Journal of Vocational Studies on Applied Research

Production of Analog Rice from Composite Flour: Mocaf, Corn, and Porang Flour

Ghiffara Amanda Florie* and Heny Kusumayanti

Department of Industrial Technology, Vocational School of Diponegoro University, Jalan Gubernur Mochtar, Tembalang, Semarang, 50275, Indonesia

*) Corresponding author: amandaflorie22@gmail.com

Abstract *– Rice is a primary food that commonly consumed by people in Indonesia and even in Asia. Apart from rice, Indonesia actually has various kinds of plants that can be used as a primary food such as corn, cassava, sweet potatoes, sago, etc., but are still rarely consumed by the public. Analog rice can be an alternative so that Indonesian people can consume non-rice primary foods with a similar texture to rice. In this research, analog rice was made from alternative raw material such as cassava, corn and porang tubers which had never been used as a formulation in previous research, then organoleptic test was carried out to determine public's preferences and proximate test also carried out to compare the analog rice produced with market rice. The aim of this research is to produce analog rice from a mixture of mocaf, corn flour and porang flour and determine public acceptance of analog rice products based on organoleptic tests. The production of analog rice consists of several processes such as preparing raw materials, mixing, steaming, extrusion process and drying the analog rice. Based on research, it was found that F1 and F5 formulation were the best analog rice based on organoleptic tests, and F5 formulation was the closest to IR64 rice based on proximate tests.*

Keywords: *analog rice; corn flour; mocaf; porang flour*

Received: May 05, 2024 Revised: August 01, 2024 Accepted: August 16, 2024

Doi: http://dx.doi.org/10.14710/jvsar.v6i1.22662

[How to cite this article: Florie, G.A., and Kusumayanti, H. (2024). Production of Analog Rice from Composite Flour: Mocaf, Corn, and Porang Flour. *Journal of Vocational Studies on Applied Research, 6*(1), 12-16. doi: http://dx.doi.org/10.14710/jvsar.v6i1.22662]

INTRODUCTION

Paddy rice is a primary food as a source of carbohydrates for the majority of Indonesian people, namely 98.35% of households in Indonesia consume rice. Indonesia imported 2.2 million tonnes of rice in 2018 to fulfil its rice needs (Badan Pusat Statistik, 2023b). So, food diversification is needed to be able to fulfil people's needs for rice.

Besides rice, Indonesia has other high-carbohydrate plant such as corn, cassava, sorghum, sago and tubers (Pudjihastuti, Sumardiono, Supriyo, et al., 2018). Cassava (*Manihot esculenta*) is a source of carbohydrates that is widely produced in Indonesia that reach 19 million tons/year (Nurcahyani & Sari, 2019). Cassava is often processed and modified; one form of cassava processing is Mocaf (modified cassava flour). Mocaf is fermented cassava flour which can be processed into various kinds of food products including analog rice. Mocaf has high levels of amylose, relatively low in protein, and does not contain gluten. The high amylose content in mocaf can make analog rice have a strong and solid structure (Zulfa et al., 2023).

Corn is also a source of carbohydrates which is widely produced in Indonesia, that reach 19 million tons/year (Badan Pusat Statistik, 2023a). In addition from being a source of complex carbohydrates, corn contains nutrients that are very beneficial for health, including vitamin B, vitamin C, carotene, potassium, iron, magnesium, phosphorus, omega 6, and unsaturated fats which can lower cholesterol (Swapna et al., 2020). Corn is often processed into corn flour so that it is easy to process into various food products, easy to store, maintains nutritional quality, and makes it easier to mix with other ingredients (Abriana et al., 2020).

Porang tubers (*Amorphophallus muelleri Blume*) are tuber plants that contain various kinds of vitamins and proteins as well as high glucomannan content but have not been utilized optimally as a food ingredient. Porang tubers cannot be consumed directly because they contain calcium oxalate which can cause itching on the tongue, so processing is needed to reduce the oxalate levels (Utami & Almiraji, 2009). Porang flour is one of the way to process porang tubers so they can be consumed (Pusat Litbang Porang Indonesia, 2013). Porang flour can be used as an alternative food ingredient because it contains high glucomannan and does not contain gluten, which is suitable for people with gluten intolerance, diabetes, and people on a low-calorie diet (Utami & Almiraji, 2009).

The habit of eating rice three times a day makes it difficult for people to change primary foods to non-rice food sources, so modification are needed to process non-rice food sources such as cassava, corn and porang tubers so that they have rice-like characteristics. According to Mishra et al., (2012), analog rice is a diversified food product which has a shape like rice made from ingredients that contain carbohydrates with the addition of substances to improve its quality through an extrusion process. In Yuwono et al., (2013) previous research, analog rice was made using the main ingredients of mocaf and rice flour with the addition of porang flour. It was found that the addition of porang flour had a real influence on the physical and chemical properties of analog rice on texture and color parameters, which when more porang flour is used, the texture becomes harder and the color becomes less bright, which the panelists don't like. In this research, it is hoped that we will get analog rice results that can accepted by Indonesian.

METHODOLOGY

Materials

The materials used in this research consisted of Mocaf (Modified Cassava Flour), corn flour (*Zea mays L.*), supplied by KUB Maju Jaya, Grobogan Central Java, Indonesia, porang flour (*Amorphophallus muelleri Blume*) supplied by Hasil Bumiku, Bantul Yogyakarta, Indonesia, cooking oil supplied by PT. Barco, Jakarta, Indonesia, glycerol monostearate (GMS), skim milk, distilled water, and IR64 rice as a comparison rice.

Preparation of Composite Flour

Mocaf, corn flour, porang flour, GMS and skim milk were weighed according to the formulation (Table 1) then add cooking oil and distilled water and mix until homogeneous. The mixture is then steamed at 80º-90ºC for 20 minutes.

Table 1. Flour formulation

Formula	Ratio of flour		
	Porang	Mocaf	Corn
F1	75	15	10
F2	70	20	10
F3	60	30	10
F4	55	30	15
F5	50	40	10
F6	50	35	15
F7	45	35	20

Extrusion Process

After the mixture is homogeneous and steamed, the mixture is then extruded into rice grains using a cold extruder. The grains are then dried for 24 hours**.**

Analog Rice Precondition

Rinse the analog rice with water then put it in a heat-resistant container, add 10% mineral water then steam it for 10-15 minutes, the analog rice is ready to be served.

Organoleptic and Proximate Analysis

Analog rice was analyzed to determine its chemical composition such as water, ash, fat, protein and carbohydrate content which then compared with IR64 rice. Organoleptic test is a test to a product that is based on human senses. In this study, 30 non-standard panelists were used to determine their preferences for the color, aroma, taste and texture of cooked analog rice with a scale of 1-5.

RESULTS AND DISCUSSION

Proximate Analysis

The results of proximate analysis on analog rice produced can be seen in Table 2 below.

Table 2. Nutritional content of analog rice produced

Formula	Water (%wb)	Ash (%wb)	Fat (%wb)	Protein (%wb)	Carbohydrate (%wb)
F1	9.74	1.52	1.27	13.09	74.38
F2	7.27	1.67	1.88	13.49	75.69
F3	5.18	2.37	1.17	2.06	89.22
F4	4.47	2.05	1.01	1.78	90.69
F5	13.73	0.97	0.73	7.67	76.9
F6	6.75	1.34	0.63	7.51	83.77
F7	5.64	2.17	0.59	9.3	82.3
IR64	13.44	0.61	0.55	6.71	78.69

Water content is one of the important parameters related to the rice storage process. The high water content in rice can cause the rice to be easily damaged and decrease the quality (Sumardiono et al., 2023). The results of the water content analysis showed that the analog rice water content ranged from 4.47% to 13.73%. The water content of all analog rice formulations is lower than the maximum water content. The maximum water content of rice is <14% (wb), with this water content it will prevent the growth of mold which often lives on cereals/grains (Pudjihastuti et al., 2018). The water content of the comparison rice (IR64) is 13.44%, the analog rice which has a water content similar to the comparison rice is F5 rice with a water content of 13.73%.

Ash content is the total mineral content remaining in the product after burned at high temperatures (Lestari et al., 2018). The results of the ash content analysis in analog rice showed that the ash content ranged from 0.97% to 2.37%. The ash content in the comparison rice (IR64) is 0.61%, analog rice which has an ash content similar to the comparison rice is F5 rice with an ash content of 0.97%.

The results of the fat content analysis in analog rice showed that the fat content ranged from 0.59% to 1.88%. The fat content in the comparison rice (IR64) is 0.55%, analogous rice which has a fat content similar to the comparison rice is F7 rice with a fat content of 0.59%. Fat content is needed in analog rice to avoid stickyness in the product (Handajani et al., 2020).

Protein is a component that needed by the body and is used to form a new tissue, maintain existing tissue, and help regulate the body's metabolic processes (Pudjihastuti et al., 2019). The results of protein content analysis in analog rice showed protein levels ranging from 1.78% to 13.49%. The protein content in the comparison rice (IR64) is 6.71%, analog rice which has a protein content similar to the comparison rice is F6 rice with a protein content of 7.51%. The protein content in analog rice is affected by the raw materials used and by other factors such as temperature because high temperatures can cause protein denaturation (Matsuura et al., 2015).

The results of the carbohydrate analysis in analog rice showed that carbohydrate levels ranged from 74.38% to 90.69%. The carbohydrate content in the comparison rice (IR64) is 78.69%, analog rice which has a carbohydrate content similar to the comparison rice is F5 rice with a carbohydrate content of 76.9%. High carbohydrate levels are obtained from the use of raw materials which is a source of carbohydrates (Noviasari et al., 2022). Carbohydrates are the main nutrition as a source of energy which obtained from consuming rice. Carbohydrate content is an important indicator in making analog rice because analog rice is expected to be a substitute for primary food.

Organoleptic Test

Organoleptic testing is a test on a product based on human senses. This test is carried out to find out public acceptance of anaog rice produces. The parameters tested are color, aroma, taste and texture. The scale used is 1-5 ranging from dislike to really liking. The test was carried out on 30 non-standard panelists.

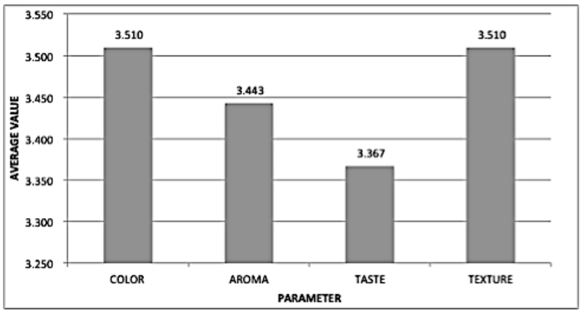

Figure 1. Average Valueof Each Organoleptic Parameters

Based on the test results, the color parameter has an average value of 3.510. Color is one factors that affect the panelists acceptance. Panelists prefer the clear white color on the rice like the paddy rice. Panelists tend not to really like the analog rice produced because the color is not as bright as paddy rice. Analog rice color affected by the raw material used where porang flour has a brownish color.

The aroma parameter has an average value of 3.443. Aroma has a function to increase appetite. The analog rice produced has a tuber-like aroma because the main raw material is porang tuber flour.

For the taste parameter of the analog rice produced has an average value of 3.367. Taste is the most important factor for food that affect panelists acceptance. The taste of the analog rice produced is almost tasteless and different from paddy rice because of the raw material used so the panelist is just slighly like it.

The texture parameters has an average value of 3.510. Texture is one factors that affect panelist acceptance. Soft texture like paddy rice is more preffered. The texture of the analog rice produced is not as soft as paddy rice.

From all parameters, the average panelist assessment shows that the panelists just slightly like the analog rice. Panelists not really like the analog rice because the color is not as bright as paddy rice, the aroma is tuber-like, the taste is bland, and the texture is not as soft as paddy rice. These parameters are affected by the raw materials used.

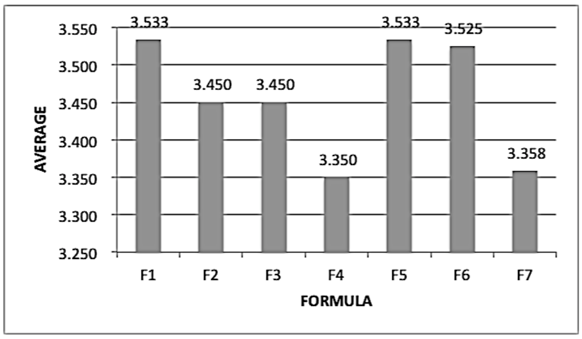

Figure 2. Average Value of Each Formula

Meanwhile, for the overall parameter assessment of analog rice, the average value was around 3.350-3.533, and analog rice F1 and F5 has the highest value that is 3.533 which means that the panelists more like to those two analog rice formulations.

CONCLUSION

The most preferred analog rice from organoleptic tests with 30 non-standard panelists were F1 and F5 rice with an average preference value of 3.533. In the proximate test, analog rice was compared with IR64 rice. In water content test, the results showed that F5 rice had a water content similar to IR64 rice (13.44%) with a water content of 13.73%. In the ash content test, the results showed that F5 rice had an ash content similar to IR64 rice (0.61%) with an ash content of 0.97%. In the fat content test, the results showed that F7 rice had a fat content similar to IR64 rice (0.55%) with a fat content of 0.59%. In protein content test, the results showed that F6 rice had a protein content similar to IR64 rice (6.71%) with a protein content of 7.51%. In carbohydrate test, the results showed that F5 rice had the carbohydrate levels similar to IR64 rice (78.69%) with a carbohydrate content of 76.9%. From the overall proximate test, F5 rice has the most similar composition compared to IR64 rice.

REFERENCES

Abriana, A., Fitriyah, A.T., Laga, S., & Sumiati. 2020. Organoleptic quality of corn flour (*Zea mays l.*) by oven method. *Canrea Journal: Food Technology, Nutritions, and Culinary Journal*, 3(1):26–33.

Badan Pusat Statistik. (2023a). Luas panen dan produksi jagung di Indonesia 2022 (Angka Sementara). *Berita Resmi Statistik*, (74):1–16.

Badan Pusat Statistik. (2023b). Luas panen dan produksi padi di Indonesia 2023 (Angka Sementara). *Badan Pusat Statistik*, (68):1–8.

Handajani, S., Sulandari, L., Purwidiani, N., & Zamroh, B.S. 2020. Study of rice analog from cassava–soybean and processed product. *Proceedings of the 2nd International Conference on Social, Applied Science, and Technology in Home Economics* (Iconhomecs), 406:287–297.

Lestari, A.P., Susanti, S., & Legowo, A.M. 2018. Optimization of coffee-clove-ginger formulated powder based on antioxidant activity and physicochemical properties. *Journal of Applied Food Technology*, 5(1):10–14.

Matsuura, Y., Takehira, M., Joti, Y., Ogasahara, K., Tanaka, T., Ono, N., Kunishima, N., & Yutani, K. 2015. Thermodynamics of protein denaturation at temperatures over 100°C: CutA1 mutant proteins substituted with hydrophobic and charged residues. *Scientific Reports*, *5*(10):1–9.

Mishra, A., Mishra, H.N., & Srinivasa R.P. 2012. Preparation of rice analogues using extrusion technology. *International Journal of Food Science and Technology*, 47(9):1789–1797.

Noviasari, S., Assyifa, P.S., & Sulaiman, I. 2022. Chemical and sensory properties of analogue rice based on kimpul flour (*Xanthosoma sagitifolium*). *IOP Conference Series: Earth and Environmental Science*, 951(1).

Nurcahyani, E., & Sari, T.L. Sulistiya, S. 2019. Analysis of resistance and specific character plantlets cassava *(Manihot esculenta Crantz.)* results induced resistance against fusarium wilt. *International Webinar & Congress XXI The Indonesian Phytopathological Society,* 1–6.

Pudjihastuti, I., Sumardiono, S., & Kusumayanti, H. 2018. Analog rice development as alternative food made of raw composite flour enriched protein canavalia ensiformis. *E3S Web of Conferences*, 73:1–4.

Pudjihastuti, I., Sumardiono, S., Supriyo, E., & Kusumayanti, H. 2018. Quality analog rice composite flour: Modified starch, Colocasia esculenta, Canna edulis Ker high protein. *AIP Conference Proceedings*, *1977*.

Pudjihastuti, I., Sumardiono, S., Supriyo, E., & Kusumayanti, H. 2019. Analog rice made from cassava flour, corn and taro for food diversification. *E3S Web of Conferences*, 125:3–6.

Pusat Litbang Porang Indonesia. 2013. Budidaya dan pengembangan porang (*Amorphophallus muelleri Blume*) sebagai salah satu potensi bahan baku lokal. *Universitas Brawijaya*, 1–19.

Sumardiono, S., Novitasari, A., Awaliyah, F.Z., & Meganingtyas, W. 2023. The effect of composite flour ratio (cassava, gembili, koro pedang, and corn) and extrusion temperature on analog rice production. *Journal of Vocational Studies on Applied Research*, 5(1):23–30.

Swapna, G., Jadesha, G., & Mahadevu, P. 2020. Assessment of correlation and path coefficient analysis for yield and it's attributing traits in rice (*Oryza sativa L.*) genotypes. *International Journal of Current Microbiology and Applied Sciences*, 9(7):3859–3865.

Utami, N., & Almiraji, M. 2009. Porang Tubers. *Media Pendidikan, Gizi, Dan Kuliner*, *1 No.*(2):129–136.

Yuwono, S.S., Febrianto, K., & Dewi, N.S. 2013. Pembuatan beras tiruan berbasis modified cassava flour (MOCAF): Kajian proporsi mocaf: tepung beras dan penambahan tepung porang. *Jurnal Teknologi Pertanian*, 14(3):175–182.

Zulfa, F., Rochmah, A.N., Saputri, F.D., Suleman, D.P., & Anandito, R.B.K. 2023. Macronutrient profile of analog rice based on cornstarch, modified cassava flour, and suweg flour. *BIO Web of Conferences*, 69:1–8.