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Physicochemical Characteristics and Dietary Fiber of Analog Rice from Seaweed (*Sargassum* sp.) and Beneng Taro Combination

Rifki Prayoga Aditia*, Sakinah Haryati, Aditia Mursyid Muhede, Devi Faustine Elvina Nuryadin
Fishery Department, Faculty of Agriculture, University of Sultan Ageng Tirtayasa, Indonesia
* E-mail: rifki.prayoga@untirta.ac.id

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ABSTRACT

Development of analog rice from *Sargassum* sp. and beneng taro combination is expected to be an alternative food to increase the amount of dietary fiber intake for the community. The aim of this research is to determine the best characteristics of analog rice from *Sargassum* sp. and beneng taro as a high fiber food. The concentration of added *Sargassum* sp. seaweed in this study were 0%, 5%, 10%, and 15%. The results showed that a concentration of 15% was the best treatment with a white degree value 1.23%; water absorption capacity 61% and swelling power 59.3%. The chemical characteristics of the best analog rice are 10.14% moisture content; ash content 4.14%; fat content 0.60%; protein content 5.69%; and carbohydrates content 79.44%. The dietary fiber of analog rice is 23.74%.
Keywords: analog rice, dietary fiber, physicochemical, Sargassum sp., taro beneng

INTRODUCTION

Fruit and vegetables are sources of fiber which the body really needs. It is known that the percentage of the Indonesian population that does not consume enough fruit and vegetables has reached 95.4% (Kemenkes 2019). The recommendation for good fiber intake according to WHO is 25-30 grams per day, while the average consumption of dietary fiber for the Indonesian population is 10.5 grams per day (Rahmah *et al.* 2017). Lack of fiber consumption can increase the risk of death from non-communicable diseases such as colon cancer, diabetes, hypertension, stroke, heart disease and obesity (Anggraini 2018).

One effort that can be made to overcome the above problems is to increase consumption of foods high in dietary fiber. These food ingredients can be found in seaweed *Sargassum* sp. Based on research by Matanjun *et al.* (2009) the amount of dietary fiber contained in 100 grams of dry *Sargassum* sp. is 39.67%. People don't like to consume seaweed directly as a vegetable because it smells fishy and tastes unpleasant. Therefore, it needs to be formulated into processed products so that the level of acceptance increases and at the same time we get the benefits we want.

Analog rice is a processed product that can be made using non-rice ingredients and has a shape like rice (Mishra *et al.* 2012). Analog rice has advantages over rice because its nutritional composition can be designed so that it has better functional properties

(Noviasari *et al*. 2017). The main ingredients in making analog rice usually come from local ingredients high in carbohydrates, such as sorghum (Anggraeni *et al*. 2016), corn (Noviasari *et al*. 2015), taro (Kumolontang and Edam 2020), cassava and sweet potato (Saragih *et al.* 2020). One of Banten's local foods that has the potential to be used in making analog rice is taro beneng (*Xanthosoma undipes* K.Kock). Taro beneng has a carbohydrate content of 79.80-84.10% (Putri *et al*. 2021).

The development of analog rice as a functional food is still ongoing, apart from reducing dependence on rice through food diversification, the functional properties of analog rice are very beneficial for health. Several studies have examined the addition of various ingredients to improve the functional properties of analog rice. Fauziyah *et al*. (2017) examined the addition of bean flour to increase fiber content and antioxidant activity in rice analog from sorghum. Anggraeni *et al*. (2016) examined the addition of fish bone meal and seaweed to gembili tubers to increase the fiber and calcium levels of analog rice. This research aims to evaluate of characteristics in making analog rice from a combination of seaweed (*Sargassum* sp.) and beneng taro as a high fiber food.

MATERIALS AND METHODS

Tools and Materials

The main ingredients used in this research were beneng taro flour from Pandeglang Regency, Banten and seaweed (*Sargassum* sp.) from the waters of Anyer Beach, Banten. Other materials used are carboxymethyl cellulose (CMC), (Ca(OH)2) 1% and water. The tools used in this research were baking pans, basins, winnowing pans, 80 mesh strainers, stoves, plastic packaging, pans, noodle makers (ATLAS), ovens (Memmert), analytical scales (Boeco BBI-32), choppers and glassware.

Making Seaweed (*Sargassum* sp.) Flour

Making seaweed flour refers to Hudaya (2008). Procedure for making seaweed (*Sargassum* sp.) flour begin by soaking the seaweed for 24 hours in fresh water to remove dirt and mineral salts. The seaweed that has been soaked is then washed under running water, then soaked in 1% lime water (Ca(OH)2) for 1 hour. Next, the samples were washed again until clean and soaked in fresh water for 24 hours, then rinsed until clean and reduced in size. The samples were dried using oven at 60°C for 15 hours. The dried seaweed is ground into flour then sieved and then stored in plastic packaging.

Making Analog Rice

Making analog rice refers to the research of Agusman *et al*. (2014) with modifications to the formulation and molding tools used. Seaweed (*Sargassum* sp.) flour and beneng taro flour mixed in a bowl. Percentage of seaweed flour addition based on the weight of beneng taro flour, namely 0, 5, 10, and 15%. Next, carboxymethyl cellulose (CMC) is added and mixed with water, then stirred until it forms a semi-wet dough. The next stage is formed using a noodle maker, then cut into pieces (3-5 mm) and shaped like rice grains. The granules are then steamed for 6 minutes at a temperature of 90 – 100 °C until they gelatinize. The steamed granules were cooled at room temperature for 20 minutes, then dried in an oven at 40°C for 10 hours. The formulation for making analog rice is presented in Table 1.

Characterization of Analog Rice

Analog rice is characterized physically, including the white degree (Kaemba *et al*. 2019), water absorption capacity and swelling power (Yudanti *et al*. 2015). Chemical characterization uses water, protein, fat, ash and carbohydrate content tests (AOAC 1980). The dietary fiber content test refers to the AOAC method (1995).

Data Analysis

The data in this study were analyzed using the ANOVA test with a confidence level of 95%, if there was a significant difference ($P<0.05$), then continued with the Duncan test.

RESULTS AND DISCUSSION

Physical Characteristics of Analog Rice

The white degree of analog rice shown at figure 1. The addition of more seaweed flour had a significant effect ($P<0.05$) on reducing the whiteness value of analog rice (Table 2). The decrease in the white degree was caused by the influence of the brown color of the seaweed (*Sargassum* sp.). This is in line with the statement by Karina and Desrizal (2021), that the addition of brown seaweed makes the color of the dodol darker. Apart from that, the dark color can also be influenced by the browning reaction (maillard) during heating processes such as steaming and drying. According to Damat *et al*. (2020) the heating process can cause maillard reactions between sugars from carbohydrates and amino acids.

The whiteness degree of analog rice added to seaweed flour ranged from 1.23 - 1.65% (Table 2). This value is lower when compared to analog rice from combination of seaweed (*E. cottonii*) and mocaf flour (17.70%) (Agusman *et al*. 2014), analog rice from combination of white corn and sago flour (66.81%) (Noviasari *et al.* 2013), analog rice from combination of cassava, coconut and sago (73.08%) (Kharisma *et al.* 2014), and rice from paddy (80.23%) (Noviasari *et al*. 2017). A low degree of whiteness can result in a decreased level of likeness (Karina and Desrizal 2021).

Water absorbtion capacity was carried out to determine the ability of analog rice to absorb water after the boiling process (Lindriati *et al*. 2014). Table 2 shows that the addition of seaweed did not have a significant effect ($P>0.05$) on the difference in the water absorbtion capacity. The average value of the water absorbtion capacity of analog rice added with seaweed flour ranges from 61 - 63%. The water absorption capacity of various rice analogues has been studied, the water absorption capacity of rice from paddy is 24.3% (Yulviatun *et al*. 2022), analog rice combination of a composite of cassava flour, corn flour and soybean flour is 60.52% (Pudjihastuti *et al.* 2021), analog rice from combination of mocaf, corn flour, and mung bean sprout flour 105.8-118% (Yulviatun *et al.* 2022). The higher the water absorption capacity, the higher the water needs for cooking. Water absorption capacity is influenced by the amylose content of the material, the higher the amylose content will have a positive correlation with water absorption capacity. Amylose in starch has the ability to form hydrogen bonds with water and consists of glucose units linked with α-1,4-glycosidic bonds (Srihari *et al*. 2016). Beneng taro has amylose and amylopectin contents of 19.27% and 37.02% respectively (Kusumasari *et al.* 2019).

Swelling power shows the level of volume expansion of analog rice due to the cooking process (Yulviatun *et al*. 2022). Table 2 shows that the addition of seaweed did not have a significant effect ($P>0.05$) on the difference in the swelling power. The swelling power of analog rice added with seaweed flour ranged from 59.3 - 62.0%. The swelling power in this study was higher compared to analog rice combination of taro flour, maizena flour and sweet potatoes (8.8%) (Srihari *et al*. 2016), analog rice from a combination of mocaf flour, corn flour and green bean sprout flour (27.25 - 30.86%) and rice from paddy (50%) (Yulviatun *et al*. 2022). The research results of Andika *et al.* (2021) indicated that the greater the swelling power, the shorter the cooking time. Swelling power is influenced by the ratio of amylose and amylopectin in the raw material. The higher the amylose content, the more difficult to form a gel because the amorphous structure formed increases the gelatinization temperature, resulting in low swelling power (Srihari *et al.* 2016). The levels of amylose and amylopectin greatly influence the texture of analog rice, the higher the amylose will produce chewy rice, while the higher the amylopectin will produce fluffier and stickier rice (Adicandra and Estiasi 2016).

Chemical Characteristics of Analog Rice

The moisture content of analog rice is an important parameter to know because it affects to shelf life. According to Miftahudin *et al.* (2015), the lower the moisture content, the longer the shelf life of the product. Based on Table 3, the moisture content of analog rice added with seaweed flour ranges from 10.14 - 13.89%. The moisture content of analog rice in this study is similar to the moisture content of analog rice from corn flour (10.37%-13.76%) (Santoso *et al.* 2013), rice analog combination of banana flour and cassava flour (10,41%-13,08%) (Yudanti *et al.* 2015), and rice from paddy (9,86%) (Yulviatun *et al*. 2022). The moisture content of analog rice can be influenced by the length of the drying process, the longer the drying process will cause the moisture content to decrease (Santoso *et al*. 2013). The water content in this study is almost similar to rice from paddy, so it can be stored for a long time like rice from paddy.

Ash content is a rough description of the mineral content found in food (Spiraliga *et al.* 2017). The addition of more seaweed flour caused a significant increase ($P<0.05$) in the ash content of analog rice (Table 3). The ash content in analog rice with addition of seaweed (*Sargassum* sp.) flour ranges from 2.75 - 4.14% (Table 3). Ash content from various analog rice has been studied, ash content from analog rice of *Eucheuma cottonii* seaweed, mocaf and sago combination is 2.24 - 3.13% (Finirsa *et al*. 2022), analog rice from cassava, corn and black soybeans combination is 1.21% (Pudjihastuti *et al.* 2021), and analog rice from white corn is 0.38% (Noviasari *et al.* 2013). The ash content in this study also showed higher results compared to the ash content of rice from paddy which was only 0.92-1.28% (Yulviatun *et al*. 2022). This is due to the mineral content in *Sargassum* sp. quite high, reaching 33.74% dry weight (Siregar *et al*. 2018). Mineral content in *Sargassum* sp. are potassium (K), sodium (Na), magnesium (Mg), and iron (Fe) (Syad *et al*. 2013). Analog rice with 15% seaweed added does not meet healthy food standards based on SNI 01-7111.1-2005, because it has an ash content above 3.5% (BSN 2005).

Addition of seaweed (*Sargassum* sp.) flour had a significant effect ($P<0.05$) on increasing the fat content of analog rice (Table 3). The fat content of analog rice with the addition of seaweed flour has a value ranging from 0.36 - 0.72%. The results of the fat content in this study were still lower than the fat content in rice from paddy, which was 1.3% (Yulviatun *et al.* 2022). The low fat content in analog rice is caused by the low fat content in the raw materials for making analog rice. The fat content of the main raw material for making analog rice is 0.17% in taro beneng flour (Kusumasari *et al.* 2019) and 0.79% in *Sargassum* sp. seaweed (Gazali *et al*. 2018). Finirsa *et al* (2022) stated that analog rice which has a low fat content will not easily become rancid, so it will last longer when stored.

Table 3 shows that the addition of seaweed did not have a significant effect ($P>0.05$) on differences in protein levels. The protein content in analog rice ranges from 5.11 - 5.69%. The protein content of analog rice in this study showed higher results than analog rice combined with seaweed *Eucheuma cottonii*, mocaf and sago (0.60 - 0.73%) (Finirsa *et al*. 2022) and analog rice from combination of taro flour, maizena flour and sweet potatoes (1.78%) (Srihari *et al*. 2016). The protein content of analog rice in this study were also close to the protein content of rice from paddy, which was 7.51% (Yulviatun *et al*. 2022). The high levels of analog rice protein in this study were influenced by the main raw materials, namely taro beneng and seaweed *Sargassum* sp. which has a protein content of 6.10% (Budiarto and Rahayuningsih 2017) and 8.42% (Siregar *et al*. 2018).

Addition of seaweed flour had a significant effect (P<0.05) on differences in carbohydrate levels (Table 3). Carbohydrate content in analog rice with the addition of seaweed ranges from 77.63-79.43%. Carbohydrate content of analog rice has been studied, carbohydrate content of analog rice from combination of seaweed (*Eucheuma cottonii*) and mocaf flour is 69.99% (Agusman *et al*. 2014), analog rice from white corn (91.54%) (Noviasari *et al.* 2013), and analog rice from cassava, corn and black soybeans combination (73.3%) (Pudjihastuti *et al.* 2021). The carbohydrate content of analog rice in this study is similar to rice from paddy 80.14% (Rasyid *et al.* 2016). This shows that analog rice with the addition of 5-15% seaweed can be used as an alternative food source of carbohydrates that is equivalent to rice from paddy.

Dietary Fiber

Dietary fiber is part of the carbohydrates that can be consumed and it is found in many plant cell walls. This fiber cannot be hydrolyzed by human digestive enzymes because it is resistant to the digestive and absorption processes in the small intestine, and can undergo complete or partial fermentation in the large intestine (Sari *et al*. 2019; Sardi *et al.* 2021). Based on Figure 2, dietary fiber in analog rice with the addition of seaweed ranges from 18.22–23.74%. Addition of seaweed had a significant effect (P<0.05) on increasing the dietary fiber content of analog rice (Figure 2). The highest levels of dietary fiber are found with the addition of 15% seaweed flour. This result is higher than the dietary fiber in analog rice from *Gracillaria* sp. (9.44%) (Purwaningsih 2022), analog rice from white corn (5.35%) (Noviasari *et al.* 2013), analog rice from sorghum (5.50%) and rice from paddy (0.19%) (Noviasari *et al*. 2015).

The dietary fiber in analog rice can be classified as a high fiber food, because it has a fiber content more than 6% (BPOM 2016). Based on BPOM (2021), the serving size for instant rice is 50-60 grams, so by consuming 50 grams of analog rice can fulfills 30.37-39.57% of daily dietary fiber intake (30 grams per day for recommended dietary fiber intake). Dietary fiber has various benefits if consumed in sufficient quantities. Consumption of dietary fiber can prevent obesity, reduce blood sugar levels, prevent cancer, stimulate the growth of good bacteria in the intestine and reduce the risk of cardiovascular disease (He *et al.* 2022).

CONCLUSION

The analog rice in this study had a darker color compared to rice from paddy. The analog rice in this research can be used as an alternative source of carbohydrates to replace paddy rice. The best treatment in this study was the addition of 5% and 10% seaweed because the ash content complies with standards and has a high dietary fiber content.

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REFERENCES

Adicandra, R.M. and Estiasih, T. 2016. Beras analog dari ubi kelapa putih (*Discorea alata* L.): kajian pustaka. Jurnal Pangan dan Agroindustri. 4(1), 383-390.

[AOAC] Association of Official Analytical Chemist. 1980. Official methods of Analysis. Washington DC. Association of Official Analytical Chemist. 869 hlm

[AOAC] Association of Official Analytical Chemist. 1995. Official methods of Analysis. Washington DC. Association of Official Analytical Chemist.

Agusman., Apriani, SNK., and Murdinah. 2014. Penggunaan rumput laut *Eucheuma cottonii* pada pembuatan beras analog dari tepung *modified cassava flour* (Mocaf). Jurnal Pascapanen dan Bioteknologi Kelautan dan Perikanan. 9(1), 1-10.

Anggraeni, N., Darmanto, Y.S., and Riyadi, P.H. 2016. Pemanfaatan nanokalsium tulang ikan nila (*Oreochromis niloticus*) pada beras analog dari berbagai macam ubi jalar *(Ipomoea Batatas L*.). Jurnal Aplikasi Teknologi Pangan. 5(4).

Anggraini. 2018. Pemanfaatan rumput laut (*Eucheuma cottoni*) menjadi roti tinggi serat dan yodium. ARGIPA. 3(1), 26-36.

[BPOM] Badan Pengawas Obat dan Makanan. 2016. Peraturan Kepala Badan Pengawas Obat dan Makanan Republik Indonesia Nomor 13 Tahun 2016: Tentang Pengawasan Klaim pada Label dan Iklan Pangan Olahan. Jakarta: BPOM RI

[BPOM] Badan Pengawas Obat dan Makanan. 2021. Peraturan Badan Pengawas Obat dan Makanan Nomor 26 Tahun 2021: Tentang Informasi Nilai Gizi pada Label Pangan Olahan. Jakarta: BPOM RI

Budiarto, M.S., Rahayuningsih, Y. 2017. Potensi nilai ekonomi talas beneng (*Xanthosoma undipes* K.Koch) berdasarkan kandungan gizinya. Jurnal Kebijakan Pembangunan Daerah. 1(1), 1-12.

[BSN] Badan Standardisasi Nasional. 2005. Makanan Pendamping Air Susu Ibu (MP-ASI)-Bagian 1: Bubuk Instan. Jakarta: Badan Standardisasi Nasional

Damat., Natazza, R.A., and Wahyudi, V.A. 2020. Kajian pembuatan beras analog berbasis tepung komposit dengan penambahan konsentrasi bubur rumput laut (*Gracilaria* sp.) dan gliserol monostearat. Food Technology and Halal Science Journal. 3(2), 174-187.

Srihari, E., Lingganingrum, F. S., and Alvina, I. 2016. Rekayasa beras analog berbahan dasar campuran tepung talas, tepung maizena dan ubi jalar. Jurnal Teknik Kimia, 11(1), 14-19.

Fauziyah, A., Marliyati, S.A., Kustiyah, L. 2017. Substitusi tepung kacang merah meningkatkan kandungan gizi, serat pangan, dan kapasitas antioksidan beras analog sorgum. Jurnal Gizi dan Pangan, 12(2), 147-152.

Finirsa, M.A., Warsidah., Sofiana, M.S.J. 2022. Karakteristik fisikokimia beras analog dari kombinasi rumput laut *Eucheuma cottoni*, mocaf dan sagu. Oseanologia. 1(2), 69-76.

Gazali, M. 2018. Aktivitas inhibitor tirosinase pada ekstrak alga cokelat *Sargassum* sp. agardh asal Pesisir LHDK Bubon, Kabupaten Aceh Barat. Jurnal Perikanan Terpadu. 1(1), 26-40.

HE, Yang., Wang, B., Wen, L., Wang, F., Yu, H., Chen, D., Su, X., and Zhang C. 2022. Effects of dietary fiber on human health. *Food Science and Human Wellness*. 11(1), 1-10. https://doi.org/10.1016/j.fshw.2021.07.001

Hudaya, R.N. 2008. Pengaruh penambahan tepung rumput laut (*Kappaphycus alvarezii*) untuk peningkatkan kadar iodium dan serat pangan pada tahu sumedang. Skripsi. Bogor. Fakultas Perikanan dan Ilmu Kelautan. Institut Pertanian Bogor. 90 hlm.

Kaemba, A., Suryanto, E., and Mamuaja, C. 2019. Aktivitas antioksidan beras analog dari sagu baruk (*Arenga microcarpha*) dan ubi jalar ungu (*Ipomea batatas* L. poiret). Chemistry Progress. 10(2), 62-68

Karina, I., Desrizal. 2021. Evaluasi mutu dodol dengan penambahan rumput laut cokelat (*Sargassum* sp.) sebagai makanan olahan sehat. *Teknologi Pangan: Media Informasi dan Komunikasi Ilmiah Teknologi Pertanian*. *12*(2), 220-230. https://doi.org/10.35891/tp.v12i2.2465

Kharisma, T., N.D. Yuliana, S. Budijanto. 2014. The effect of coconut pulp (*Cocos nucifera* L.) addition to cassava based analogue rice characteristics. The 16Th Food Innovation Asia Conference 2014; 2014 Juni 12–13; Bangkok, Thailand.

[Kemenkes] Kementerian Kesehatan Republik Indonesia. 2019. Laporan Riset Kesehatan Dasar 2018. Jakarta. Badan Penelitian dan Pengembangan Kesehatan.

Kumolontang, N.P, Edam, M. 2020. Formulasi beras analog berbahan tepung talas dan tepung kelapa. Jurnal Penelitian Teknologi Industri. 11(2), 93-100.

Kusumasari, S., Eris, F.R., Mulyati, S., and Pamela, V.Y. 2019. Karakterisasi sifat fisikokimia tepung talas beneng sebagai pangan khas Kabupaten Pandeglang. Jurnal Agroekoteknologi, *11*(2), 227-234.

Lindriati, T., Djumarti., and Ismawati, L. 2014. Sifat fisik dan organoleptik beras tiruan dari mocaf dan tepung jagung dengan tepung ketan sebagai bahan pengikat. Jurnal Teknologi Hasil Pertanian. 8(1), 55-66.

Matanjun, P., Mohamed, S., Mustapha, N.M., and Muhammad, K. 2009. Nutrient content of tropical edible seaweeds, *Eucheuma cottonii*, *Caulerpa lentillifera* and *Sargassum polycystum*. Journal of Applied Phycology. 21(1), 75-80.

Miftahudin, M., Liman, L. and Fathul, F., 2015. Pengaruh masa simpan terhadap kualitas fisik dan kadar air pada wafer limbah pertanian berbasis wortel. Jurnal Ilmiah Peternakan Terpadu, 3(3),121-126.

Mishra, A., Mishra, H.N., and Rao, P.S. 2012. Preparation of rice analogues using extrusion technology. Int J Food Sci Tech. 47(9), 1789-1797.

Noviasari, S., Kusnandar, F., Setiyono, A., and Budjianto, S. 2017. Karakteristik fisik, kimia, dan sensori beras analog berbasis bahan pangan non beras. Jurnal Pangan. 26(1), 1-12.

Noviasari, S., Kusnandar, F., Setiyono, A., and Budijanto, S. 2015. Beras analog sebagai pangan fungsional dengan indeks glikemik rendah. Jurnal Gizi dan Pangan. 10(3), 225-232

Noviasari, S., F. Kusnandar, S. Budijanto. 2013. Pengembangan beras analog dengan memanfaatkan jagung putih. jurnal teknologi dan industri pangan. 24(2), 195–201. doi:10.6066/jtip.2013.24.2.195

Pudjihastuti, I., Supriyo, E. and Devara, H.R., 2021. Pengaruh Rasio Bahan Baku Tepung Komposit (Ubi Kayu, Jagung Dan Kedelai Hitam) Pada Kualitas Pembuatan Beras Analog. Gema Teknologi. 21(2), 61-66.

Purwaningsih, S. 2022. Kajian serat dan komponen aktif beras analog dari rumput laut *Gracilaria* sp. Jurnal Pengolahan Hasil Perikanan Indonesia.

25(3), 382-392. http://dx.doi.org/10.17844/jphpi.v25i3.40138

Putri, N.A., Riyanto, R.A., Budijanto, S. and Raharja, S., 2021. Studi awal perbaikan kualitas tepung Talas Beneng (*Xanthosoma undipes* K. Koch) sebagai potensi produk unggulan Banten. Journal of Tropical AgriFood, 3(2), 63-72.

Rahmah, A.D., Rezal, F., and Rasma. 2017. Perilaku konsumsi serat pada mahasiswa angkatan 2013 Fakultas Kesehatan Masyarakat Universitas Halu Oleo Tahun 2017. JIMKESMA (Jurnal Ilmiah Mahasiswa Kesehatan Masyarakat). 2 (6), 1-10.

Rasyid, M.I., Yuliana, N.D. and Budijanto, S. 2016. Karakteristik sensori dan fisiko-kimia beras analog sorghum dengan penambahan rempah campuran. Agritech. 36(4), 394-403.

Santoso, A.D., Warji., Dwi, D.N., and Tamrin. 2013. Pembuatan dan uji karakteristik beras sintetis berbahan dasar tepung jagung. Jurnal Teknik Pertanian. 2(1), 27-34.

Saragih, B., Nisyawati, H., Sitohang, B., Singalingging, C.N., and Marwati, M. 2020. Formulasi mocaf, tepung ubi jalar ungu dan jelai terhadap sifat sensoris, antioksidan, nilai gizi, profil FTIR dan indeks glikemik beras analog. Jurnal Riset Teknologi Industri. 14(2), 297-308.

Sardi, M., Tobing, M.N.B., Putri, A.W., Nasution, A.M., Pratiwi, A., Butar, K.A.B., Putri, R.N., Tumangger, S.H., and Sahira, S. 2021. Klaim kandungan zat gizi pada berbagai kudapan (snack) tinggi serat: literature review. Jurnal Gizi Pangan. 1(1): 39-45

Sari, F., Nugrahani, R.A., Susanty., Redjeki, A.S., and Hendrawati, T.Y. 2019. Pelatihan pemanfaatan dedak padi (rice bran) sebagai bahan tambahan pangan dan produk perawatan tubuh bagi masyarakat. Prosiding Seminar Nasional Pengabdian Masyarakat LPPM UMJ. E-ISSN: 2714-6286. 1-5.

Siregar, I.D., Rahman, K., and Mery, S. 2018. Ekstraksi senyawa fenolik dan kandungan kimia pada rumput laut coklat (*Sargassum* sp.). Jurnal Online Mahasiswa Universitas Riau. 5(1), 1-9.

Spiraliga, R.R., Darmanto, Y.S., and Amalia, U. 2017. karakteristik nasi analog tepung mocaf dengan penambahan tepung rumput laut *Glacilaria verrucosa* dan tiga jenis kolagen tulang ikan. Jurnal Pengolah dan Bioteknologi Hasil Perikanan. 6(1), 1-10.

Syad, A.N., Shunmugiah, K.P., and Kasi, P.D. 2013. Seaweed as nutritional supplement: analysis of nutritional profe, physicochemical propeeties and proximate composition of *G. acerosa* and *S. wightii*. Biomedicine and Preventive Nutriniotn. 3(1), 139-144.

Yudanti, YR., Waluyo, S., and Tamrin. 2015. Pembuatan beras analog berbahan dasar tepung pisang (*Musa paradisiaca*). Jurnal Teknik Pertanian Lampung. 4(2), 117-126.

Yulviatun, A., Purnamasari, S., Ariyanto, A.R, and Atmuka, W. 2022. Karakteristik fisik, kimia dan organoleptik beras analog berbasis mocaf, tepung jagung (*Zea mays* L.) dan tepung kecambang kacang hijau (*Vigna radiata* L.). Jurnal Teknologi Hasil Pertanian. 15(1), 46-61.

Table 1. Rice analog formulations

Material	Addition of seaweed flour			
	0%	5%	10%	15%
Seaweed flour (g)	0	25	50	75
Beneng taro flour (g)	500	475	450	425
CMC (g)	5	5	5	5
Water (mL)	500	500	500	500

Table 2. Physical characteristics of analog rice

Parameters (%)	Addition of seaweed flour			
	0%	5%	10%	15%
White degree	4,42 ± 0,14[c]	1,65 ± 0,03[b]	1,38 ± 0,06[a]	1,23 ± 0,03[a]
Water absorption capacity	63 ± 0,01[a]	63 ± 0,01[a]	61 ± 0,01[a]	61 ± 0,01[a]
Swelling power	61,8 ± 0,14[a]	62,0 ± 0,13[a]	61,3 ± 0,14[a]	59,3 ± 0,12[a]

Note: Value with different notation in the same row has a significant differences (*P*<0.05)

Tabel 3. Chemical characteristics of analog rice

Parameters (%)	Addition of seaweed flour			
	0%	5%	10%	15%
Moisture content	11,56 ± 0,32[b]	13,89 ± 0,06[c]	12,38 ± 0,08[b]	10,14 ± 0,23[a]
Ash	2,62 ± 0,04[a]	2,75 ± 0,04[a]	3,24 ± 0,22[b]	4,14 ± 0,08[c]
Fat	0,21 ± 0,00[a]	0,36 ± 0,06[a]	0,72 ± 0,14[b]	0,60 ± 0,25[b]
Protein	5,47 ± 0,21[a]	5,37 ± 0,16[a]	5,11 ± 0,02[a]	5,69 ± 0,14[a]
Carbohydrat	80,14 ± 0,14[d]	77,63 ± 0,12[a]	78,55 ± 0,14[b]	79,43 ± 0,25[c]

Note: Value with different notation in the same row has a significant differences (*P*<0.05)

Figure 1. Analog rice: (A) 0%, (B) 5%, (C) 10%, (D) 15%

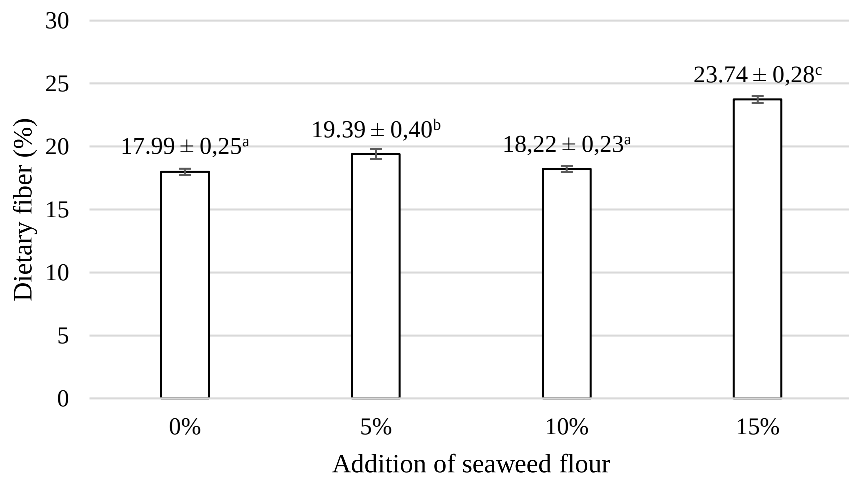

Figure 2. Dietary fiber in analog rice