroma of the product affects the quality of the snack bar (sig 0.001) with a significance level of 5%. To see which groups are different, a Mann-Whitney test was conducted, which showed that the aroma quality of snack bars with tofu pulp flour substitution was significantly different ($P<0.05$) in F_0 and F_1, F_0 and F_2, and F_0 and F_3. There was a significant difference in the aroma quality of the control formula snack bars compared to the other formulas due to the addition of tofu pulp flour, where the higher the percentage of tofu pulp flour added, the more pronounced the soybean aroma. According to Antara (2014), the aroma of a product can be detected by the sense of smell not only because of the

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presence of volatile compounds in its ingredients, but also because it is influenced by the concentration of ingredients used in the product. This aroma is caused by the action of the lipoxygenase enzyme in soybeans, which reacts with fats and produces an organic compound called ethyl phenyl ketone (Ratnawati, 2018).

Texture

Texture assessment plays a role in providing a pleasant chewing experience and can be influenced by the type of ingredients, the proportion of dry and wet ingredients, and the processing method. In general, snack bars have varying textures, such as crunchy, chewy, or dense. Based on Table 1, the hedonic test results show that the panelists preferred the texture of snack bar F_2 (70% tofu pulp flour), which had a dense texture but was not as dense as F_3 (80% tofu pulp flour). Further testing using the Kruskal-Wallis test showed no significant difference in preference for the texture indicator between the control formula and the substitution formula (sig 0.496) at a 5% significance level. The average panelist preference score for texture was 3, which means “slightly like.” This indicates that the product texture was still within the panelists' acceptance range, although there was no significant increase in preference scores.

Based on Table 1, the texture of the product affects the quality of the snack bar (sig 0.036) with a significance level of 5%. To see which groups were different, a Mann-Whitney test was conducted, which showed that the texture quality of snack bars with tofu pulp flour substitution was significantly different ($P<0.05$) in F_0 and F_2, as well as F_0 and F_3. The addition of tofu pulp flour to different snack bars can produce varying levels of density due to the high crude fiber content, which has the ability to bind water and inhibit the gelatinization process of starch. This is in line with Wati's (2013) research, which also showed that although the addition of tofu pulp flour can increase the protein and fiber content in snack bars, it also affects the texture and density of the product, making the product structure more solid and feel denser when consumed.

Taste

The taste assessment of snack bars aims to evaluate the panelists' level of preference for the product's taste, which is one of the main determining factors in

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consumer acceptance. This assessment is important to determine whether the substitution of ingredients such as tofu pulp flour has a significant effect on taste characteristics. In general, snack bars have varying tastes depending on the type of main ingredients and additives. Based on Table 1, the hedonic test results show that the panelists liked the taste of snack bar F_0 (0% tofu pulp flour). Further testing using the Kruskal-Wallis test showed no significant difference in preference for the taste indicator between the control formula and the substitution formula (sig 0.006) with a significance level of 5%. The average preference score of the panelists for taste was 3, which means "slightly like." This indicates that the taste of the product is still within the panelists' acceptance limits even though there was no significant increase in preference value.

Based on Table 1, the taste of the product affects the quality of the snack bar (sig 0.002) with a significance level of 5%. To see which groups were different, a Mann-Whitney test was conducted, which showed that the taste quality of snack bars with tofu pulp flour substitution was significantly different ($P<0.05$) in F_0 and F_2, F_0 and F_3, and F_1 and F_3. Although according to Koswara (2002) the addition of tofu pulp flour has the potential to increase the levels of compounds that cause a rancid smell and bitter taste, such as saponins, lipoxygenase, hemagglutinin, and anti-trypsin, the panelists' assessment of the snack bar flavor was 4, which means "not bitter" and could be due to the use of good quality soybean pulp and an optimal processing method, thereby reducing the content of compounds that cause a bitter taste. However, preference for the taste still decreased with increasing amounts of tofu pulp flour, as written by Wijaya (2023), where there was a pattern of decreasing preference for peanut cookies formulated with tofu pulp flour at higher concentrations, which reduced panelists' preference for the taste due to the appearance of a bitter aftertaste. Thus, although the final taste is still acceptable, too high a concentration of tofu pulp flour tends to reduce consumer acceptance.

Overall

The overall assessment of the snack bar aims to determine the panelists' final acceptance level of the product as a whole, taking into account all organoleptic aspects,

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including color, aroma, texture, and taste. Based on Table 1, the hedonic test results show that, on average, the panelists liked the snack bar as a whole at F_0 (0% tofu pulp flour). Further testing using the Kruskal-Wallis test showed no significant difference in final results between the control formula and the substitution formula (sig 0.114) at a 5% significance level. The average panelist preference score for the overall results was 3, which means "slightly like." This indicates that the product is still within the panelists' acceptance limits even though there was no significant increase in preference value.

Determination of Selected Products

The selected snack bar products were determined using the exponential comparison method, which is a method of alternative decision making that has multiple criteria and determines priority order by considering the results of hedonic tests, hedonic quality, and fiber content, which have different weights. The results of the selected product determination are attached in Table 2.

Based on Table 2, it can be concluded that snack bar F_1 with 60% tofu pulp flour substitution is preferred by panelists over other snack bar formulations.

Table 2. Selected Product Assessment Scores

Parameter	Treatment			
	F0	F1	F2	F3
		Hedonic Test		
Texture	0,8	0,4	0,2	0,6
Taste	0,15	0,3	0,45	0,6
Color	0,1	0,2	0,3	0,4
Aroma	0,02	0,04	0,06	0,08
Overall	0,03	0,06	0,09	0,12
		Hedonic Quality Test		
Dense Texture	0,8	0,6	0,4	0,2
Bitter Taste	0,15	0,3	0,45	0,6
Brown Color	0,4	0,2	0,3	0,1
Tofu Aroma	0,02	0,04	0,06	0,8
		Nutritional Content		
Fiber*	0,12	0,09	0,06	0,03
Total	2,59	2,23	2,37	2,81

*Primary data from laboratory tests

Nutritional Content of Selected Snack Bars

The snack bars analyzed for macro nutrients and dietary fiber content were selected from organoleptic tests, namely F_1

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snack bars with 60% tofu pulp flour substitution. The nutritional content of F_1 snack bars with 60% tofu pulp flour substitution can be seen in Table 3.

The dietary fiber content obtained during laboratory testing with two repetitions, the results of which were averaged, was 16.755 grams of dietary fiber per 100 grams of snack bar. According to BPOM RI (2022) regulations, solid foods can be labeled as a source of fiber if they contain at least 3 grams of fiber per 100 grams of product. Meanwhile, to be labeled as a high-fiber food, the fiber content must reach a minimum of 6 grams per 100 grams.

Based on BPOM RI Regulation (2022), solid foods can be labeled as a source of fiber if they contain at least 3 grams of fiber per 100 grams of product, and are considered high in fiber if the fiber content reaches a minimum of 6 grams per 100 grams. Meanwhile, for protein source claims, solid products must meet a minimum of 20% of the Nutrition Labeling Values (NLV) per 100 grams, while for high-protein claims, the protein content must reach at least 35% NLV per 100 grams of product. Based on these criteria, if re-evaluated, the snack bar using 60% tofu pulp flour substitution can be categorized as a high-fiber and protein-rich product, as the fiber content in 100 grams of the snack bar exceeds 6 grams and contains over 12 grams of protein.

Table 3. Nutritional Content and Serving Size of F1 60% Tofu Waste Flour Snack Bars

Nutritional Content		
Parameter	Unit	Result
Ash	%	2,035
Energy from fat	Kkal/100 g	190,71
Total fat	%	21,19
Water	%	15,49
Total calories	Kkal/100 g	435,85
Carbohydrate	%	47,125
Protein	%	14,16
Dietary fiber	%	16,755
Nutrition Fact		
1 serving per container		
Serving size 1 bar (30 g)		
Amount Per Serving		
Calories 130 kcal		
Energy from fat 57 kcal		
		% Daily Value*
Total carbohydrate	14 g	4%
Protein	4 g	7%
Total fat	6 g	9%

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Nutritional Content		
Parameter	Unit	Result
Dietary fiber	5 g	17%
**The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet 2,500 calories a day is used for general nutrtion advice.*		

kcal :Kilocalorie

Recommended Serving Size for Selected Snack Bars

Serving suggestions play an important role in helping to prevent excessive or insufficient nutritional intake from consuming a food product. According to BPOM (2019), a serving size is the amount of processed food that is generally consumed in one meal, expressed in metric units or household measures (HM), BPOM RI (2021), depending on the type of food product. With serving suggestions, consumers can determine the appropriate amount of consumption based on their nutritional needs, referring to the Nutrition Label Reference (NLR), which is a guideline for listing nutritional information on food product labels. Information regarding serving suggestions is usually included on the packaging label, indicating the serving size, which is the portion typically consumed in one meal and expressed in household measurements.

Serving suggestion for one snack bar as a snack contains 130 kcal of calories obtained from 1 piece of snack bar weighing 30 g. Based on the serving suggestion for snack bars, the dietary fiber intake that can be consumed from each package is 5 g. According to the Nutrition Label Reference (NLR) for processed foods, the general dietary fiber requirement is 30 g per day. Consuming one package of snack bars will fulfill 17% of the dietary fiber requirement. The nutritional content of snack bars from the serving suggestion can be seen in Table 3.

Fiber Content of All Snack Bar Formulations

The fiber content of the snack bars showed an upward trend as the percentage of tofu pulp flour in the formulation increased. Formulation F0 (control) had a fiber content of 5.595 grams per 100 grams, which increased significantly in F1 to 16.755 grams. The increase continued in F2 with a fiber content of 17.695 grams, and reached its highest value in F3, which was 22.690 grams. This trend shows that the gradual addition of tofu pulp flour contributes significantly to

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increasing the fiber content of the product. This is in line with the research by Nuri et al. (2017), which states that an increase in the proportion of tofu pulp flour in snack bar formulations will be directly proportional to an increase in the dietary fiber content of the resulting product. Based on the 2022 Indonesian Food and Drug Administration (BPOM) Regulation, F0 is still classified as a source of fiber, while F1, F2, and F3 meet the criteria for high-fiber foods. According to Damat et al. (2008), foods with high fiber content tend to be digested more slowly, thereby helping to lower blood sugar levels after eating (postprandial glucose). This confirms that tofu pulp flour has great potential as an alternative raw material in the development of functional snack bars rich in fiber.

CONCLUSION

Based on the results of the study, the use of tofu pulp flour as a substitute in the production of high-fiber snack bars had a positive effect on panelist acceptance. In addition to increasing the fiber content as the percentage of tofu pulp flour was added, the addition of this ingredient also enriched the protein value of the product. Although there are differences in sensory characteristics compared to conventional products, certain formulations are still able to produce colors, aromas, textures, and flavors that are preferred. These findings indicate that tofu pulp has the potential to be a nutritious and organoleptically acceptable alternative ingredient in the development of functional foods.

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