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High-fibre analog rice made from beneng taro flour

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ABSTRAK

Latar belakang: *Beras merupakan komoditas pangan utama yang memengaruhi kesejahteraan masyarakat Indonesia. Makanan pokok di Indonesia masih didominasi dengan beras, karena beras masih sesuai dengan kulinari Indonesia. Kuliner Indonesia dikenal memiliki keragaman dan keunikan budaya serta kaya akan citarasa, selain itu erat kaitannya dengan budaya dan kebiasaan di Indonesia sejak lama. Oleh karena itu perlu upaya strategis dalam pemanfaatan umbi-umbian lokal, yaitu alternatif makanan pokok dengan mengembangkan produk ramah sebagai bagian dalam perwujudan ketahanan pangan nasional dengan cara diversifikasi pangan.*
Tujuan: *Menganalisis pengaruh formulasi tepung talas beneng sebagai bahan baku utama pada beras analog terhadap kandungan zat gizi (air, abu, lemak, protein dan karbohidrat),kandungan serat pangan serta karakteristik sifat fisik.*
Metode: *Jenis penelitian adalah eksperimental dengan desain Racangan Acak Lengkap (RAL). Taraf perlakuan beras analog dengan perbandingan tepung talas beneng, tepung jagung kuning F1(75:25), F2(50:50) dan F3 (25:75) dan ditambahkan tepung kacang kedelai kuning 5%. Analisis kandungan zat gizi dilakukan melalui uji proksimat (AOAC 2012). Analisis kandungan serat pangan dilakukan dengan metode enzimatis gravimetri.*
Hasil: *Berdasarkan variabel perlakuan dari formulasi F1 (75:50) merupakan taraf perlakuan terbaik karena memiliki kandungan zat gizi dan serat pangan yang tinggi (karbohidrat 76,0%; serat pangan yang memenuhi standar BPOM (2022) nomor 1 dengan produk tinggi serat pangan (18,6 gr >6 gr/100 gr).Oleh karena itu beras analog berbahan tepung talas beneng dapat dijadikan sebagai pilihan alternatif makanan pokok untuk menjaga kesehatan terhadapa kelompok sensitif.*
Kesimpulan: *Beras analog berbahan tepung talas beneng dapat dijadikan sebagai alternatif makanan pokok yang mengandung serat pangan 18,6 g.*

KATA KUNCI: *beras analog; karbohidrat; umbi lokal; serat pangan; tepung talas beneng;*

ABSTRACT

Background: *Rice is the main food commodity that affects the welfare of the Indonesian people. The staple food in Indonesia is still dominated by rice because rice still follows Indonesian cuisine. Indonesian cuisine is known to have cultural diversity and uniqueness as well as rich in taste. Besides that, it is closely*

related to culture and customs, so it has been part of the eating culture of various ethnic cultures in Indonesia for a long time. Therefore, strategic efforts are needed in using local tubers, namely alternative staplefoods, by developing friendly products as part of the realization of national food security by means of food diversification.

Objectives: *To analyze the effect of the formulation of beneng taro flour as the primary raw material for analog rice on the analysis of nutritional content (water, ash, fat, protein, and carbohydrates), dietary fiber content and physical characteristics.*

Methods: *This type of research was experimental with a completely randomized design (CRD). The level of rice treatment is analogous to the ratio of beneng taro flour, yellow corn flour, namely F1 (75:25), F2(50:50), and F3 (25:75) and added yellow soybean flour 5%. Analysis of nutrient content was carried out through a proximate test (AOAC 2012). Analysis of dietary fiber content was carried out by enzymatic gravimetric method*

Results: *Based on the treatment variable, the F1 formulation (75:50) was the best treatment level because it had a high content of nutrients and dietary fiber (76,0% carbohydrates; dietary fiber that meets BPOM standard (2022) number 1 with high-fiber products (18,6 g > 6 g/100 g). Therefore, analog rice made from beneng taro flour can be used as a staple food to maintain the health of sensitive groups.*

Conclusions: *Analog rice made from beneng taro flour can be used as an alternative to staple food which contains 18.6 g of dietary fiber.*

KEYWORDS: *analog rice; beneng taro flour; carbohydrate; dietary fiber; local tubers.*

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INTRODUCTION

Rice is the main food commodity that affects the welfare of the Indonesian people. The average national rice consumption in 2019 was 114.3 kg/cap/year, exceeding the recommended ideal consumption of 100.4 kg/cap/year by around 82.98% (1). The staple food in Indonesia is still dominated by rice because rice still follows Indonesian cuisine. Indonesian cuisine is known to have cultural diversity and uniqueness rich in flavor. Besides that, it is closely related to culture and customs, so it has become part of the eating culture of various ethnic cultures in Indonesia for a long time (2).

According to the Central Statistics Agency, the population growth rate is increasing rapidly from year to year, including an increase in 2010-2020 by an average of 1.25% (3). This is related to the availability of rice that will also increase, causing excessive rice consumption and making the Indonesian government import more rice to meet public demand. The current pattern of food consumption in Indonesia is still limited to local food types because it is seen from its limited availability and focuses only on specific groups, such as the grain group. Indonesia has a variety of biodiversity that is relatively high, one of which there are 77 types of carbohydrate sources that can potentially be used widely and openly (1). Therefore, strategic efforts are needed in the use of local food as part of the realization of national food security using food diversification. Food diversification is a food selection process that not only depends on one type of food but also has a preference for various food ingredients (4). Tubers are another source of carbohydrates and are well-known to the public. Several tubers are found throughout the region and have been used as a food source. One food source of carbohydrates that can be used as an alternative to staple food and has the potential as a functional food is beneng taro.

Beneng taro (*Xanthosoma undipes* K. Koch) is a taro originating from Pandeglang Regency, Banten Province. Beneng taro has several advantages. Namely, it has a higher dietary fiber and protein content than other taro types, such as green taro, polished taro, and butter taro (5). One of the constituent components of carbohydrates is fiber. The main types of carbohydrates in beneng taro are starch and dietary fiber.

The content of resistant starch in beneng taro can be used as a source of carbohydrates and functional food as fiber. Analog rice was previously widely developed but generally still uses cereals based on a mixture of sorghum flour, yellow corn, and corn starch. Therefore, new innovations are needed by developing analog rice from the tuber group or a combination of cereals and tubers. Other additives in the manufacture of analog rice are corn flour and soybean flour. This dry matter becomes a determining variable in the nutrient composition of analog rice. Therefore, this study aimed to develop alternative staple foods as functional foods that are beneficial for health to maximize the health benefits of beneng taro analog rice.

MATERIAL AND METHODS

This study is an experimental study using a completely randomized design (CRD). The main ingredients used in this research are beneng taro flour, yellow corn flour, soybean flour, and GMS (*glycerylmonostearate*). Beneng taro flour (*Xanth osoma undies* K. Koch) harvested 12 months old was obtained from Malang Jejeg. Yellow corn flour (*Zea mays*) with hybrid variety BISI two derived from 100% whole local non-GMO corn with P-IRT no. 215320101903. Soybean flour (*Glycine max* L.) derived from soybeans with P-IRT no 211340401177723. GMS (*glyceryl monostearate*) was obtained from the chemical shop Setia Guna Bogor. Analysis of nutrient content was carried out through a proximate test (AOAC 2012) in laboratory of analysis of nutrients and biochemistry IPB University (6). Analysis of dietary fiber content was carried out by enzymatic gravimetric method in laboratory PT. Saraswanti Indo Genetech (SIG) Bogor.

The preparation of the analog rice formula design was carried out by trial and error with treatment. Namely, the comparison of the amount of beneng taro flour, corn flour, and soybean flour which consisted of three formulations referring to the modification of (7) in the manufacturing process one time running with an extrusion machine with a total dry matter a minimum of 2 kg or 2,000 grams as shown in **Table 1**.

Table 1. Analog rice formulation

Material	Material weight (g)		
	F1	F2	F3
Beneng taro flour	1.500	1.000	500
Corn flour	500	1.000	1.500
Soybean flour	100	100	100
Water	900	900	900
GMS (*Gliseryl monostearat*)	40	40	40

It made analog rice using a twin screw extruder machine (Berto BEX-DS-2256). Making analog rice is done by mixing dry ingredients (beneng taro flour, corn flour, soybean flour, and GMS) with a pin disc mill. Then they added water, and the mixing continued for 5 minutes. The dough is fed into a double screw extruder with a temperature of 1 (°C): 70°C–73°C; temperature 2 (°C): 70°C–78°C; temperature 3 (°C): 70°C–98°C; with an auger speed of 25.5 Hz, screw 26.8 Hz, and cutter 33.8 Hz. The extruded rice was then dried in an oven at 60°C for 2 hours. Analog rice was analyzed, including cooking time and rice color, proximate analysis, and dietary fiber content. The research data were processed Microsoft Excel 2013 and analyzed in Nutrisurvey and IBM Statistical Program Social Sciences (SPSS) version 25.0 using Oneway- ANOVA and One-sample T-test. Furthermore, if there are significantly different results, it will be continued with Duncan's Multiple Range Test. with a significant difference with a p-value of less than 0.05 ($p<0.05$)

RESULTS AND DISCUSSIONS

Beneng taro rice contains proximate nutrients, namely ash, protein, water, and dietary fiber fat, with total carbohydrates as the main

proximate content in rice. Table 2 showed the results of the proximate analysis of the three analog rice formulations that were not significantly different ($p<0.05$) in ash, fat, and protein content and were significantly different ($p<0.05$).

Table 2. The nutritional content of analog rice

Nutritional content (g)	F1	F2	F3	Milled rice[1]	p-value
Water	12.0 ± 0.021	11.0±0.042	13.0±0.033	12	0.763
Ash	2.0±0.001	1.0±0.001	1.0±0.002	0.8	0.096
Fat	1.0±0.001[a]	2.0±0.001[b]	3.0±0.002[c]	1.7	0.000*
Protein	9.0±0.001[a]	11.0±0.003[b]	12.0±0.005[c]	8.4	0.004*
Dietary fiber	18.6±0.622	14.5±0.509	11.4±0.148	-	0.000*
Crude fiber	-	-	-	0.2	-
Carbohydrate	76.0±2.645	75.0±2.645	71.0±2.645	77.1	0.000*

Description : [1]source : TKPI (2017);The average score in the same line and followed by the same letter shows significantly different scores (Duncan's Multiple Range Test); *The two codes are the same for fat and protein one way-ANOVA and the two codes are the same for dietary fiber and carbohydrate one-samplet-test.

Water Content

The water content in analog rice of beneng taro ranges from 12 g -13g. The water content in this product is equivalent to raw milled rice, which has a water content of 12 g. When compared based on the raw materials used, beneng taro flour and corn flour also have a water content of 12 g. However, the water content of taro analog rice is still below 14 g water content so it is safe for storage. Based on the results of one-way-ANOVA statistical analysis, there was no significant difference in the water content of analog rice ($p<0.05$). High water content tends to make the texture of the material softer and more elastic.

Ash content

The ash content in analog rice of beneng taro is in the range of 1 g -2 g. The ash content in this study was lower. Ash content shows the amount of mineral content contained in a food ingredient (7).

The results of the one-way-ANOVA statistical analysis showed that there was no significant difference in the ash content of analog rice ($P<0.05$). It can be assumed that the mineral content in rice is relatively the same.

Fat content

The fat content in rice analog of beneng taro in ranges from 1 g -2 g. Beneng taro flour has a relatively low-fat content. However, adding 5% soybean flour in each formulation will also increase the fat content of the analog rice produced. The results of one-way ANOVA statistical analysis showed a significant difference in fat content in analog rice ($p<0.05$). Then proceed with the Duncan's multiple range test which showed differences in fat content of each formulation

that showed each treatment does not affect each other on the fat content. The difference in fat content is influenced by the contribution of corn flour and soybean.

Yellow soybean flour has a relatively high-fat content of 20.6 g, so adding soybean flour to analog rice will also increase the fat content. This is in accordance with Anindita's research (2019), along with the addition of grobogan soybeans to analog rice containing fat content ranging from 1.04 g - 3.92 g (8). However, when compared with milled rice, it is also not too high when viewed from the F1 formulation (75:25) which contains fat content below 2 g.

Protein content

The protein content in analog of beneng taro rice ranges from 9 g-12 g. Protein content in food is a factor that affects the glycemic index of food sources of carbohydrates. The higher the protein content in the food, the lower the glycemic index will tend to be. The protein content in this

analog rice is relatively higher than milled, raw rice. This is because, in the composition of the ingredients for making rice, soybean flour is added to provide a protein source. Nuts are one of the most common foodstuffs in Indonesia and have been known as a source of protein.

According to Messina (2014) the protein content in nuts in general is 20 g-30 g (9).Based on the results of the one-way-ANOVA statistical analysis showed that there was a significant difference in the protein content of analog rice ($p<0.05$). Then proceed with the Duncan's multiple range test which showed differences in protein content of each formulation that showed each treatment does not affect each other on the protein content. The difference is influenced by the contribution of corn flour and addition of 5% soybean flour in each of the same formulation. So that the analog rice produced can be used for consumers who require a high enough protein intake.

Another research on analog rice, according to Fauziyah (2017), analog rice substitution of red bean flour for sorghum flour has a relatively high amount of protein (10). There is a tendency to increase the protein content of analog rice along with the increase in the level of substitution of red bean flour. This tendency is caused by the high protein content in red bean flour compared to sorghum flour. Therefore, the protein composition of a product is very dependent on the raw materials used, especially in the group of nuts that have a relatively high protein content.

Dietary Fiber

Dietary fiber is briefly described as carbohydrates that are not digested in the digestive tract. Dietary fiber includes polysaccharides, oligosaccharides, lignin, and other related substances. Dietary fiber can be divided into two, namely soluble dietary fiber (SDF) and insoluble dietary fiber (IDF) (11). Soluble fiber is fiber that can be dissolved in buffers and enzyme solutions after the presence of enzymes in the digestive tract, while insoluble fiber is fiber that cannot be dissolved by digestive enzymes. Both types of dietary fiber can provide health benefits with different mechanisms.

Starch and dietary fiber are the main types of carbohydrates in beneng taro. The food fiber content in beneng taro flour is 7.19 g and has a starch content of 75.62 g (5). Beneng taro has a higher dietary fiber content than some other types of taro. This is in accordance with analog rice which is made in 3 formulations with a mixture of different compositions of beneng taro. Dietary fiber in rice analog of beneng taro ranged from 11.4 g - 18.6 g > 6 g/100 g) and meet BPOM standards (2022) as a high-fiber products (12).

The results of one sample t-test statistical analysis showed a significant difference in dietary fiber content in analog rice ($p<0.05$). Thus, beneng taro has the potential to be used as an alternative food for general and sensitive groups as a friendly product in maintaining health.

Total Carbohydrates

Total carbohydrates obtained through the method by difference. Carbohydrate content in analog rice ranges from 76 g-77 g. The total carbohydrate content in this product is equivalent to raw milled rice in general. The results of one sample t-test statistical analysis showed a significant difference in carbohydrat content in analog rice ($p<0.05$).

The total carbohydrates for analog rice produced are mostly related to the composition of the raw materials added by the ratio of beneng taro flour and yellow corn flour so along with adding beneng taro flour will also increase the total amount of carbohydrates to analog rice. The high amount of carbohydrate content in the analog rice produced indicates that the analog rice produced can be used as a source of carbohydrates as a substitute for rice.

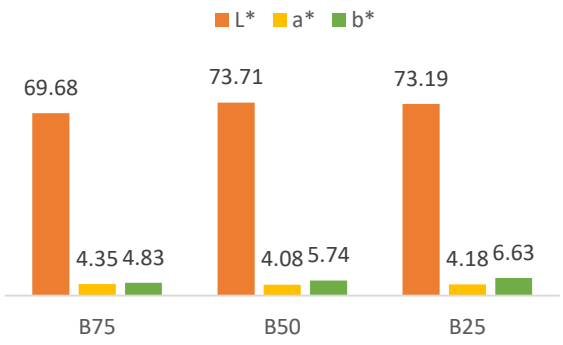
Physical characteristics of analog rice

The physical characteristics of the beneng taro analog rice were carried out to determine the initial characteristics of rice. The parameters analyzed were the rice cooking time and the color of the beneng taro analog rice. Based on the analog rice cooking time, 50 g of rice in each formulation ranged from 5-6 minutes and cooked in a rice cooker to approximately 100 g of rice. The analog rice cooks faster than ordinary rice.

The cooking time for analog rice only ranges from 3-5 minutes, which is faster when compared to sosoh rice, which is about 14 minutes (13)(14).

The color of the raw material has a big influence on the color of the raw material and has a big influence on the formation of color. This research uses the raw materials of beneng taro flour (brown-white), corn flour (yellow), soybean flour (light-yellow) to produce a brownish-gray product. Besides Beneng influenced by the raw material, the formation of color also depends on the composition of sugar or protein in the material. Sugars and proteins can cause browning caused by caramelization or Maillard processes(15).

Based on the results of one-way-ANOVA statistical analysis, showed that there was a significant difference in the color content of analog rice ($p<0.05$) in terms of brightness (L* a* b*). It can be said that all analog rice formulations have a tendency to darken slightly compared to the original flour color and the brightness of the rice is highly dependent on the temperature stability of the analog rice manufacturing process against the extrusion machine. The following is a measurement of the color of rice presented in **Figure 1**.



Description: L*= brightness; a*=red-green mixed chromatic color; b*= blue-yellow mixed chromatic color.

Figure. 1 The colour of analog rice

CONCLUSIONS AND RECOMMENDATIONS

Analog rice formulations made from beneng taro flour, yellow corn flour, and soybean flour can be used as an alternative to staple foods and rice can be consumed by general and specific groups to increase the intake of dietary fiber from rice and maintain health.The recommendation for this research is that the temperature in the manufacture of analog rice with an extrusion machine is set to be stable so that the color of the rice produced does not darken to the color of the original flour and it is hoped that it can be preferred and accepted by certain groups. Other raw local materials can also be added
to increase the nutritional content of analog rice.

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