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The Characteristics of Local Dark Brown Waxy Sorghum Rice from Lamongan Due to the Different Polishing Frequency and Soaking Conditions

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ABSTRACT

Dark brown local glutinous sorghum has the potential to replace white rice because it has higher carbohydrate and dietary fiber contents and lower total sugar content. Sorghum has the disadvantages of hard seeds and astringency, which can be reduced by polishing and soaking. The aim of the research was to study the effect of the polishing frequency and soaking condition on sorghum seed with 2 research variables: (1) the polishing frequency [once and twice] and (2) soaking conditions [(1) 100°C water allowed to reach room temperature for 24 h; (2) 100°C water allowed to reach room temperature for 36 h; (3) baker's yeast 0.25% b/v at room temperature for 24 h; and (4) baker's yeast 0.25% b/v at room temperature for 36 h]. Rice quality was tested for hardness, elasticity, chewiness, stickiness, organoleptic properties, and antioxidant activity. Data was processed using ANOVA (α = 0.05) and Duncan's Multiple Range Test. The results showed that the polishing frequency and soaking conditions affected the hardness, elasticity, chewiness, and stickiness of sorghum rice. The best sample was found to be twice-polished dark brown glutinous sorghum rice, with a 100 °C water soaking condition, and allowed to reach room temperature for 36 h. The sorghum rice had a hardness of 2,578.6 ± 1,044.4 gf, elasticity of 48.24 ± 0.20%, chewiness of 0.3622 ± 0.00, stickiness of (–76.88 ± 0.76) gs, with antioxidant activity of 0.0041 mg/g (strong), which panelists liked and similar with rice from the parameters of color (score 5.0 ± 0.2), aroma (score 4.5 ± 0.1), texture (score 4.8 ± 0.1), and taste (score 4.5 ± 0.1).

Keywords: dark brown waxy sorghum, Lamongan city, local commodity, polishing frequency, soaking condition

INTRODUCTION

Indonesia has abundant sources of local food commodities that remain undeveloped, including sorghum (*Sorghum bicolor* L.). Sorghum is a cereal crop that ranks third after rice and corn in Indonesia; is a substitute source of carbohydrates, food ingredients, feed, and export commodities (Suarni 2016). In terms of cultivation, it is easy to grow and develop in Indonesia because it is more drought resistant than rice (Zubair 2016). In 2023, the government allocated 100,000 ha of sorghum planting land in various regions of Indonesia (Rochmadi 2022). The government is trying to make sorghum an alternative to white rice as a staple food by realizing food diversification and making it part of the B2SA (Bergizi, Beragam, Seimbang, dan Aman; means Nutritious, Diverse, Balanced, and Safe) food program (Dinas Ketahanan Pangan dan Peternakan Provinsi Jawa Barat 2022).

To realize sorghum as a substitute for rice, various methods need to be pursued, such as socializing the benefits of sorghum and overcoming its deficiencies, such as the astringent, bitter taste, and difficulty in removing the husk. The high tannin content of sorghum seeds causes an astringent and bitter taste. Tannins are polyphenolic compounds that can bind to proteins and other enzymes, forming complex compounds that reduce protein digestibility and enzyme activity (Mahendra *et al.* 2016). However, they are beneficial because they possess antioxidant activity. Deficiencies in sorghum can be overcome in various ways, such as by polishing the outer shell of sorghum seeds, soaking, boiling, and fermentation (Amrinola *et al.* 2015).

Polishing sorghum removes the skin layers of the testa, pericarp, aleurone, subaleurone, embryo, and organ. Generally, sorghum polishing is performed once to twice. To obtain sorghum seeds with a bright color, polishing once or twice reduces the tannin content in the sorghum pericarp layer, thereby reducing the astringent and bitter taste and making processing easier (Rahmawati *et al.* 2023). In addition to polishing, tannin levels can be reduced by soaking. Soaking can reduce anti-nutritional compounds, increase the yield of sorghum (Putri *et al.* 2017), and soften the seeds (Budiyanto *et al.* 2021). Rahmawati and Yaniansah (2021) reported that soaking local white corn of the

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Anoman 1 variety using 0.25% yeast for 48 h can soften corn grits. The longer the soaking time, the higher the water absorption, and the softer the texture of the corn grits. Also, soaking white corn grits in water for 36, 48, and 72 h can increase the peak viscosity value and produce flour with stable paste characteristics (Farasara *et al.* 2014).

Sekretariat Jenderal Pertanian (2017) stated that sticky sorghum has a fluffier texture. One of the sticky sorghum varieties produced in Indonesia, especially in the Lamongan area, is the local dark brown sticky sorghum. The nutritional content of dark brown sticky sorghum seeds is influenced by polishing. Rahmawati *et al.* (2023a) carried out polishing once and twice on dark brown sorghum seeds and obtained the following results: carbohydrates 71.28 ± 0.51% and 75.19 ± 0.26%; protein 10.00 ± 0.27% and 11.69 ± 0.01%; fat 2.12 ± 0.07% and 1.48 ± 0.12%; water-soluble dietary fiber 8.40 ± 0.20% and 2.65 ± 0.32%; and insoluble dietary fiber 46.37 ± 0.33% and 13.90 ± 0.26%, respectively. Thus, the nutritional content of dark brown sticky sorghum is equivalent to that of white rice; therefore, dark brown sticky sorghum from Lamongan has the potential to be a substitute for rice and needs to be studied. This research aims to provide sorghum that has the potential to be a substitute for white rice by reducing the astringent and bitter taste and making it easy to process through polishing and soaking. It is suspected that the amount of polishing and soaking conditions will produce sorghum rice that is low in astringency and bitterness and is easy to process by the community so that it can be more accepted by the community and has the potential to be a substitute for white rice.

METHODS

Research Site

The work was carried out in Laboratorium Pengolahan Pangan, Kimia, dan Mikrobiologi, Universitas Sahid, Jl. Prof. Dr. Soepomo, SH, No. 84, Jakarta Selatan; Laboratorium Kesehatan Daerah, Provinsi DKI Jakarta, Jl. Rawasari Selatan No.2, Kota Jakarta Pusat; and PT Vicma Lab Indonesia, Jl. H. Abdul Gani II 002/010 No. 22B, Harapan Jaya, Cibinong, Bogor.

Materials and Tools

The material were a dark brown sticky sorghum that has been polished 1 and 2 times and was obtained from the city of Lamongan, East Java, Fermipan yeast, rice (Si Pulen Pandan Wangi), and mineral water. The chemicals used were distilled water (technical), pro-analyst methanol (Merck), pro-analyst DPPH (Sigma Aldrich), and pro-analyst ethanol absolute (Merck). The tool used was a Satake-type rice polishing machine with an Amrill-type grinding stone no. 50, and a texture analyzer (TA-XTI2) at a speed of 0.1–40 mm/s, and a UV-Vis spectrophotometer at a wavelength of 515 nm.

Procedures

Phase 1 aimed to obtain information regarding people's preferences for consuming white rice. The survey was conducted using a questionnaire, distributed via social media WhatsApp groups and Instagram. Phase 2 research aimed to study the production of dark brown sticky sorghum rice and the characteristics of the rice produced. There were two research variables: the frequency of polishings (once and twice) and soaking conditions (100 °C water left to reach room temperature for 24 h; 100 °C water left to reach room temperature for 36 h, 0.25% w/v baker's yeast at room temperature for 24 h, and 0.25% w/v baker's yeast at room temperature for 36 h). A total of 500 g of sorghum was used in each experimental unit. The quality of sorghum rice was determined based on hardness, elasticity, chewiness, stickiness, and hedonic tests. The best samples were tested for their antioxidant activity.

White Rice Preference Survey

The white rice consumer's preference survey was collected from questionnaires consisting of five questions. The survey aimed to determine the color, aroma, taste, type of rice, and preferred method of cooking rice. According to Alwi (2015), to maintain data stability, the minimum number of respondents should be 200.

Polishing

Polishing began with cleaning the sorghum seeds from materials other than sorghum seeds, such as stems and skin. The sorghum seeds of uniform size were selected and polished using a grinder. The polishing system involves rubbing sorghum seeds with an abrasive surface (such as a stone) to remove the seed coat (pericarp) from the grain. For the twice polishing, the sculpting process with the tool was repeated once more (twice in total).

Preparation of Dark Brown Waxy Sorghum Rice

The process of dark brown sticky sorghum rice was modified from Rahmawati and Yaniansah (2021) and Budiyanto *et al*. (2021). The procedure consisted of (1) weighing 500 g of sorghum seeds that had been polished (once and twice) separately; (2) washing using running water three times until clean; (3) soaking using bottled mineral water under the following conditions: (a) 100 °C water was allowed to reach room temperature for 24 h; (b) 100 °C water was left to reach room temperature for 36 h; (c) baker's yeast 0.25% w/v at room temperature for 24 h; and (d) baker's yeast 0.25% w/v at room temperature for 36 h. Each condition was performed separately. The ratio of sorghum to water was 1:3 w/v; (4) draining until no water dripped; (5) washing again with running water three times until the remaining soaking was completely rinsed off; (6) draining again until no water dripped; (7) weighing; and (8) cooking sorghum seeds using a rice cooker (adding 1:2.5 b/v drinking water).

Sample Testing Techniques

The quality of dark brown waxy sorghum rice was determined based on testing for hardness, elasticity, chewiness, and stickiness using a TA-XTI2 texture analyzer with an SMS P/35 aluminum probe cylinder with a diameter of 3.5 cm, pre-test speed of 5 mm/s, test speed of 2 mm/s, and strain rate of 80% (Zhuang *et al.* 2010), organoleptic test using the hedonic method (likeability), and antioxidant activity (IC_{50}) using DPPH solution in ethanol, after which the absorbance was measured using a UV-Vis spectrophotometer with a wavelength of 515 nm (Punia *et al.* 2021).

Statistical Analysis

The data was analyzed using ANOVA (α = 0.05) and the IBM SPSS Statistics 25 application. If the test results had a significant effect, a further DMRT test was performed.

RESULTS AND DISCUSSION

White Rice Preference

The survey included 207 respondents aged between 19 and 44 years. Based on the Ministry of Health (2016), the above age group was included as adult age. The results showed that people preferred rice that is white (97.1%), with pandan aroma (63.8%), slightly sweet (72%), fluffier texture (51.7%), and cooked in a rice cooker (92.8%). The data can be seen in Table 1. Based on this, Si Pulen Pandan Wangi brand rice was used because it is fluffier, white in color, and has a pandan aroma.

Hardness

Hardness is the ability of a material to withstand a given load or pressure (Rahmawati *et al.* 2023). The hardest in the fluffiness test was the value obtained from the highest peak curve. This peak represents the maximum force on the probe when pressing sorghum rice grains (Indrianti *et al.* 2013). The highest hardness was in sorghum rice, which was polished once and soaked in 0.25% yeast for 36 h (12,480 ± 260.2 gf). The data is presented in Table 2. The lowest hardness was in sorghum rice, which was polished twice and soaked

Table 1 Results of a survey on the preference of white rice consumption

Question on preference	Parameter	Result (%)
Color of rice	White	97.1
	Grey	1.4
	Brownish	0.5
	Dark	1
Aroma of rice	Musty	0
	Pandan	63.8
	Not scented	36.2
Taste of rice	Too sweet	0
	Sweet	7.2
	A little bit of sweet	72
	Tasteless	20.8
Type of rice	Fluffier	51.7
	Half	44.9
	Non-sticky (*pera*)	3.4
How to cook rice	Using rice cooker	92.8
	Using cormorant	7.2

Table 2 Average hardness (gf) results for dark brown waxy sorghum rice

Soaking conditions	Frequency of polishing		Average
	Once	Twice	
Water 100 °C 24 hours	7,896±1,518.6	1,795±106,9	4,845.9±4,314.6[a]
Water 100 °C 36 hours	10,923.7±1,239.4	2,578.6±1,044.4	6,751.2±5,900.9[b]
Baker yeast 0.25% 24 hours	8,633.95±3,062.3	2,377.6±286.7	5,505.8±4,423.9[b]
Baker yeast 0.25% 36 hours	12,480±260.2	2,140.6±39.9	7,310.3±7,311.1[c]
Average	9,983.6±2,104.9[b]	2.222.9±336.8[a]	

Remarks: numbers followed by the same letter in the same column or row indicate that the results are not significantly different based on the 5% DMRT test.

in water at 100°C for 24 h (1,795 ± 106.9 gf). The hardness of sorghum rice that was polished once tends to be higher than that of polished twice, while sorghum rice soaked in 100°C water and 0.25% yeast for 24 h is relatively softer than that soaked for 36 h. The ANOVA test results showed that the frequency polishing and soaking conditions affected the hardness, but there was no interaction between them.

The hardness of sorghum rice is influenced by the pericarp and testa layers in the endosperm of the sorghum seeds. In once polishing, only the pericarp layer was sanded, whereas in twice polishing, the pericarp and testa layers were also sanded, thereby reducing hardness (Rahmawati *et al.* 2023). Soaking sorghum seeds in 100°C water can soften the texture of sorghum. Mustika *et al.* (2019) reported that soaking red sorghum in 100°C water produces flour with a smooth and soft texture. According to Farasara *et al.* (2014), soaking white corn grits for 36, 48, and 72 h can increase the peak viscosity value and produce flour with stable paste characteristics. In addition, Rahmawati and Yaniansah (2021) showed that soaking Anoman 1 white corn grits in 0.25% yeast for 48 h can soften them. Yeast contains *Saccharomyces cerevisiae*, which can hydrolyze amylopectin into amylose (Khazalina 2020). High amylose can affect the texture and make it hard (Budijanto and Yuliyanti 2012). The amylose content in the dark brown glutinous sorghum seeds was 10.65 ± 0.05% (once polishing) and 11.90 ± 0.01% (twice polishing) (Rahmawati *et al.* 2023).

Elasticity

Elasticity is the ability of a sample to return to its original shape after pressure is applied. The elasticity was measured on the thickness of the initial sorghum rice grains, which was compared with the thickness after the application of the first pressure (Indrianti *et al.* 2013). The highest elasticity was polished once and soaked in water at 100°C for 24 h (69.88 ± 0.17%). The complete data can be seen in Table 3 and the lowest was in sorghum rice with twice polishing and 0.25% yeast soaking for 24 h (30.94 ± 0.02%). The elasticity of sorghum rice that was once polished tended to be higher than that of twice polished. Sorghum rice soaked in 100°C water was relatively more elastic than that soaked in 0.25% yeast. ANOVA results showed that the polishing frequency and soaking conditions significantly influenced elasticity and that there was an interaction between them.

A higher frequency of polishing can increase amylose levels. Luna *et al.* (2015) reported that rice with a high amylose content produces low elasticity. The amylose content in dark brown glutinous sorghum seeds was 10.65 ± 0.05% (once polishing) and 11.90 ± 0.01% (twice polishing) (Rahmawati *et al.* 2023). Soaking in 100 ℃ water or hot temperatures can cause protein structural bonds to break and reduce protein levels (Darmajana 2012) and low protein levels can reduce elasticity (Rosalina *et al.* 2018). The protein content of dark brown glutinous sorghum seeds was 10.00 ± 0.27% (once polishing) and 11.69 ± 0.11% (twice polishing) (Rahmawati *et al.* 2023). The low concentration of yeast during soaking decreased the elasticity of sorghum rice. Puspitasari *et al.* (2023) found that sorghum flour bread with a high yeast concentration (6%) has a high elasticity value (86.67%).

Chewiness

Elasticity in the fluffiness test is the ability of a sample to return to its original shape after being subjected to a force and then released. The average elasticity ranged between 0.2659 ± 0.01 and 0.3253 ± 0.05. The data is presented in Table 4. The highest elasticity was in sorghum rice with polishing twice and soaked in 100°C water for 36 h (0.3622 ± 0.00), meanwhile, the lowest elasticity was twice polishing and soaked in 100°C water for 24 h (0.2523 ± 0.00). The elasticity of sorghum rice with twice polishing was higher than that of once polishing. Sorghum rice soaked in 100°C tended to be chewier than that soaked in 0.25% yeast. ANOVA results showed that the polishing amount and soaking conditions significantly affected the elasticity, and there was an interaction between them in influencing the elasticity of sorghum rice.

Polishing sorghum seeds damage the outer layers of the seeds, such as the aleurone and testa, resulting in an increase in the concentration of amylose and amylopectin (Kurniawan *et al.* 2016). The elasticity of dark brown sticky sorghum rice is affected by the amylopectin content of the sorghum seeds. Amylopectin can form a gel and has a strong sticky power during the gelatinization process (Indrianti *et al.* 2013). The amylopectin content of dark brown

Table 3 Average elasticity results (%) of dark brown waxy sorghum rice

Soaking conditions	Frequency of polishing		Average
	Once	Twice	
Water 100 °C 24 hours	69.88±0.17^{g}	41.40±0.41^{c}	55.64±20.14^{c}
Water 100 °C 36 hours	53.74±0.91^{e}	48.24±0.20^{d}	50.99±3.89^{b}
Baker yeast 0.25% 24 hours	60.27±3062.3^{f}	30.94±0.02^{a}	45.61±20.74^{a}
Baker yeast 0.25% 36 hours	60.46±0.74^{f}	40.12±0.22^{b}	50.29±14.38^{b}
Average	61.09±6.64^{b}	40.18±7.11^{a}	

Remarks: Numbers followed by the same letter in the same column or row indicate that the results are not significantly different based on the 5% DMRT test.

glutinous sorghum seeds was 44.00% (once polishing) and 58.82% (twice polishing) (Rahmawati *et al.* 2023a). The higher the amylopectin level, the more elasticity can be increased. Soaking, especially with water, can dissolve amylose and increase amylopectin content (Arifin *et al.* 2014). This is in accordance with the nature of amylopectin, which is non-polar or difficult to dissolve in water (Hidayat *et al.* 2022). The low elasticity value of sorghum rice with 0.25% yeast soaking was caused by a decrease in amylopectin levels. In the fermentation process, amylopectin is hydrolyzed to amylose, resulting in increased amylose levels (Arifin *et al.* 2014).

Stickiness

Stickiness in the fluffiness test is the negative area, which indicates the amount of effort required to pull the probe free from the sample. The greater the negative area on the curve, the greater the stickiness value of the dark brown sticky sorghum rice (Indrianti *et al.* 2013). The stickiness ranged between (–26.00 ± 1.13) and (–76.88 ± 0.76) gs. The data have been showed in Table 5. The highest stickiness value was in twice polished and soaked in water at 100°C for 36 h (–76.88 ± 0.76) gs, and the lowest was in sorghum rice with twice polishing cycles and 0.25% yeast soaking for 24 h (–26.00 ± 1.13 gs). Stickiness was not detected in any type of sorghum rice that was once polished. Meanwhile, sorghum rice soaked in 100°C water tended to be stickier than that soaked in 0.25% yeast solution.

The stickiness of sorghum rice is influenced by the amylopectin levels. High amylopectin content can increase stickiness because it contains a high-water content (Putriningsih *et al.* 2018). Polishing sorghum seeds damage the outer layers of the seeds, such as the aleurone and testa, resulting in increased amylose and amylopectin content (Kurniawan *et al.* 2016). Amylopectin can form a gel and has a strong sticky power during the gelatinization process (Indrianti *et al.* 2013). The amylopectin content of dark brown glutinous sorghum seeds was 44.00% (once polishing) and 58.82% (twice polishing), where soaking with water causes the endosperm in dark brown sticky sorghum seeds to become soft and sticky (Rahmawati *et al.* 2023). The low stickiness of sorghum rice soaked in 0.25% yeast was attributed to the decreased amylopectin levels. In the fermentation process, amylopectin is hydrolyzed to amylose, increasing the amylose content (Arifin *et al.* 2014), thereby reducing adhesiveness.

Hedonic Test

The hedonic test aims to measure the panelists' liking for the sample. The test was conducted by 35 untrained panelists. They were asked to taste the dark brown sticky sorghum rice and provide feedback on it and compare it with white rice. The parameters tested were color, aroma, texture, and taste preferences. The highest color preference for sorghum rice was sorghum rice with twice polishing and soaking in 100°C water for 36 h, with a score of 5.0 ± 0.2 (like). We can see the data in Table 6. Polishing causes the testa layer to disappear, resulting in the brown pigment being removed. The higher the frequency of polishing, the lighter the color. The brown color of sorghum seeds is caused by tannins. During soaking, the tannin dissolves because it is polar (Azhari and Rahmawati 2024); thus, the longer the soaking, the lighter the color of the sorghum. Rahmawati *et al.* (2023) revealed that the sticky sorghum seeds were dark brown; the color

Table 4 Average chewiness of dark brown waxy sorghum rice

Soaking conditions	Frequency of polishing		Average
	Once	Twice	
Water 100 °C 24 hours	0.2523±0.00[a]	0.2796±0.00[bc]	0.2659±0.01[a]
Water 100 °C 36 hours	0.2884±0.00[cd]	0.3622±0.00[f]	0.3253±0.05[d]
Baker yeast 0.25% 24 hours	0.2797±0.00[bc]	0.2781±0.00[b]	0.2789±0.00[b]
Baker yeast 0.25% 36 hours	0.2925±0.00[d]	0.3053±0.0[e]	0.2989±0.00[c]
Average	0.2782±0.01[a]	0.3063±0.03[b]	

Remarks: Numbers followed by the same letter in the same column or row indicate that the results are not significantly different based on the 5% DMRT test.

Table 5 Stickiness (gs) of dark brown waxy sorghum rice

Soaking conditions	Frequency of polishing	
	Once	Twice
Water 100 °C 24 hours	ND	–52.62±1.87
Water 100 °C 36 hours	ND	–76.88±0.76
Baker yeast 0.25% 24 hours	ND	–26.00±1.13
Baker yeast 0.25% 36 hours	ND	–73.82±0.21

Remark: ND = Not detected.

Tabel 6 Hedonic test results of white rice and dark brown waxy sorghum rice

Parameter	White rice	Once				Twice			
		Water 100°C 24 h	Water 100°C 36 h	Baker yeast 0.25% 24 h	Baker yeast 0.25% 36 h	Water 100°C 24 h	Water 100°C 36 h	Baker's yeast 0.25% 24 h	Baker's yeast 0.25% 36 h
Color	5,4±0,0	3.5±0.1	3.3±0.0	3.4±0.4	3.4±0.2	4.3±0.2	5.0±0.2	4.6±0.0	4.4±0.2
Aroma	4,5±0,3	3.6±0.2	3.7±0.2	3.4±0.0	3.6±0.4	4.3±0.0	4.5±0.1	3.7±0.1	2.4±0.2
Texture	5,5±0,0	2.2±0.1	2.5±0.1	2.3±0.1	2.2±0.1	4.4±0.0	4.8±0.1	3.9±0.5	4.2±0.1
Taste	5,2±0,0	2.4±0.1	2.7±0.0	2.3±0.1	2.2±0.0	4.5±0.2	4.5±0.1	4.9±0.1	3.6±0.0

Remarks: 1 (Dislike), 2 (Less dislike), 3 (Neutral), 4 (Somewhat like), 5 (Like), and 6 (Very like).

was red purple for once polishing, and red for twice polishing. Compared with paddy rice, sorghum rice was equally popular.

The highest liking for the aroma of sorghum rice was the twice polishing treatment and the condition of soaking in 100°C water for 36 h, with a score of 4.5 ± 0.1 (like). The aroma of sorghum rice is influenced by tannins, which have aromatic rings with one or two hydroxyl groups (Sukmawaty and Afni 2019). Soaking and polishing can reduce tannin levels; therefore, the longer the soaking time and the more polishing cycle, the more preferred the aroma of sorghum rice. Soaking with 0.25% yeast for 36 h produced sorghum rice, which was less preferred because the yeast breaks down carbohydrates during soaking and produces sour aroma. Compared with rice, the preferences for sorghum rice were relatively the same.

The highest texture hedonic value in sorghum rice was obtained with twice polishing and soaking in water at 100°C for 36 h, which was rated as liking (score 4.75 ± 0.07). The lowest texture hedonic value was for once polishing and 0.25% yeast for 36 h and 100°C water for 24 h which was slightly disliked (score 2.2 ± 0.1). It is suspected that the rice was stickier than in the other treatments.

The highest taste hedonic value is twice polished sorghum rice and 0.25% yeast soaking conditions for 24 h, namely somewhat like - like (score 4.9 ± 0.1). The hedonic value of the lowest taste was in once polished sorghum rice under conditions of soaking with 0.25% yeast for 36 h, namely slightly disliked (score 2.2 ± 0.0). This is thought to be due to the sour taste caused by the decomposition of carbohydrates by yeast into acid during the soaking process. In general, the panelists liked sorghum rice as much as paddy rice.

Antioxidant Activity

Based on the above description, the best sample was dark brown sticky sorghum rice with twice polished and soaked in 100 °C water for 36 h. Rice has an antioxidant activity of 0.0041 mg/g. The antioxidant level before treatment was 2.35 mg/g (Rahmawati *et al.* 2023). Soaking in water can reduce the level of antioxidant activity in sorghum because the phenolic compounds found in the outer layer, namely the pericarp and testa, were dissolved (Anggreini and Choiriyah 2022). Antioxidant activity was assessed based on the IC_{50} values. The antioxidant activity is the ability of the dark brown glutinous sorghum rice extract concentration to inhibit the oxidation process by 50% of free radicals (DPPH) (Cahyadi *et al.* 2020). Antioxidant activity is considered very strong if the IC_{50} value is <50 mg/L, strong if it is 50–100 mg/L, moderate if 100–150 mg/L, and weak if 150–200 mg/L. The antioxidant activity of dark brown sticky sorghum rice polished twice can be concluded to have very strong antioxidant activity.

CONCLUSION

Preliminary research results found that 207 consumers representing the community liked white rice (97.1%) with the aroma of pandan (63.8%), slightly sweet taste (72%), fluffier texture (51.7%), and cooking using a rice cooker (92.8%).

Results on dark brown sticky sorghum revealed that the frequency of polishing and soaking conditions significantly influenced the hardness, stickiness, elasticity, chewiness, and preference of sorghum rice (α = 0.05). The best quality was obtained from local dark brown sticky sorghum rice, which was twice polished, soaked in water at 100 °C, and left for 36 h. The quality characteristics of sorghum rice included hardness of 2,578.6 ± 1,044.4 gf, elasticity of 48.24 ± 0.20%, chewiness of 0.3622 ± 0.00, stickiness of (–76.88 ± 0.76) gs, with antioxidant activity of 0.0041 mg/g (strong), which the panelists liked from the parameters of color (score 5.0 ± 0.2), aroma (score 4.5 ± 0.1), texture (score 4.8 ± 0.1), taste (score 4.5 ± 0.1). The panelists' preferences for sorghum rice were the same as their preferences for regular rice.

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