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# Rice Bran Substitution to Vitabran as A Snackyfication Trend Model and Diabetes Mellitus Prevention

Oktia Woro Kasmini Handayani[1]✉, Arif Rahmat Kurnia[2], Siti Fathonah[3]

[1]Public Health Science, Universitas Negeri Semarang, Indonesia
[2]Semarang Health Training Center, Ministry of Health of the Republic of Indonesia
[3]Cullinary Art, Universitas Negeri Semarang, Indonesia

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**Abstract**

Snackyfication is a trend where snacks as a substitute for staple food are more efficient. On the other hand, the Diabetes Mellitus case increases, and it is related to unhealthy foods, so there is a need for healthy foods on the market. The research objective was to find which product formula would be recommended as Vitabran. Vitabran is made from rice bran, while additional ingredients are yellow sweet potato pulp, cornstarch, soy milk, flour, eggs, honey, baking powder, margarine, and oats. The formula tested consists of 2 variations of bran content (20% and 30%). The product was made of biscuits in the form of bars. The tests consisted of 1) organoleptic test 2) hedonic test. 3) proximate test and 4) Glycemic Index test. The final result of functional food substitution is a synergistic effect of the functional substances contained therein.

## Introduction

Currently, Indonesia is in 7th place in the world regarding DM sufferers. It tends to increase from 5.7% in 2007 to 6.9% in 2013 and 8.5% in 2018 (RI, 2014). The treatment is lasting for a lifetime, which results in family financial burdens, thus increasing the severity of symptoms and grievance in sufferers(Sneha & Jyotsna, 2017; Tol et al., 2013; Casqueiro & Casqueiro, 2012; Yu, 2014). Lifestyle-related to eating habit is the main reason for the increase in cases of DM (Begic & Arnautovic, 2016; Silva, 2012; M, 2016; Aye & Aung, 2014; Chakraborty et al., 2018; Handayani, 2019). It including snacks that are often consumed are high in carbohydrates, as well as high fat, which has a response to a potential increase in blood sugar or a high glycemic index (GI) (Handayani, 2019; Chakraborty et al., 2018; Malviya & Jain, 2010). Snackyfication is a new trend in consuming food by the millennial community, food in the form of snacks eaten several times a day and carried out simultaneously with activities (without special time), and can meet the body's energy needs. Snackyfication, which can be said to be a snack, must be supported by healthy food substances and does not affect the DM cases addition in the community.

The results found several local food ingredients that are also consumed as functional foods and have a low GI, which can be used to support the treatment of DM sufferers and prevention of non-sufferers, such as rice bran flour and sweet potato (W, 2015; Ayeleso & Ramachela, 2016; Chakraborty *et al.,* 2018; Sivamaruthi & Kesika, 2018; Das *et al*., 2014). Rice bran flour is a by-product of rice processing that is rich in nutrients such as dietary fiber, minerals, vitamin B complex, vitamin E, essential fatty acids, amino acids, and antioxidants (W, 2015; Das *et al*., 2014; Sivamaruthi & Kesika, 2018). Sweet potatoes

✉ Correspondence Address:
Public Health Science, Universitas Negeri Semarang, Indonesia
Email: oktia.woro1@gmail.com

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contain carbohydrates, fat, and protein. It contains high fiber, vitamin A and potassium minerals (Aye & Aung, 2014; Rose IM, 2011). This food ingredient is widely grown in Indonesia and is easily available at an affordable price, so it is an effort to conserve food, and has an effect on improving blood sugar levels, as well as other health effects, such as anti-infection, anti-oxidant, so that it can be used for snackyfication in a form that is preferred, and selected in the form of a bar. The research problems are: 1) How is the acceptance of target consumers for products related to the organoleptic test and hedonic test at bran levels of 20% and 30%. 2) What are the proximate product test results at bran content of 20%, and 30%. 3) Which product formula to recommend as Vitabran. 4) What is the Vitabran IG value.

The urgency of this research is related to the trend of snacks as a substitute for staple foods. It is considered more efficient (snackyfication), an increase in DM cases in the community affecting the quality of human resources, health financing, decreased performance. On the other hand, the main cause of the increase in DM cases is related to the consumption of unhealthy food. So there is a need for availability or supply of healthy food in the market, favored and affordable by the community, both for preventive purposes and to support the successful treatment of DM sufferers. So it is necessary to test the usage of rice bran as a snack, which in this study the product produced is called Vitabran.

**Method**

The ingredients consist of rice bran as base ingredients. Additional ingredients include yellow sweet potato pulp, cornstarch, soy milk, wheat flour, eggs, honey, baking powder, margarine, and oats. The tested Vitabran formula consisted of 2 kinds of rice bran content (20% and 30%), with the formula according to Table 1.

To obtain fresh rice bran. Fresh rice bran is seen from its fresh brown color, not rancid aroma, and contains no contaminants. After that, the rice bran is sieved using an 80 mesh sieve. This sieve is chosen to ensure that all contaminants are properly filtered. The sieved rice bran is then sterilized using an autoclave at 121$^{o}$C for 3 minutes. After autoclaving, the bran is drained until the moisture is gone, then it is baked at 105$^{o}$C for 1 hour. Then, it is cooled and packed in plastic storage added with silica gel.

The Vitabran making begins with making a dough, which is made by mixing rice bran flour, yellow sweet potato porridge, cornstarch, soy milk flour, wheat flour, egg white, honey, baking powder, and margarine which is then kneaded into a smooth dough. The dough is then flattened in a pan having a thickness of 2 cm and then cut into pieces measuring 12 cm long and 3 cm wide. Before baking, the dough that has been molded is smeared with egg yolk and greased with oats. Roasting is then carried out for 20 minutes, with a reversal after the first 10 minutes.

The product was tested by organoleptic analysis to determine the value of the preferred color, texture, taste, aroma. The hedonic test was carried out to determine the preferred formula of all Vitabran formulas. Proximate analysis by moisture content and ash content

Table 1. Vitabran Formula

| No | Substances | Formula 1 | Formula 2 |
|---|---|---|---|
| 1 | Rice Bran | 20% | 30% |
| 2 | Yellow sweet Potato porridge | 40% | 30% |
| 3 | Corn starch powder | 14% | 14% |
| 4 | Soy bean milk | 10% | 10% |
| 5 | Baking powder | 1% | 1% |
| 6 | Margarine | 10% | 10% |
| 7 | Honey | 5% | 5% |
| 8 | Oats | | |

using the oven method (Akhtar & Anjum, 2011; Hussain J, 2009), protein content using the Kjeldahl (Akhtar & Anjum, 2011). Micro method, fat content using the Soxhlet (Akhtar & Anjum, 2011) method, carbohydrate content using carbohydrate by difference (Akhtar & Anjum, 2011), Analysis of food fiber content (Aye & Aung, 2014; Hussain J, 2009).

Sensory analysis was carried out on trained panelists aged 25-40 years. Ten people (five male and five female) using a quality scale of 9 points, (1 very low quality and 9 very very good quality) (Saji *et al*., 2019; Civille, 2012). Aspects considered for analysis are color, texture, sweetness, aroma, and overall quality. The assessment of the level of product preference was carried out by 80 consumer panelists, with an acceptability test with a preference scale of 1 - 9. The value of 1 was very disliked, up to the value of 9 was very very like (Saji *et al*., 2019; Iannario *et al*., 2012). This proximate test was tested by an independent sample t-test to know the difference in the chosen formula.

Assessment of the Glycemic Index (GI), using adult human volunteer panelists, consisting of five males and five females, the criteria for the panelists are in good health, do not suffer from diabetes, aged 25-40 years, have a standard body mass index (BMI) (18 -25 kg / m2). The sample with the GI contains 40 g of total carbohydrates is then given to the panelists who have undergone a fast (except water) for one night (around 8.00 pm to 08.00 am). For 2 hours in 30 minutes intervals after giving the tested product, 20 µL of blood samples were taken using the finger-prick capillary blood samples method (measurement 0, 30,60,90, and 120 minutes). As a standard (reference food), blood sugar levels were also measured by giving 50 g of pure glucose (d-glucose anhydrous) to the panelists. Measurement of blood glucose levels between the reference food and product testing is given a 7-day interval (1 week). The data were analyzed by the t-test to compare the reference food GI with the product GI.

**Results and Discussion**

The process of making biscuit bars begins by trying six formulas for the combination of mixed ingredients to get a texture of biscuits that is not easily broken (compact). The color is not too brown, but with a crunchy taste, without changing the composition of the main ingredients, namely rice bran content of 20% and 30% with sweet potato content of 40% and 30%. We get two formulas which are then tested organoleptic, proximate, and GI test. The

Table 2. Results Of Sensory Quality Assessment (Organoleptic Test)

| Product Assestment | Overall | Color | Aroma | Crispy/ Texture | Sweetness | Sweet Potato Taste | Total Score |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Vitabran F1 | 49 | 46 | 48 | 44 | 45 | 45 | 277 |
| Vitabran F2 | 53 | 49 | 55 | 52 | 47 | 53 | 309 |

Table 3. Hedonic Test Assessment Results

| Product Assestment | Overall | Color | Aroma | Crispy/ Texture | Sweetness | Sweet Potato Taste | Total Score |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Vitabran F1 | 488 | 484 | 438 | 429 | 447 | 475 | 2761 |
| Vitabran F2 | 503 | 495 | 515 | 509 | 458 | 482 | 2962 |

Table 4. Proximate Content In Biscuits F1 And F2 And Difference Test Results

| Biscuits | Average | | | | | |
|---|---|---|---|---|---|---|
| | Carbohydrate (%) | Protein (%) | Fat (%) | Water (%) | Ash (%) | Crude Fiber(%) |
| Vitabran F1 | 63.149 | 10.648 | 6.203 | 0.083 | 17.413 | 2.219 |
| Vitabran F2 | 68.286 | 11.161 | 6.540 | 0.073 | 13.010 | 0.442 |
| p-value | 0.000 | 0.003 | 0.005 | 0.251 | 0.000 | 0.000 |

results of the sensory quality score were carried out on ten panelists. Overall the biscuit bar 2 had a higher value of 53, as well as the total value of each aspect assessed which was 309, while the highest value was in the aroma aspect of 55 (Table 2).

The results of the favorite value or hedonic test conducted on 80 consumer panelists. Overall, the highest value was in Vitabran F2, namely 503, and the highest total of all assessed aspects was also found in Vitabran F2, which was 2962, and the highest value was in this aspect. Aroma with a value of 515 (Table 3).

The results of the proximate test showed that the carbohydrate, protein, and fat content was higher in the Vitabran F2 while the water, ash, and crude fiber content was higher in the Vitabran F1 (Table 4). Meanwhile, the difference test resulted in a significant difference in carbohydrate, protein, fat, ash, and crude fiber between Vitabran F1 and F2. In the water content test, there was no significant difference between Vitabran F1 and F2.

Vitabran selected for the GI test is by the Vitabran F1, based on the following considerations: 1) Proximate test results, which contain lower carbohydrates, fat, higher protein, ash, and crude fiber. 2) hedonic test results, where the overall value between Vitabran F1 and F2 is not too striking (15 points or a value of 503 and a value of 488), or in other words, it is still acceptable to target consumers. GI results are calculated based on examination of blood sugar I (for panelists when consuming 50 g of pure glucose or anhydrous d-glucose) and blood sugar II (for panelists when consuming Vitabran which contains 40 g of carbohydrates or the equivalent of 63,277 g of Vitabran biscuits or about 5 pieces. biscuit Vitabran), the GI results were 65.091 (moderate category).

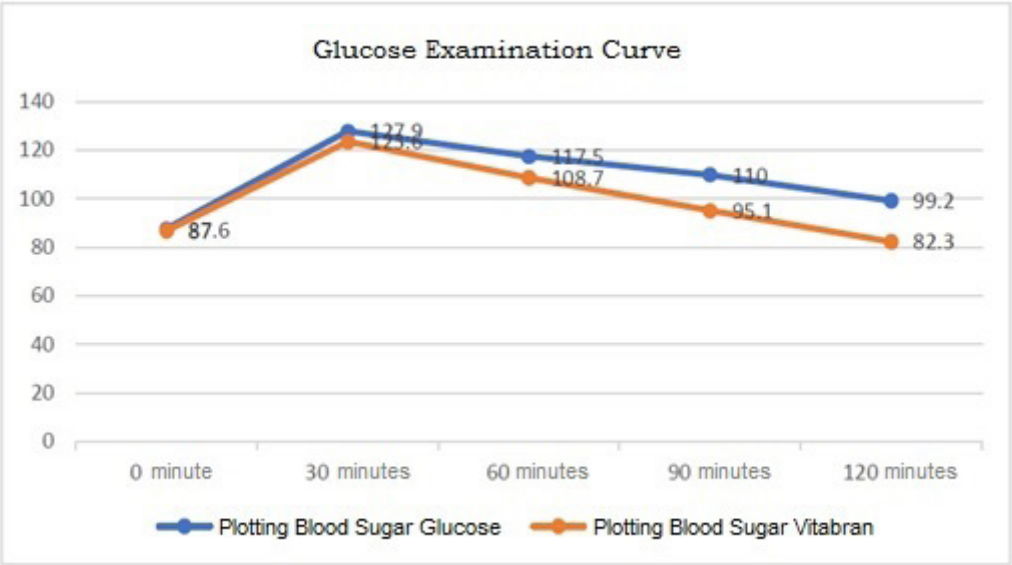


Figure 1. Glucose Examination Curve

The proximate and hedonic tests associated with the sensory and the preference test concluded that the biscuit bar 2 formula with higher rice bran content (30%) and lower yellow sweet potato (30%). The formula is preferred by the panelists (in terms of the value of sweetness, color, aroma, crunchiness, texture). Although the rice bran content in the Vitabran F2 is higher than the Vitabran F1, this is possible because the composition resulting from the added sweet potato content can make the aroma and crunchiness more delicious and received by the panelists. It was as expressed by the panelist :

"Biscuit number one is a bit soft or not crunchy, I really prefer number two. Is this made from rice bran? how come it doesn't taste, like biscuits made from flour, if it doesn't cause a rapid rise in blood sugar, I would also like to provide for snack"

Based on the proximate test results, Vitabran F2 has a higher carbohydrate content than Vitabran F1, with a difference of 5.355. Includes a higher content of protein and fat. Meanwhile, the ash and crude fiber content are low. It is probably due to the effect of the rice bran which is given in a higher concentration in the biscuit bar 2 formula where the bran contains higher carbohydrates and protein than the sweet potato. The results of other studies show that per 100 grams of rice bran contains 50 grams of carbohydrates, 16.5 grams of protein, 21.3 grams of fat, and 0.9 grams of magnesium, while per 100 grams of sweet potato contains 20.1 grams of carbohydrates, 1.6 grams of protein., 0.05 g fat and 25.70 mg magnesium (M, 2016; Chakraborty *et al*., 2018; Handayani, 2019).

The Vitabran formula chosen for the GI test on panelists is the most beneficial formula based on the proximate test, namely the Vitabran F1. Glycemic index is the time required for the increase or the increased speed in blood sugar levels after consuming food which is equivalent to 50 g carbohydrates (Rose, 2011; Sivamaruthi & Kesika, 2018; Aye & Aung, 2014). Such as the results of research which states that the rate of increase in blood sugar levels is different for each food ingredient, in this case, it is classified into low GI <55, medium GI 55-70, and high GI> 70 foods. Carbohydrates that are broken down quickly in the body during digestion have a high GI value, whereas carbohydrates that are broken down slowly will release glucose into the blood slowly so that they have a low GI (Marciani, 2013; Bornhorst, 2012; Lee, 2014). The results of the Glycemic Index (GI) examination on volunteers who were given Vitabran consumption was categorized as moderate (65.091). It is possible because the overall composition of Vitabran will have a synergistic effect that comes mainly from rice bran and sweet potato, as stated in the results which state that the effect on GI is a synergistic effect of the bran content consisting of 34% -62% carbohydrates, 15% -20% fat, 11% -15% protein, 7% -11% fiber, minerals, such as Phosphorus, Potassium, Magnesium, Calcium, and strong anti-oxidants (Chakraborty *et al.,* 2018; Sivamaruthi & Kesika, 2018). Other supporting research results suggest that the anti-diabetic effect that occurs after rice bran supplementation is a synergistic effect of various compounds such as acylated steryl glycerides, flavonoids, resveratrol, oryzanol, ferulic acid, policosanol, tocotrienol, hydroxycinnamic acid derivatives, and several bioactive peptides (Brennan *et al*., 2012; Saji *et al.*, 2019; Hong *et* al., 2017). Meanwhile, fortification of rice bran with wheat in the form of sausage and bread obtained an increase in satiety compared to sausage and whole wheat bread without rice bran, besides that fortification in snack products prolongs the glucose release period and shows the potential to increase satiety (Brennan *et al*., 2012; Sivamaruthi & Kesika, 2018; Akhtar & Anjum, 2011; Hallberg & Brune, 1986).

Magnesium in rice bran can cause increased glycemic control and prevent resistance to insulin from working optimally (Das *et al*., 2014), while the strong anti-oxidants in rice bran can help manage the incidence of DM associated with oxidative stress (Chakraborty *et al.,* 2018; JG, 2014).

The effect of adding sweet potato mixed to Vitabran (in the biscuit formula 1), which tested the Glycemic Index results in a proximate test that is more supportive towards lower GI results, if one looks at a lower content of carbohydrates (63,214), and higher in ash. (17.44) and crude fiber (2,232). The results of

the research are in line with the nutritional content of sweet potatoes per 100 grams, including calories (86kcal), carbohydrates (20.1g), fat (0.1 g), protein (1.6g), fiber (1.7g), high vitamin A (709µg), high in the mineral potassium (337mg). Or other proximate analysis results of yellow sweet potato per 100 grams are 20.12 g carbohydrates, 1.57 g protein, 3 g fiber, 0.05 g lipids, various kinds of vitamins such as Thiamin, Riboflavin, Niacin, B6, B9, vitamin C, vitamin K, and vitamin A, as much as 14187 IU. Various minerals such as Calcium 30.78 mg, Iron 0.61 mg, Magnesium 25.70 mg, Phosphor 47.81 mg, Potassium 337 mg, Sodium 55 mg. The effect of lowering blood glucose in sweet potatoes is associated with increased adiponectin levels, which is an adiposity hormone that functions as a metabolic process for insulin (Ayeleso & Ramachela, 2016; Kalyani, 2009). The sweet potato's carbohydrate content can be used as a source of calories and has a Low Glycemic Index (LGI 51) value (Murtiningsih, 2011; Aye & Aung, 2014; Kato C, 1976). It is a type of carbohydrate if it is consumed, will not increase blood sugar levels drastically. Sweet potato dietary fiber is a polysaccharide that is not digested and absorbed in the small intestine, which is a larger part of the biscuit bar 1 formula, which is also a determinant of the resulting GI value.

## Conclusion

The biscuit bar test results concluded that Vitabran F1 with 30% bran and 30% yellow sweet potato was the formula preferred by the panelists (color, aroma, texture/crunchiness, sweetness). The proximate test results showed that the carbohydrate, protein, fat content was higher in the Vitabran F2, while the water, ash and crude fiber content was higher in the Vitabran F1. Vitabran selected for the GI test was the Vitabran F1, with consideration of proximate test results and hedonic test results which are favorable for the GI category and are still acceptable to target consumers, with the results of the Glycemic Index (GI) examination on volunteers categorized as moderate (65.091).

The results showed that the functional food substitution is a synergistic effect of the substances contained in it, so it needs to be tested in a more varied formula. The effect of food consumption on the metabolism (in this study is the effect on blood sugar) in the body can be estimated based on the proximate test, but the certainty of this effect requires a GI examination.

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