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Original Research Article

Study on Physicochemical and Organoleptic Properties of Gebang Starch-Based Artificial Rice with Mung Bean Flour Supplementation

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Abstract: Gebang starch traditionally has been used by Timorese for making local food. However, it is used to told in mass media that people eat feed because rice has become the most prestigious staple food. Therefore, a study has been conducted to know the physicochemical and organoleptic properties of artificial rice made from gebang starch (GS) in combination with mung bean flour (MB). Five combinations of the flours studied were 100% of GS, 95% of GS with 5% of MB, 90% of GS with 10% of MB, 85% of GS 15% of MB, and 80% of GS with 20% of MB. The rice was processed using an extruder. Proximate, physical, and organoleptic of the rice were then evaluated. The nutrient content of all artificial rice is almost similar to natural rice. Mung bean flour supplementation increased the protein content of the rice. Most of the artificial rice has a yellowish-brown to fallow-brown color. The artificial rice dimension is almost similar to natural rice, which is the length is almost 7 mm, and thickness is almost 3 mm. The artificial rice weight of 1000 kernels ranges from 0.45 to 0.49 g/ml. Except for the aroma of the rice, all other organoleptic properties have a positive response from panelists.It can be concluded that artificial rice made from GS and MB has a good potency to be used as a natural rice complement, especially in terms of the nutritional content.
Keyword: Artificial rice, physicochemical properties, Organoleptic, gebang starch, mung bean flour.

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1. INTRODUCTION

Rice has been the main staple food of the people of Indonesia as well as many other Asian Countries. Even though there are still some other staple foods for local people in some islands of Indonesia, rice is being the top and most prestigious staple food among all. The high need for rice has driven the Indonesian government to import rice every year due to the insufficiency of domestic rice production. The trend of rice import is also increasing as a consequence of increasing in Indonesia's population. The dependency of Indonesia on the import of rice leads to low food security. Therefore, some efforts are being intensively carried out to overcome this problem.

Gebang (*Corypha utan* Lamk) is a kind of palm tree wildly grown in most parts of Indonesia with a wide-ranged type of soil. It can grow well from 0 to 1000 m above sea level (Hong *et al.*, 1998). The stem of a mature tree aged 20 years or more has a pit rich in starch. One tree can produce about 281 kg of dry starch on average with the composition of amylose and amylopectin similar to sago starch (Lalel *et al.*, 2018).

Gebang starch traditionally has been used by Timorese and other local communities in Eastern Indonesia for making local food. However, sometimes it is negatively being told in mass media that people are starving and the local government is blamed to be not able to keep the food security of the community. The gebang pith can also be used for feed and thus the issue that arose is people using feed for food. Therefore, it is better to use the starch of gebang to form artificial rice (a prestigious food form). Artificial rice may also help in fulfilling the demand for rice in Indonesia, especially for people living in Eastern Indonesia.

Artificial rice is also known as analogous rice mechanically produced by using starch other than rice flour with size and shape similar to rice grain (Samad, 2003). It is, therefore, possible to be fortified with other nutrient resources to increase the nutrient value of the rice. One of the important nutrients is the protein that may be acquired from the seed of legumes including mung bean (*Vigna radiata* L.), as it is available in Timor. Several research works on the combination of starch and protein resource flours in producing artificial rice have

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been reported (Fitriyanto and Putra, 2013; Franciska *et al*., 2015; Yuwono and Zulfiah, 2015).

Research on the combination of gebang starch and mung bean flour in making artificial rice has not been reported yet. Therefore, it is important to know the physicochemical and organoleptic properties of the artificial rice resulting from the combination of gebang starch and mung bean flour.

2. MATERIALS AND METHOD

Gebang starch was extracted from the pit of gebang stem according to the wet method described by Lalel *et al*., (2018). The pit was obtained from Kupang Regency, East Nusa Tenggara Province of Indonesia. Dolichos bean flour was prepared from local mung beans purchased from a local market in Kupang. Chemicals for analyses were pa grades of several chemical providers.

Combinations of gebang starch (GS) and mung bean flour (MB) used in this study were A (100% GS), B (95% GS + 5% MB), C (90% GS + 10% MB), D (85% GS + 15% MB), and E (80% GS + 20% MB). Each combination was added with water (900 mL per 2.5 kg of composite flour) and glycerol monostearate (2%) to get a dough. The dough was then to be fed into an extruder (Berto Industries) with the speed of cutter, auger and screw were 50.1 Hz, 30.5 Hz, and 35.1 Hz, respectively. The temperature of the extruder was set at 90^{o}C. Extrudes were dried in an oven at the temperature of 60^{o}C for about 1 hour.

The analogous rice was analyzed for its chemical properties including the proximate contents. Proximate analyzes were performed according to AOAC (1984). The physical properties of artificial rice recorded were color, size similarity, bulkiness, and cooking time. Data were taken in duplicate and presented on average. The organoleptic properties were recorded as the hedonic value with 9 Likert's scale (very much dislike=1 to very much like = 9) using 20 trained panelists (Lim, 2011).

The color and whiteness of the rice were recorded using Samsung digital camera (16 megapixels) fitted with constant light (2800 lx). The camera was equipped with On Color Measure software (Potatotreesoft Company) to record real-time RGB value, HSV value, Hex code, and HTML color name. RGB values were then converted to CIE Lab values using Colormine software (Colormine.org).

3. RESULT AND DISCUSSION

3.1 Chemical properties

3.1.1 Proximate

The result from proximate analyses of artificial rice shows that carbohydrates were found in the range of 83.36% and hence become the major nutrient of the rice. Data also show that mung bean flour supplementations contribute to the content of protein in the rice, which is the increase in mung bean flour increased the protein content of rice (Table 1). The nutrient content of artificial rice of B to E is almost similar to natural rice with the content of lipid being a bit lower (Susiyanti *et al.*, 2020). It is understandable that all raw materials of this reported artificial rice have low content in lipid. The content of ash in artificial rice is almost similar to that in natural rice reported by Susiyanti *et al*., (2020).

Table 1: Proximate of the artificial rice

No	Product	Formulas (%GS+%MB)	Water (%)	Protein (%)	Lipid (%)	Ash (%)	Carbohydrate (%)
1	Rice A	100 + 0	9.05±0.04	2.18±0.22	0.14±0.03	0.75±0.06	87.98±0.08
2	Rice B	95 + 5	6.79±0.05	4.73±0.17	0.10±0.06	0.77±0.04	87.61±0.11
3	Rice C	90 + 10	7.14±0.11	5.30±0.09	0.10±0.07	0.88±0.07	86.58±0.08
4	Rice D	85 + 15	7.73±0.07	5.69±0.31	0.11±0.04	1.00±0.11	85.47±0.07
5	Rice E	80 + 20	8.45±0.06	6.95±0.08	0.12±0.05	1.12±0.08	83.36±0.07

3.2 Physical Properties

3.2.1 Color and whiteness

Table 2 shows that the color of artificial rice from all combinations is yellowish-brown to fallow brown with saturated values are higher than 75%. They are in line with the L (lightness) value, which is not more than 80. These phenomena are mainly due to the impact of the color of raw materials and the reaction of browning during heating in the extruder. The brown color can be clearly noticed by the RGB value with the red color that is being dominant (the value is above 200). The value of b* of the CIE lab showed the yellow color intensity was quite strong and hence significantly contributed to the color of the rice.

Sumardiono *et al*., (2018) reported that all artificial rice studied in their research have L value below 80 and is similar to the L value of the Rojolele variety of natural rice. Millati *et al.*, (2021) even reported that some rice sold in the market in Kalimantan has an L color below 70. It indicates that the color of artificial rice reported here is not much different and could be acceptable for consumers.

Table 2: Color and whiteness of the artificial rice

No	Product	HTML color name	Hex code	RGB value	HVS value	CIE Lab value
1	Rice A	Yellowish-brown	#ffe2c192	226, 193, 146	35º, 35%, 88%	L 80.09332 a* 6.90622 b* 20.9761
2	Rice B	Yellowish-brown	#ffcfae7b	207, 174, 123	36º, 40%, 81%	L 72.87053 a* 5.02166 b* 30.6328
3	Rice C	Fallow brown	#ffc29d6f	194, 157, 111	33º, 42%, 76%	L 71.67122 a* -0.22692 b* 28.8312
4	Rice D	Yellowish-brown	#ffd8bd99	216, 189, 153	34º, 29%, 84%	L 78.04828 a* 4.25510 b* 21.7508
5	Rice E	Yellowish-brown	#ffdabb8d	218, 187, 141	35º, 35%, 85%	L 77.50106 a* 4.57960 b* 27.4195

3.2.2 Size and bulkiness of the artificial rice

Table 3: Size and bulk density of the artificial rice

No	Product	Length (mm)	Thickness (mm)	Length to thickness Ratio	Weight of 1000 kernels (g)	Bulk density (g/ml)
1	Rice A	6.56±0.07	2.67±0.06	2.46±0.07	21.76±0.08	0.49±0.03
2	Rice B	6.57±0.06	2.52±0.04	2.61±0.05	21.51±0.07	0.48±0.04
3	Rice C	6.46±0.07	2.54±0.03	2.54±0.05	21.51±0.11	0.45±0.05
4	Rice D	6.51±0.05	2.68±0.07	2.43±0.06	19.64±0.10	0.47±0.03
5	Rice E	6.56±0.06	2.67±0.05	2.46±0.06	21.76±0.08	0.49±0.05

The rice length was about 6.5 mm, while the rice thickness was around 2.5 to 2.7 mm. It causes the ratio of length to thickness of the rice to be around 2.5. The weight of 1000 kernels of artificial rice ranges from 19.64 to 21.76 g. All these properties of artificial rice have resulted in the value of bulk density ranging from 0.45 to 0.49 g/ml (Table 3).

The thickness and length of artificial rice are much lower than most of the natural rice have as reported by Susiyanti *et al.*, (2020), but they are higher than those of the PR-106 rice variety (Ghadge dan Prasad, 2012). The weight of 1000 kernels of all artificial grains of rice is higher than those of some natural rice reported by Susiyanti *et al.*, (2020). This indicates that all types of artificial rice are more compact and heavier than natural rice.

3.2.3 Similarity of the rice

It can be seen from Table 4 that more than 70% of the A, B, D, and E of artificial rice kernels have 2.4-3.3 mm thick. This indicates that the similarity of the rice kernels is high. Rice C, on the other hand, has kernels with a thickness range a bit broader than others that is between 1.7 mm to 3.3 mm.

Table 4: The similarity of artificial rice based on thickness

No	Product	% kernels with < 1.7 mm thick	% kernels with 1.7-2.3 mm thick	% kernels with 2.4-3.3 mm thick	% kernels with 3.4-4.7 mm thick	% kernels with > 4.7 mm thick
1	Rice A	0	20	76	4	0
2	Rice B	0	26	74	0	0
3	Rice C	0	40	56	4	0
4	Rice D	0	24	70	0	0
5	Rice E	0	20	76	4	0

3.3 Organoleptic Properties

Table 5: Organoleptic properties of artificial rice

No	Product	Color score	Aroma score	Taste score	Texture score	Overall score
1	Rice A	5,15 ^{ab}	4,45 ^{ab}	5,70 ^{b}	5,70 ^{b}	5,40 ^{a}
2	Rice B	4,90 ^{a}	3,70 ^{a}	4,50 ^{a}	4,50 ^{a}	4,90 ^{a}
3	Rice C	5,50 ^{b}	3,90 ^{ab}	5,15 ^{ab}	5,15 ^{ab}	5,30 ^{a}
4	Rice D	6,20 ^{c}	4,30 ^{ab}	5,35 ^{b}	5,35 ^{b}	5,45 ^{a}
5	Rice E	5,35 ^{ab}	4,60 ^{b}	5,00 ^{ab}	5,00 ^{ab}	5,15 ^{a}

Note: numbers followed by different letters in the similar column means significantly different at α= 0.05 of Least Significant Different Test.

4. CONCLUSION

It can be concluded that artificial rice made from gebang starch and mung bean flour has a good potency to be used as a natural rice complement, especially in terms of the nutritional content. Most of the artificial rice has a yellowish-brown to fallow-brown color. The artificial rice dimension is almost similar to natural rice, which is the length ranges from 6.46 mm to 6.56 mm, thickness ranges from 2.52 mm to 2.67 mm. The weight of 1000 kernels of analogous rice ranges from 0.45 to 0.49 g/ml. Except for the aroma of the rice, all other organoleptic properties have a positive response from panelists.

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