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Bran Bar Product Development for Athletes (Organoleptic Assessment and Nutritional Content)

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Abstract

Background: Rice milling produces a by-product of rice bran (8-12%) with good nutritional content, which can be used as raw material for making snack bars to optimize athlete performance. **Objectives:** The study aimed to analyze the organoleptic assessment and nutritional content of bran bars as snack bars for athletes. **Methods:** The research was conducted from May to November 2024 at the D III Nutrition Study Programme Cirebon and Saraswanti Indo Global Laboratory. Organoleptic assessment using a completely randomized design and 2 repetitions by 32 students who are active in sports, on the parameters of colour, aroma, taste, texture, and overall with a rating scale of 1 (very dislike), 2 (dislike), 3 (normal), 4 (like), and 5 (very like). Nutritional content analysis included moisture, ash, protein, fat, carbohydrate, fiber, iron, and energy content. The organoleptic assessment was analyzed using the one-way ANOVA test and Duncan's test to determine differences between treatments, while nutrient content was analyzed descriptively. **Results:** Organoleptic assessment showed significant differences between treatments in colour, aroma, taste, texture, and overall parameters (p-value 0.000 <0.05). The best formula based on organoleptic assessment was treatment P2 (average 3.96), almost the same as the control treatment (F0) (average 3.94). However, based on nutritional content, treatment F8 had the lowest water content (15.27 g), highest ash content (4.03 g), lowest fat content (16.28 g), highest protein content (9.24g), highest iron content (8.07 g) and high dietary fiber content (8.07 g). **Conclusion:** The best formula based on organoleptic assessment is F2, but based on nutritional content, F8 is the best formula.

INTRODUCTION

Rice production in 2022 was 54.75 million tonnes of MDG, an increase of 333.68 thousand tonnes (0.61%) compared to 2021 at 54.42 million tonnes of MDG (BPS, 2023). The rice milling process produces rice as the main product of 60-65%, by-products such as rice bran 8-12%, and the rest in the form of husks (Luthfianto, et. al., 2017). A large amount of rice bran has not been proportional to its utilization in Indonesia. During this time, rice bran is only used as animal feed. Rice bran contains 16.5 grams of protein, 21.3 grams of fat, and 49.4 grams of complex carbohydrates including 25.3 grams of dietary fiber. Bran also contains various vitamins and minerals (Tuarita, et. al., 2017). Bran with a myriad of nutritional content can be utilized as raw material for local food, one of which is made into snack bars.

The snack bar is a flour-based solid food with additional ingredients through the baking process. Snack bars can also be developed as an Emergency Food Product by fulfilling critical requirements (Darniadi, 2012). The consumption of snack bars in Indonesia is still very small and some people do

not even know. Only 34.5% of Indonesians are aware of snack bars (Pratiwi, et. al., 2017). Some snack producers in Indonesia have started producing these foods so that they are widely circulated in various supermarkets in Indonesia. Snack bars that have been widely sold in supermarkets and traditional markets are a type of healthy snack that contains a lot of energy, protein, and fiber. However, until now there has not been a bran-based snack bar intended for athletes.

Athletes require greater energy intake than ordinary people. Many athletes are unable to meet nutritional needs to optimize sports performance. This is due to high activity that can increase energy expenditure for metabolism, heat, and hormone synthesis (Braun & Miller, 2008). An athlete's daily nutritional needs change depending on the intensity of their training. Calorie requirements for each athlete range from 2500-5000 calories with proportions such as fat 20-45%, protein 12-20%, and carbohydrates 40-70% (Ministry of Health of the Republic of Indonesia, 2013). The nutritional adequacy of people with normal physical activity with an age range of 13-18 years requires calories ranging from 2100-2700 calories with a food proportion consisting of 60-65% carbohydrates, 20% fat, and 15-20% protein from the total energy needs or output per day (Arsani, et. al., 2014).

Efforts to optimize athlete performance to support their achievements require adequate nutritional intake through the use of rice bran. Rice bran is a by-product of the rice milling process. Bran contains nutrients that are beneficial for human health. However, its utilization is not optimal, including as a snack bar for athletes. Athletes require greater energy intake than ordinary people. However, many athletes are unable to meet their nutritional needs to optimize sports performance. Therefore, it is necessary to develop alternative food products in the form of bran bars that are high in calories, high in protein, and sufficient fiber for athletes.

The research objective was to analyze the organoleptic assessment and nutritional content of bran bars as a snack bar for athletes. The research aims to produce diversified food products processed bran (bran) as a high-calorie high-protein snack bar for athletes to meet energy and protein needs in improving nutritional status performance.

METHOD

Research Type and Design

The type of research is quantitative with experimental methods. The research consisted of two stages, namely organoleptic assessment and nutritional content analysis of bran bars. The organoleptic assessment design used a completely randomized design (CRD) with 9 bran bar formulations including control and 2 repetitions, so there were 18 treatment units. Nutritional content analysis included moisture, ash, protein, fat, carbohydrate, dietary fiber, iron, and energy.

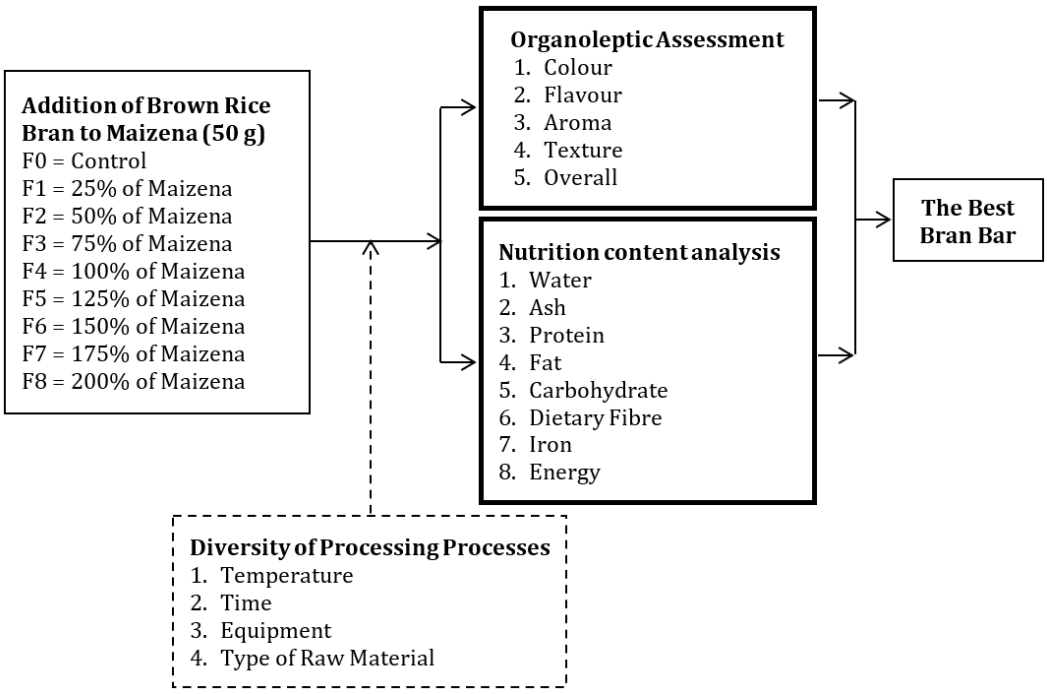

Figure 1. Research Roadmap

The organoleptic assessment design using a completely randomized design (CRD) can be seen in Table 1 as follows.

Table 1. Complete Randomised Design Design of Organoleptic Assessment

Repeat	Description	Treatment								
		F0	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
Repeat 1	Treatment	F0R1	F1R1	F2R1	F3R1	F4R1	F5R1	F6R1	F7R1	F8R1
	Random Code	615	695	112	572	965	187	119	384	587
	Assessment Sequence	7	5	2	8	9	1	4	6	3
Repeat 2	Treatment	F0R2	F1R2	F2R2	F3R2	F4R2	F5R2	F6R2	F7R2	F8R2
	Random Code	889	896	338	937	313	594	158	687	932
	Assessment Sequence	1	7	4	5	2	9	6	3	8

The bran bar formulation as a snack bar for athletes can be seen in Table 2 as follows.

Table 2. Bran Bar Formulation

Raw Materials	F0		F1		F2		F3		F4		F5		F6		F7		F8	
	g	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**
Maizena	50	19.1	50	18.2	50	17.4	50	16.7	50	16.0	50	15.4	50	14.8	50	14.3	50	13.8
Brown Rice Bran	0	0.0	13	4.6	25	4.4	38	4.2	50	16.0	63	19.3	75	22.3	88	25.0	100	27.6
Isolate Whey Protein	20	7.6	20	7.3	20	7.0	20	6.7	20	6.4	20	6.2	20	5.9	20	5.7	20	5.5
Chocolate Powder	10	3.8	10	3.6	10	3.5	10	3.3	10	3.2	10	3.1	10	3.0	10	2.9	10	2.8
Skim Milk	15	5.7	15	5.5	15	5.2	15	5.0	15	4.8	15	4.6	15	4.5	15	4.3	15	4.1
Chicken Eggs	60	22.9	60	21.9	60	20.9	60	20.0	60	19.2	60	18.5	60	17.8	60	17.2	60	16.6
Flour Sugar	60	22.9	60	21.9	60	20.9	60	20.0	60	19.2	60	18.5	60	17.8	60	17.2	60	16.6
Margarine	45	17.2	45	16.4	45	15.7	45	15.0	45	14.4	45	13.9	45	13.4	45	12.9	45	12.4
Salt	1	0.4	1	0.4	1	0.3	1	0.3	1	0.3	1	0.3	1	0.3	1	0.3	1	0.3
Vanilla	1	0.4	1	0.4	1	0.3	1	0.3	1	0.3	1	0.3	1	0.3	1	0.3	1	0.3
Total	**262**	**100**	**275**	**100**	**287**	**96**	**300**	**92**	**312**	**100**	**325**	**100**	**337**	**100**	**350**	**100**	**362**	**100**

Place and Time of Research

The research was conducted from May to November 2024. The process of making bran bars and organoleptic tests was carried out at the Food Laboratory of the D III Nutrition Study Programme, Cirebon, Poltekkes Kemenkes Tasikmalaya, West Java. Nutritional content testing was carried out at the Saraswanti Indo Global Laboratory, Bogor City, West Java.

Bran Bar Manufacturing Process

The process of making bran bar as a snack bar for athletes is described in the form of a flow chart as shown in Figure 2.

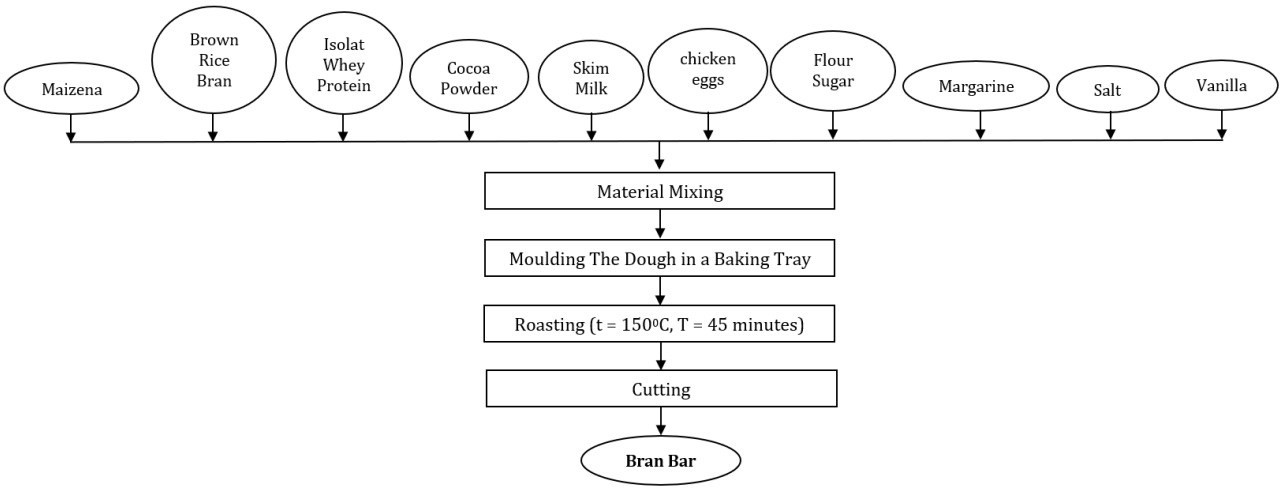

Figure 2. Flowchart of Bran Bar Manufacturing
(Referring to Chandra, 2010)

Data Collection and Analysis Techniques

1. Organoleptic assessment by 30 non-standardized panelists aged 17 - 18 years. The organoleptic assessment was conducted on colour, aroma, taste, texture, and overall parameters. The rating scale consists of 5 scales, namely 1 (very dislike), 2 (dislike), 3 (normal), 4 (like), and 5 (very like). Organoleptic testing was carried out with 2 repetitions on different days at the time between breakfast and lunch, namely 09.00 - 10.00 AM. Organoleptic assessment data with a ratio data scale were analyzed using the one-way ANOVA test. If there is a difference, followed by Duncan's test to determine the difference between treatments.
2. Nutritional content including moisture, ash, protein, fat, carbohydrate, fiber, iron, and energy content was obtained through laboratory testing. Furthermore, the data were analyzed descriptively.

RESULTS AND DISCUSSION

Organoleptic Assessment

One way to determine a person's acceptance of food products is through organoleptic assessment, which is a test that uses the human senses as the main tool for assessing product quality which includes quality specifications for appearance, smell, taste, and texture as well as several other factors needed to assess the quality of the product. Requirements for panelists involved in the organoleptic assessment are interested in sensory testing and willing to participate, able-bodied and free from ENT (Ear, Nose, Throat) diseases, not colour blind and do not have allergies to components of protein source food products (BSN, 2015).

Organoleptic assessment based on the level of liking (hedonic) was carried out on the parameters of colour, aroma, taste, texture, and average. The rating scale consists of 5 scales, namely 1 (very dislike), 2 (dislike), 3 (normal), 4 (like), and 5 (very like). Organoleptic assessment is carried out by panelists, namely people who are in charge of assessing the sensory quality specifications of the product subjectively, in this case, carried out by students who are active in sports regularly. Organoleptic assessment was carried out 2 times Repeat by 32 panellists. The results of the organoleptic assessment are presented in the following table.

Table 3. Results of Organoleptic Assessment of Bran Bar

Treatment	Colour	Aroma	Flavor	Textures	Overall
F0	3.95^{cd}	3.97^{d}	4.19^{d}	3.66^{b}	3.94^{e}
F1	4.02^{d}	3.80^{d}	3.92^{cd}	3.86^{b}	3.90^{de}
F2	3.94^{cd}	3.86^{d}	4.17^{d}	3.86^{b}	3.96^{e}
F3	3.72^{bc}	3.48^{bc}	3.88^{cd}	3.56^{b}	3.66^{bc}
F4	3.80^{bcd}	3.22^{ab}	3.44^{b}	3.50^{b}	3.49^{b}

F5	3.70^{bc}	3.67^{cd}	3.73^{bc}	3.73^{b}	3.71^{cd}
F6	3.56^{b}	3.44^{bc}	3.64^{bc}	3.59^{b}	3.56^{bc}
P7	3.22^{a}	3.19^{ab}	3.09^{a}	3.08^{a}	3.14^{a}
P8	3.08^{a}	3.09^{a}	2.97^{a}	2.92^{a}	3.02^{a}
P-value	*0.000**	*0.000**	*0.000**	*0.000**	*0.000**

*Description: *each different letter states significantly different at the 5% level*

Colour is the first sensory that can be seen directly by panelists and determines the quality of food. The determination of food quality generally depends on its colour. Colour that does not deviate from the colour it should be will give the impression of its own assessment by panelists (Negara, et. al., 2016). The assessment of colour aims to prove that the panelists are not colour blind (BSN, 2015). Based on the results of ANOVA analysis on the colour parameter of bran bar, there was a significant difference between treatments (p-value 0.000 <0.05). The colour of Treatment F7 and F8 had no difference. The colour of Treatment F0, F1, F2, F3, F4, F5, F6 has no difference. Since there were differences in colour between treatments, it was determined that the best colour was Treatment F1 (average 4.02), higher than the control treatment (F0) (average 3.95). Treatment F1 had the darkest brown colour and was preferred by the panelists compared to the other treatments, this is because as the concentration of brown rice bran increases, the brown colour fades.

Aroma is an odour caused by chemical stimuli smelled by olfactory nerves in the nasal cavity (Negara, et. al., 2016). Aroma is considered very important because it can quickly give the results of whether a food product is liked or not (Wadli & Hasdar, 2022). Aroma is one of the factors determining the quality of food products, where food products that have been damaged will experience a deterioration in the quality of the aroma (BSN, 2015). Based on the results of ANOVA analysis, the aroma parameter of the bran bar shows a significant difference between treatments (p-value 0.000 <0.05). Based on Duncan's further test, the difference between each treatment, including the control, can be said that there is no difference between treatments. Thus, it was determined that the best aroma was Treatment F2 (average 3.86), lower than the controlled Treatment (F0) (average 3.97). The aroma of Treatment F2 is more favorable than the aroma of other treatments, because the more the concentration of brown rice bran increases, the less favorable the aroma is because the more the aroma of brown rice bran is felt.

Flavor is one of the factors that can determine product acceptance by consumers. Assessment of taste aims to measure the ability of panelists, in general, to taste basic flavors, especially sour and bitter flavors, so that panelists can feel the deterioration of food products (BSN, 2015). Based on the results of the ANOVA analysis of bran bar flavor parameters, there was a significant difference between treatments (p-value 0.000 <0.05). The flavor of Treatment F7 and F8 had no difference. The taste of Treatment F0, F1, F2, F3, F4, F5, F6 had no difference. Since there were differences in taste between treatments, it was determined that the best taste was Treatment F2 (average 4.17), almost the same as the control treatment (F0) (average 4.19). The taste of P2 is more preferred than the taste of other treatments, because the more the concentration of brown rice bran increases, the taste is less preferred because it tastes worse due to the more pronounced taste of brown rice bran.

Texture is an important parameter in the assessment of various types of products. The texture is a stimulus sensation that can be felt with the sense of touch, which is more sensitive to touch (Wadli, et. al., 2022). Assessment of texture by touching food products related to firmness and elasticity (BSN, 2015). Based on the results of ANOVA analysis of the texture parameters of the bran bar showed significant differences between (p-value 0.000 <0.05). Texture Treatment F7 and F8 had no difference. The texture of Treatment F0, F1, F2, F3, F4, F5, F6 has no difference. Since there were differences in texture between treatments, it was determined that the best texture was Treatment F1 and F2 (average 4.02), higher than the control treatment (F0) (average 3.66). The texture of Treatment F1 and F2 is softer than the other treatments, where the more the concentration of brown rice bran increases, the denser and harder the texture will be.

The overall organoleptic assessment is a panelist assessment of the product to determine the level of panelist preference for all organoleptic parameters (Rachmayani, et al., 2017). The average assessment is used to determine the best product based on all organoleptic parameters. The average assessment is the average assessment of all organoleptic parameters assessed including colour, aroma,

taste and texture carried out by researchers. Based on the results of ANOVA analysis of all bran bar parameters, there were significant differences between treatments (p-value 0.000 <0.05). The mean organoleptic parameters of Treatment F7 and F8 had no difference. The mean organoleptic parameters of Treatment F0, F1, F2, F3, F4, F5, F6 have no difference. Since there is a difference in the mean between treatments, it is determined that the best mean is Treatment F2 (average 3.96), almost the same as the control treatment (F0) (average 3.94).

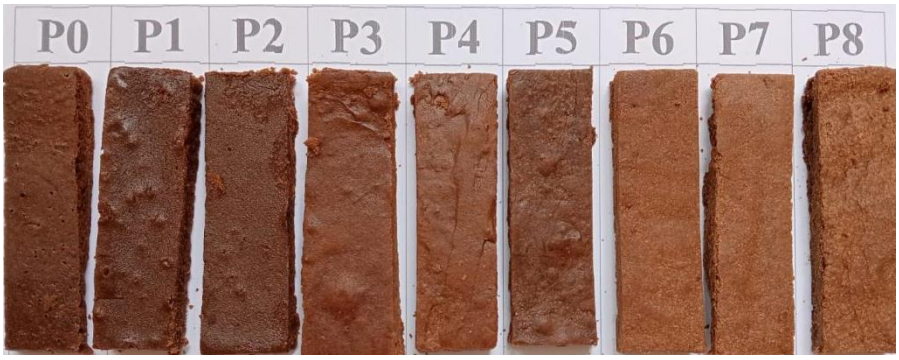

Figure 3. *Bran Bar*

Nutritional Content

The nutritional content of bran bars includes water, ash, total fat, protein, carbohydrate, iron, and dietary fiber. The nutrient content between treatments can be seen in the table below.

Table 4. Nutritional Content of Bran Bar per 100 g

Types of nutrients	F0	F1	F2	F3	F4	F5	F6	F7	F8
Water (g)	16.37	17.35	18.43	17.50	16.20	18.18	16.29	18.43	15.27
Ash (g)	2.16	2.30	2.54	2.80	3.30	3.25	3.56	3.77	4.03
Total Fat (g)	18.55	18.28	18.55	17.15	17.16	17.13	17.68	17.67	16.28
Protein (g)	6.63	6.54	7.10	7.20	7.92	7.54	8.67	9.13	9.24
Carbohydrates *by Difference* (g)	56.30	55.50	53.39	55.36	55.43	53.91	53.81	51.01	55.19
Iron (mg)	2.17	2.78	3.18	4.14	4.35	4.69	6.08	6.76	7.92
Dietary Fiber (g)	6.67	6.02	8.61	7.16	6.05	6.41	8.53	7.61	8.07
Energy from fat (kkal)	166.91	164.48	165.56	154.35	154.44	154.17	159.12	159.03	146.48
Total Energy (kcal)	418.61	412.80	408.85	404.57	407.84	399.95	409.00	399.57	404.20

Based on the nutritional content, it is known that Treatment F8 has advantages compared to other formulas. The nutritional advantages of Treatment F8 include the lowest water content (15.27 g), the highest ash content (4.03 g), the lowest fat content (16.28 g), the highest protein content (9.24 g), the highest iron content (8.07 g) and high dietary fiber content (8.07 g).

The best product based on organoleptic assessment is Treatment F2, which is different when compared to its nutritional content. Based on nutritional content, Treatment F8 has an advantage over Treatment F2 and other formulas. The nutritional advantages of bran bar Treatment F8 include the lowest water content (15.27 g). The moisture content in the product greatly affects the quality of the food product, the lower the moisture content contained, the food product has a longer shelf life (Handayani, et. al., 2022).

The ash content of bran bar Treatment F8 was the highest (4.03 g). Ash is an inorganic substance left over from the combustion of an organic material. Ash content is a mixture of inorganic or mineral components found in food. Food consists of 96% inorganic materials and water, while the rest are mineral elements. The ash content can show the total minerals in a food. Organic materials in the combustion process will burn but the inorganic components will not, which is why it is referred to as ash content (Nurhidayah et. al., 2019).

The fat content of bran bar Treatment F8 was the lowest (16.28 g). Fat and oil are found in almost all types of food and each has a different amount of content. Therefore, it is very important to

analyze the fat content of a food ingredient so that the calorie requirement of a food ingredient can be calculated properly because 1 g of fat produces 9 kcal (Pargiyanti, 2019).

The protein content of bran bar Treatment F8 was the highest (9.24 g). Protein is a polypeptide macromolecule composed of a number of amino acids connected by peptide bonds. Amino acids consist of the elements carbon, hydrogen, oxygen, and nitrogen. The element nitrogen is the main element of protein as much as 16% of protein weight. Protein molecules also contain phosphorus, and sulfur, and there are types of proteins that contain metal elements such as copper and iron (Probosari, 2019).

The iron content of bran bar Treatment F8 was the highest (8.07 g). Iron is required in the process of hematopoiesis (blood formation), namely the synthesis of hemoglobin (Hb). Iron is an important micro mineral in the formation of haemoglobin which functions in the transport, storage, and utilisation of oxygen. Therefore, iron deficiency can lead to pallor, weakness, fatigue, dizziness, lack of appetite, decreased fitness, decreased ability to work, decreased immunity, and impaired wound healing (Yunida et. al., 2022).

The dietary fiber content of bran bar Treatment F8 was high (8.07 g). In general, the dietary fiber content of food will be higher than its crude fiber content. In other words, if a food contains high crude fiber, its dietary fiber content will be higher. The high content of crude fiber in a food product can facilitate the digestive metabolic process in the body, thus having better health effects compared to food products that have low crude fiber. A food product can be called a source of fiber if it contains dietary fiber of at least 3%, and is called high fiber if it contains dietary fiber of at least 6% (Hidayat et. al., 2016). Thus, it can be said that bran bar products are high-fibre food products.

Referring to the Peraturan Kepala Badan Pengawas Obat Dan Makanan Republik Indonesia Nomor 9 Tahun 2016 concerning Nutrition Label Reference for the public, the Treatment F8 snack bar per serving (50 g) can meet 12% total fat, 8% protein, 9% total carbohydrates, 18% iron, 13% dietary fiber %, and 9% energy. The nutritional contribution of the bran bar to the nutrition label reference per day can be seen in the following table.

Table 5. Nutritional Contribution of Treatment F8 to the Daily Nutrition Label Reference

Types of Nutrients	Nutritional Content of Treatment F8		Reference Nutrition Label (RNL) (per day)**	F8 Nutritional Contribution per serving to RNL(%)***
	Per 100 g*	per serving (50 g)*		
Total Fat Content (g)	16	8	67	12
Protein (g)	9	5	60	8
Carbohydrates *by Difference* (g)	55	28	325	8
Iron (mg)	8	4	22	18
Dietary Fiber (g)	8	4	30	13
Total Energy (kcal)	400	200	2150	9

Description: * Values are rounded, ** Peraturan Kepala Badan Pengawas Obat Dan Makanan Republik Indonesia Nomor 9 Tahun 2016 Tentang Acuan Label Gizi untuk umum

*** Referring to the calculation formula Hizni, et al (2024):

$$\text{Nutritional Contribution} = \frac{\text{Nutrition Content Per Serving}}{\text{Reference Nutrition Label Per Day}} \times 100\%$$

CONCLUSIONS AND RECOMMENDATIONS

The organoleptic assessment showed significant differences between treatments in colour, aroma, taste, texture, and overall parameters (p-value 0.000 <0.05). The best formula based on organoleptic assessment was Treatment F2 (average 3.96), almost the same as the controlled Treatment (F0) (average 3.94). However, based on nutritional content, Treatment P8 had the lowest moisture content (15.27 g), highest ash content (4.03 g), lowest fat content (16.28 g), highest protein

content (9.24 g), highest iron content (8.07 g) and high dietary fiber content (8.07 g). The recommended bran bar product to optimize the fulfillment of nutritional intake for athletes is Treatment 8 with nutritional advantages over other Treatments.

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