AL-KAUNIYAH: Jurnal Biologi, 15(2), 2022, 290-297
Website: http://journal.uinjkt.ac.id/index.php/kauniyah
P-ISSN: 1978-3736, E-ISSN: 2502-6720

INDIGENOUS KNOWLEDGE OF BLACK RICE (*Oryza sativa* L. var. *indica*) IN CENTRAL ACEH

PENGETAHUAN ADAT MENGENAI PADI BERAS HITAM (Oryza sativa L. var. indica) DI ACEH TENGAH

Namira Hamim[1], Zumaidar[2,3*], Saida Rasnovi[2], Risa Nursanty[4]

[1]*Post Graduate of Biology Department, Natural Sciences and Faculty, Syiah Kuala University, Banda Aceh*
[2]*Biology Department, Natural Sciences and Mathematics Faculty, Syiah Kuala University, Banda Aceh*
[3]*Ethnoscience Research Center, Syiah Kuala University, Banda Aceh*
[4]*Department of Food Science, Faculty of Food Science and Technology, University Putra Malaysia*
**Corresponding author:* zumaidar@unsyiah.ac.id

Naskah Diterima: 8 Juli 2021; Direvisi: 20 April 2022; Disetujui: 30 Agustus 2022

Abstract

Black rice (*Oryza sativa* L. var. indica) is less available in the market than the usual white rice. Its availability is closely related to its utilization. One of the studies on the use of plants in certain tribes was obtained through ethnobotany. This study aimed to examine information regarding the use of black rice in Central Aceh. The methods used were Purposive Sampling and Participatory Rural Appraisal (PRA). This study involved 197 respondents of ethnic group; farmer, seller, and consumer of black rice, traditional healer. The results showed that black rice in Central Aceh was used by the community as medicine (72%) for gastritis, stomach acid, cholesterol, diabetes, thrush, fever, and as fertility booster; as food ingredients (10%) to make black rice tapai, *gutel*, and black rice crackers; as plant protectors (9%); as tools for traditional game (4%) called bebeulen; as cosmetic (3%) for smooth facial skin; and as animal feed (2%). Differences in regions indicated differences in recipes and habits of using certain plants.

Keywords: Black rice; Central Aceh; Ethnobotany; *Oryza sativa* L. var. indica

Abstrak

Padi beras hitam (Oryza sativa L. var. indica*) keberadaannya di pasaran sedikit dibandingkan dengan beras putih. Ketersediaan erat kaitannya dengan pemanfaatan. Salah satu kajian tentang pemanfaatan tumbuhan di suku tertentu diperoleh melalui etnobotani. Penelitian ini bertujuan untuk mengkaji informasi menyangkut pemanfaatan padi beras hitam di Kabupaten Aceh Tengah. Metode yang digunakan adalah Purposive Sampling dan Participatory Rural Appraisal (PRA). Pada penelitian ini melibatkan 197 responden yang terdiri dari kelompok adat; petani, penjual, dan pengguna beras hitam, serta tabib. Hasil penelitian menunjukkan bahwa padi beras hitam di Kabupaten Aceh Tengah dimanfaatkan oleh masyarakat sebagai obat-obatan (72%) yaitu untuk mengobati maag, asam lambung, kolesterol, diabetes, sariawan, demam, dan mudah memiliki keturunan, sebagai bahan pangan (10%) yaitu membuat tapai beras hitam, gutel, dan kerupuk nasi hitam, sebagai pelindung tanaman (9%), sebagai alat permainan (4%) yaitu bebeulen, serta sebagai bahan kosmetik (3%) yaitu menghaluskan wajah, dan sebagai pakan ternak (2%). Perbedaan daerah menunjukkan perbedaan resep dan kebiasaan penggunaan tumbuhan tertentu.*

Kata kunci: *Aceh Tengah; Etnobotani; Oryza sativa* L. var. indica*; Padi beras hitam*

Permalink/DOI: http://dx.doi.org/10.15408/kauniyah.v15i2.21571

INTRODUCTION

Rice is the main food crop in Indonesia. Most consumed staple food in Indonesia is rice (Lestari, 2012). The diversity of rice species has an important role in realizing national food security and diversification (Sa'adah et al., 2013). Rice is also a staple food in many Asian countries. In general, there are three main types of rice, namely white rice (*Oryza sativa*), brown rice (*O. glaberrima*), and black rice (*O. sativa* var. *indica*) (Hartati et al., 2017). Rice has a variety of colors due to the presence of pigments. Color pigments, especially anthocyanins, are found in the pericarp, seed coat, or aleurone, such as red rice and black rice. Black rice is starting to be widely consumed as functional food. Either naturally or through a certain process, black rice contains one or more compounds that considered to have physiological functions, such as anthocyanins with function as antioxidants. In general, the constraint on the development of black rice is that the long harvest can reach 200 days. However, there are some varieties of black rice that have matured (short harvest age) or can be harvested in 4 months (Sayekti & Qurrohman, 2018). Black rice has different names depending on where it is grown. Some local names include: Wulung rice (Solo), Cempo ireng/Jlitheng rice (Sleman), and Melik rice (Bantul). In history, the consumption of black rice was taboo for ordinary people. Black rice is also called forbidden rice because in the past, it was only reserved for the nobles (Muktisari & Hartati, 2018).

Black rice is a local variety that contains the best pigment compared to other rice. Black rice is becoming one of the popular types of rice because of its health benefits, which can increase endurance, repair damaged liver cells, prevent kidney function disorders, prevent cancer or tumors, slow down aging, act as antioxidants, clean the cholesterol in the blood, and prevent anemia (Badan Penelitian dan Pengembangan Pertanian Departemen Pertanian, 2009). Several studies have shown that natural compounds in food have an important role in preventing various chronic diseases such as anthocyanins as antioxidants that have a protective effect against inflammation, atherosclerosis, carcinoma, and diabetes. The main anthocyanin in black rice is cyanidin-3-glucoside (C3G). Black rice also contains active phytochemicals such as tocopherols, tocotrienols, oryzanols, B complex vitamins, and phenolic compounds (Jang et al., 2012).

Black rice seed is still difficult to find. In fact, its availability is unpredictable. The local black rice has a tall or sturdy plant structure. The height of black rice stem can reach two meters. However, some of the current crosses have shorter plants. In terms of black rice production, based on the information from *Balai Besar Biogen*, black rice variety has been developed since 2003, resulted in a cross between the Silugonggo variety and brown rice. This cross line successfully produced mature rice plants (age to harvest of 90–100 days) with a plant height of 90–100 cm. Another effort in black rice breeding was recorded by *Dinas Pertanian Jawa Barat* in 2009. Three varieties of rice commonly grown by farmers in Cibeusi and Ciater Villages, Subang Regency were obtained. The variant is bright yellow, dull, and black. The rice from Subang is known as Cibeusi. Cibeusi rice has an early maturity of up to 200 days with a productivity of more than five tons per hectare. The black rice is food, not medicine. However, it may function as drugs in certain circumstances (Maharni, 2015).

Ethnobotany is a field of science that examines the use of plants for foods, protection, treatment, clothing, and traditional ceremonies (Purwanto, 1999). Utilization of existing natural resources, particularly plants, is necessarily developed. This could be the first step, especially to search for medicinal plants based on traditional community knowledge over generations (Dharma, 2001). The introduction of ethnobotany to the community can increase public knowledge about the maximum use of plants that have potential as drugs. The next expected impact is the improvement of public health and economy from processed products that are competently produced and attractively packaged. Ethnobotany is the basis for the development of science to find out further clinical studies through the laboratory (Atmojo, 2013).

Central Aceh is one of the regencies that produce black rice in Aceh Province. Black rice in Gayo language is called *peudarang* or charcoal rice. Information about the use of black rice in Central Aceh Regency is not yet scientifically documented. Therefore, it is necessary to conduct research, examine and seek information about black rice ethnobotany in Central Aceh Regency.

MATERIALS AND METHODS

Tools and Materials

Stationery, camera, sound recording device, spray bottle, needle, scissors, notebook, questionnaire, paperboard, newspaper, 70% alcohol, yarn, specimen labels, and specimen folders.

Research Location and Regency

The location of the research was selected using a purposive sampling technique based on the existence of the black rice population and respondent selection. The presence of black rice in some sub-districts was known by visiting black rice sellers in the market and people engaged in rice field activities. In four selected sub-districts, three villages were identified to be inhabited by community that cultivated black rice, namely Kala Lengkio, Mendale, and Lot Kala villages in Kebayakan sub-district, Pegasing, Kute Lintang and Blang Bebangka villages in Pegasing sub-districts, One -One, Toweren Antara, and Kenawat villages in Lut Tawar sub-district, and Mongal, Kebet, and Daling villages in Bebesen Sub-district.

Research Respondents

Respondents selected for the interview process in each village consisted of seven groups of respondents, namely the village head, “adat chief”, “petue kampong”, black rice farmer, black rice seller, user community, and traditional healer. Total respondents in this study amounted to 197 people. There were 12 village heads, 12 traditional leaders, 12 “petue kampong”, 75 black rice farmers, 15 black rice sellers, 60 black rice users/consumers, and 11 traditional healers.

RESULTS

In general, black rice has the same share as other rice varieties. In terms of taste and texture, black rice is not as fluffy or “pulen" as white rice. Black rice can be mixed and cooked together with white rice, but it will need more water and take longer time. Cooked black rice has a strong aroma that arouses the appetite. Black rice is considered a long-living plant.

Table 1. Differences in morphological characters of black rice, black sticky rice, and white rice in Central Aceh

Morphological character	Black rice	Black sticky rice (Hamawi et al., 2019).	White rice
Leaf length (cm)	58–67	38.27	50–60
Infructescence length (cm)	29–33	23.37	25–30
Seeds of rachilla	60–70	126	17–35
Seed shape	Slightly round	Slightly oval	Oval (long)
Seed length (cm)	0.8–0.9	0.7	0.9–1
Seed color	Yellowish-brown	Black and black with yellow stripes	Straw yellow
Grain color	Dark chocolate	Black	White
Endosperm color	Black a little white	Black	White

People in Indonesia are more familiar with black sticky rice than black rice. Even though they are both black, they are different and have dissimilar nutrient content. The properties and texture are similar to ordinary rice compared to glutinous rice. The types of black rice in Indonesia come from various cultivars, but mostly inherited over generations of farmer family. Some performed rice purification from black rice sold in the market. These types of black rice normally have physical characteristics, namely black rice grains, brown grain color, long-living plants, and tall plant structure. The black color of the grains is genetically regulated by aleurone color and starch composition in the endosperm. Aleurone and endosperm produce anthocyanins which cause the purple color. The high levels of anthocyanins in this purple color look black. Anthocyanins are antioxidants that are needed as anti-cancer. The skin of the grain is brown like ordinary rice, although the rice is black. It is only during the grain filling process when the color of the grain will

blacken, but will turn back to brown when ripe. This is different from black sticky rice which has black grain as well. A comparison of morphological characteristics of black rice, black sticky rice, and white rice is presented in Table 1.

Black rice and white rice found in the research location are usually planted together in the same rice field. Both of these varieties are mature rice. The organs of the black rice plant used are fruit and stems. The parts of the black rice fruit used by the people of Central Aceh are rice grains and bran. Rice grains are used as ingredients for medicines, cosmetics, and foods. Black rice bran and rice bran are used as animal feeds. The black rice stalks are used as a game tool and the whole black rice paddy is used as plant protector. The people of Central Aceh were found to use black rice as medicine (72%), feed ingredients (10%), plant protection (9%), game tools (4%), cosmetic ingredients (3%), and animal feed (2%) (Figure 1).

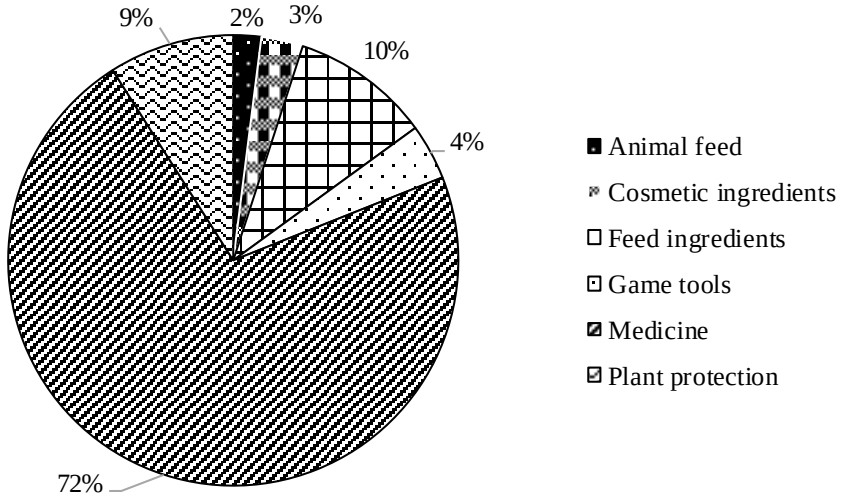

Figure 1. Percentage of black rice used by the people of Central Aceh

DISCUSSION

Utilization of Black Rice for Food and Animal Feed

It was found that black rice is used as food by the people of Central Aceh. A popular Acehnese food made from processed black rice is called “gutel”. It is a typical food made from ground black rice mixed with brown sugar and grated coconut. The mixed ingredients are further wrapped in young banana leaves to prevent sticking, steamed for 20–30 minutes, and “gutel” is ready to eat.

Moreover, black rice can also be processed into other foods, such as black rice “tapai” and crackers. Black rice “tapai” is one type of foods processed with the basic ingredients of fermented black rice (Sutanto & Martono, 2006). The people of Central Aceh process black rice into “tapai” by cooking black rice into rice, mixing it with yeast, and stirring the mix until evenly distributed. Later, the mix is added with salt and sugar, put in a container, wrapped in cloth, and left for two days. After two days, black rice “tapai” can be eaten with coconut milk.

Black rice crackers are another form of processed black rice made by the people of Central Aceh. It is made by drying the black rice crust in the sun for 2–3 hours. Next, the dry rice crust is sprinkled with salt to be further fried.

The bran of black rice is used as animal feed by the people of Central Aceh by mixing the remains of vegetables and other foods. Black rice bran extract is known to have antioxidant activity (Kaneda et al., 2006). Phenol and anthocyanin compounds contained in black rice are higher than that in other types of rice, such as white rice and brown rice. Various studies have also shown the ability of black rice to inhibit the growth of several types of cancer. The methanolic extract fraction of black rice bran has cytotoxic activity against T47D and WiDr cells besides its ability to induce apoptosis that is higher than doxorubicin. Black rice extracts are also able to induce apoptosis for HL-60, MCF-7, and Caco-2 cells and inhibit the proliferation of HL-60 cells, MCF-7 cells, and

Caco-2 cells. According to Takashima et al. (2013), aqueous and methanolic extracts of black rice are able to inhibit the proliferation of LS174T colon cancer cells.

Black rice (*Oryza sativa* L. var. *indica*) and black rice bran have been used as functional food ingredients, but the extract has not been utilized. Black rice and black rice brain contain phenolic compounds, flavonoids, and anthocyanins. Those compounds are known to have antioxidant activity. The extraction method used is maceration, while the solvents used are methanol, ethanol, and aquades. Methanol is the best solvent to determine the highest level of phenolic compounds and antioxidant activity. The results of the review of these studies showed that the total phenolic content of black rice and its bran was not correlated with antioxidant activity. The total phenolic content of black rice extract from 4 studies was 156.93–830.1 mg gallic acid equivalent/100 g sample, while black rice bran extract was 3.50–7.52 mg gallic acid equivalent/100 g sample. The antioxidant activity of black rice extract from 4 studies in the form of DPPH reduction was 4.98–77.3%, while black rice bran extract was 57.94–88.84% (Najib, 2020).

Utilization of Black Rice for Medicine and Cosmetics

Black rice has more phenolic compounds compared to white rice, some of which are related to antioxidant activity. Phytochemical extracts of brown rice and black rice extracts contain alkaloids, flavonoid terpenoids, tannins, quinones, and nine types of anthocyanins (Hartati et al., 2017). A recent study showed that anthocyanins are one of the most powerful antioxidants in rice. Black rice pigment is the strongest one among other rice colors. This pigment is also rich in flavonoids, and the levels are five times higher than that of white rice. Flavonoids are phenolic compounds that act as antioxidants and prevent free radical damage (Dwijayanti et al., 2016). Black rice extract can inhibit the formation of blood vessels in CAM. The higher the concentration of black rice extract, the lower the number of blood vessels formed (Sayekti & Qurrohman, 2018). The antioxidant content in black rice and black rice flour is very useful in preventing anemia (Muktisari & Hartati, 2018), and black rice also functions as an immunomodulator (Hartati et al., 2017).

The people of Central Aceh use black rice for medicine and cosmetic ingredients. As a medicine, the benefits of black rice are treating ulcer disease, stomach acid, cholesterol, diabetes, fever, thrush, and as fertility booster. Black rice is also commonly used as cosmetics in the form of cold powder for facial skin. People use it by washing their face with deposited black rice water and letting it air dry. They believe that the sediment in black rice washing water contains beauty ingredient for facial skin because it can make the skin smooth.

Beneficial biological activities are found in rice. The content of vitamins, minerals, fiber, and several types of antioxidants, such as ferulic acid, phytic acid, tocopherol, and oryzanol is thought to have potential as a tyrosinase inhibitor. A study was conducted to determine the potential of extracts from various types of rice, namely white rice, brown rice, and black rice as antioxidants and tyrosinase inhibitors with the extraction solvents of n-hexane, ethyl acetate, and methanol. The result of this study showed that rice extracts with the highest antioxidant activity using the 1,1-diphenyl-2-picrylhydrazyl method were black rice methanol extract (IC50 290 g/mL), while white rice ethyl acetate extract obtained the highest antioxidant activity using the phosphomolybdate method (41 mmol-tocopherol equivalent/g sample). Therefore, black rice methanol extract and white rice ethyl acetate extract have the potential as antioxidants, while the rice extract with the highest tyrosinase inhibitor activity was the n-hexane extract of brown rice in monofelase (3156 g/mL) (Maharni, 2015).

The part of black rice that is used as an ulcer medicine is the black rice grain. According to the people of Central Aceh, to be used as an ulcer medicine, black rice is processed in three ways. First, chewing directly after cleaning the skin without washing it. Second, cooking black rice grains into the rice, adding salt to prevent bitterness, and eating it as substitute for white rice. Third, just drinking the black rice washing water.

The people of Central Aceh use black rice as a stomach acid remedy. GERD (Gastroesophageal Reflux Disease) is the term for acid reflux and we often call it acid reflux disease. There are two methods commonly applied to process the black rice concoction into

stomach acid medicine. First, black rice is cooked into rice and then consumed three times a day. Second, black rice grains are mashed and given a little water, mixed with bananas, then squeezed, and the juice is drunk twice a day.

The people of Central Aceh also use black rice as a cholesterol drug and consume it by drinking it like coffee or tea. The black rice grains are cleaned of fruit by winnowing the rice and grinding until smooth. Later, the ground black rice is roasted with cloves and shallots. The mixture of black rice and the above ingredients is ground into powder and drunk at least once a day (Figure 4).

Black rice is used as a substitute for the usual rice consumed daily by diabetic patients since it has a low glycemic index value. Prijatmoko (2007) explained that the glycemic index is a measurement of the speed of carbohydrate absorption and the ability of carbohydrates to increase blood glucose concentrations within a certain time. The low glycemic index in black rice is considerably suitable for diabetics and healthy diet.

Black rice is also believed to have properties for women who face difficulty in having children. The people of Central Aceh process black rice by cooking black rice into rice and mixing it with ash plantain (cooking banana). The mix is squeezed and filtered, and the juice is drunk. Another method is by grinding black rice grains and squeeze them with long bean leaves and grated coconut, then drink the water. However, literature that explains the use of black rice as fertility booster is not yet available.

The people of Central Aceh use black rice as one of the ingredients in a potion to reduce fever. The method of processing black rice as medicine for fever is by mixing black rice, long bean leaves, and grated coconut. The mix is squeezed and later applied to the head by gently massaging the head. The water is drunk twice a day until the fever goes down. Black rice is also used as a medicine for thrush, which is processed by mixing black rice grains, long bean leaves and grated coconut. The mix is squeezed until the juice comes out. Gargle the juice and drink it at least once a day.

Utilization of Black Rice in the Ecology

In the field of ecology, the people of Central Aceh used black rice as a protector against white rice plants. In addition, the community also used black rice stalks as children's toys, while the bran was used as animal feed. It was found that black rice in the ecological field was used as a barrier plant for animals, especially pigs that want to eat white rice. According to the community, pigs do not eat black rice due to its bitterness, hence farmers applied this method to protect their white rice against pig attacks.

The people of Central Aceh also used rice stalks as a game tool (“bebeleun”) especially during the harvest season. Rice stalks are cut into small pieces and used as toys like small flutes or whistles. This game is often played by children in Central Aceh while waiting for rice milling activity in the rice fields. The sound produced depends on the stalk length, for example for loud sounds, they need 7–8 cm of rice stalks, while a long cut of about 13–15 cm length is needed to make duck sound.

Utilization of Black Rice in the Economics

During the research, black rice in Central Aceh was sold at price higher than that of other types of rice, ranged from Rp. 22,000–30,000/kg. This price difference was due to its limited availability since not many farmers grew black rice in the fields.

CONCLUSIONS AND SUGGESTIONS

It is concluded that the people of Central Aceh utilized black rice for various purposes, such as medicine (72%), food (10%), plant protection (9%), game tools (4%), cosmetic ingredients (3%), and animal feed (2%). Black rice was used in the food sector as black rice “tapai”, “gutel”, and crackers. The use of black rice in the field of medicine is to treat ulcers, stomach acid, cholesterol, diabetes, thrush, fever, and as fertility booster. In cosmetic, it is used as ingredient for smooth facial

skin. In term of ecological function, black rice is used as children's toys (stems), protectors of white rice plants in the field, and animal feed (bran).

Based on this research, it is recommended that Central Aceh become one of regencies that can develop knowledge of local wisdom about black rice in order to improve the welfare of the people in Central Aceh Regency. This research is also the basis of knowledge for further testing on phytochemicals since they are the raw materials for medicines.

ACKNOWLEDGEMENTS

We would like to thank the people of Central Aceh for their help in providing information and direct involvement in the data collection process.

REFERENCES

Atmojo, S. E. (2013). Pengenalan etnobotani pemanfaatan tanaman sebagai obat kepada masyarakat Desa Cabak Jiken Kabupaten Blora. *Jurnal WUNY, 15*(1). doi: 10.21831/jwuny.v15i1.3529.

Badan Penelitian dan Pengembangan Pertanian Departemen Pertanian. (2009). Beras hitam, pangan berkhasiat yang belum popular. *Warta Penelitian dan Pengembangan Pertanian, 31*(2), 9-10.

Dharma, A. (2001). Uji bioaktifitas metabolit sekunder (Makalah Workshop Peningkatan Sumber Daya Alam Hayati dan Rekayasa Bioteknologi). FMIPA Universitas Andalas, Padang, Sumatra Barat, Indonesia.

Dwijayanti, D. R., Widodo., Ibrahim, M., & Rifa'i, M. (2016). EMSA eritin polyherbal as an antioxidant can suppress nf-?b activation and decrease il-17 cytokine in irradiation mice model. *Food and Agricultural Immunology*, *27*(3), 422-433.

Najib, M. F. (2020). Penetapan kadar fenolik total dan uji aktivitas antioksidan beras hitam (*Oryza sativa* L. *indica*) dan bekatul hitam (Skripsi sarjana). Universitas Ngudi Waluyo, Jawa Tengah, Indonesia.

Hamawi, M., Setyaningrum, H., & Etica, U. (2019). Karakter morfologi kultivar padi ketan lokal Ponorongo. *Jurnal Agronomi Indonesia, 47*(3), 224-231.

Hartati, F. K., Widjanarko, S. B., Widyaningsih, T. D., & Rifai, M. (2017). Anti-inflammatory evaluation of black rice extract inhibits TNF-α, IFN-γ and IL-6 cytokines produced by immunocompetent cells. *Food and Agricultural Immunology*, *28*(6), 1116-1125.

Jang, H. H., Park, M. Y., Kim, H. W., Lee, Y. M., Hwang, K. A., Park, J. H., … Kwon, O. (2012). Black rice (*Oryza sativa* L.) extract attenuates hepatic steatosis in C57BL/6 J mice fide a high-fat diet via fatty acid oxidation. *Nutrition and Metabolism, 27*(9), 2-11.

Kaneda, I., Kubo, F., & Sakurai, H. (2006). Antioxidative compounds in the extracts of black rice brans. *Journal of Health Science*, *52*(5), 495-511.

Lestari, A. (2012). Uji daya hasil beberapa varietas padi (*Oryza sativa* L. *indica*) dengan metode sri (*The System of Rice Intensification*) di Kota Solok (Skripsi sarjana). Fakultas Pertanian Universitas Andalas, Padang, Sumatra Barat, Indonesia.

Maharni, M. (2015). Potensi beras putih (*Oryza sativa*), beras hitam (*O. sativa* L. *indica*), dan beras merah (*O.nivara*) sebagai antioksidan dan inhibitor tirosinase (Skripsi sarjana). Institut Pertanian Bogor, Bogor, Jawa Barat, Indonesia.

Muktisari, R. D., & Hartati, F. K. (2018). Analisis aktivitas antioksidan pada beras hitam dan tepung beras hitam (*Oryza sativa* L. indica). *Food Science and Technology Journal, 1*(1), 20-27.

Prijatmoko, D. (2007). Indeks glikemik 1 jam postprandial bahan makanan pokok jenwas nasi, jagung dan kentang. *Cermin Dunia Kedokteran (CDK), 34*(6), 285-288.

Purwanto, Y. (1999). Peran dan peluang etnobotani masa kini di Indonesia dalam menunjang upaya konservasi dan pengembangan keanekaragaman hayati. Prosiding Seminar Hasil-hasil Penelitian Bidang Ilmu Hayat. Pusat Antar Universitas Ilmu Hayat Institut Pertanian Bogor, Bogor, Jawa Barat, Indonesia. Retrieved from https://repository.ipb.ac.id/handle/123456789/24877.

Sa'adah, I. R., Supriyanta., & Subejo. (2013). Keragaman warna gabah dan warna beras varietas lokal padi beras hitam (*Oryza sativa* L.) yang dibudidayakan oleh petani Kabupaten Sleman, Bantul, dan Magelang. *Vegetalika, 2*(3), 13-20.

Sayekti, F. D. J., & Qurrohman, M. T. (2018). Aktivitas antiangiogenesis ekstrak beras hitam (*Oryza sativa* L. *indica*) pada chorioalantoic membrane (cam) sebagai kandidat antikanker. *International Journal of Agriculture System*, *8*(1), 7-12.

Sutanto, T. D., & Martono, A. (2006). Studi kandungan *etanol* dalam tapai hasil fermentasi beras ketan hitam dan putih. *Jurnal Gradien, 2*(1), 123-125.

Takashima, A., Ohtomo, M., Kikuchi, T., Iwashita, J., Abe, T., & Hata, K. (2013). Differentiation- and apoptosis-inducing activities of rice bran extracts in a human colon cancer cell line. *Journal of Food Science and Technology, 50*(3), 595-599. doi: 10.1007/s13197-011-0368-2.