Original Research Article

Siger rice made from cassava (waxy) as rice which is recommended for diabetics

Subeki [1], Muhartono [2,*], Nanda Cynthia Huzna [3]
[1]Department of Agricultural Technology, Agriculture Faculty, University of Lampung, Indonesia
[2]Department of Pathology, Medical Faculty, University of Lampung, Indonesia
[3]Medical Faculty, University of Lampung, Indonesia

***Corresponding author:** Muhartono, Department of Pathology, Medical Faculty, University of Lampung, Lampung, Indonesia. E-mail: drmuhartono@gmail.com*

DOI: 10.22034/HBB.2020.11
Received: May 27, 2020; **Accepted:** Sep 17, 2020

ABSTRACT

Siger rice has a very high amylose. The high amylose in Siger rice caused the amylose came out from the starch granules during the cooking process and release the water when it was cold until the rice became hard. This research aimed to measure the content of Siger rice from sticky cassava, using a single short screw extruder. The research results showed that the addition of water had significant effect on texture, color, taste, flavour of Siger rice. Addition of 30 % water produced the best sensory properties with texture score of 2.79 (same like white rice), color is 3.27 (slightly yellowish-white), taste and flavour is 3.35 (rather-like). This Siger rice contained water content 9.81 %, ash 0.47 %, protein 2.13 %, fat 0.90 %, crude fiber 4.79 %, carbohydrate 81.90 %, glycemic index 29, and HCN 17 mg/kg. The results show that the content of Siger rice was acceptable, safe and very good for diabetics.

***Keywords*:** Cassava, diabetic, Siger rice, amylose

INTRODUCTION

Siger rice is Siger Cassava Rice which is an artificial rice made from cassava. Siger rice is made with granular shape, color, and flavor such as common rice, so that it can be accepted by the Indonesian traditional people of eating. Siger rice has been instructed to become food menu served in offices and hotels in Lampung province [1].

The high amylose in Siger rice caused the amylose came out from the starch granules during the cooking process and release the water when it was cold until the rice became hard. In this research, Siger rice will be made from waxy cassava clone that do not contain amylose to produce Siger rice which remains soft and fluffier after being cold [1].

Siger rice is expected to be a good food for diabetics. One of the parameters of good food for diabetics to consume is the Glycemic Index (IG). Foods with high IG contains carbohydrates that are processed quickly by the body and cause blood sugar levels rise rapidly. While foods with low IG are foods that are digested slowly by the body and cause a rise in blood sugar levels gradually. IG levels commonly can be categorized into low 55 and below [2].

It is well known that common rice has a very high IG, so it is necessary to substitute rice for consumption of diabetics. Now, red rice is used to substitute common rice because of the lower glycemic index than common rice, has fiber which can reduce cholesterol, and outer skin contains many fibers, minerals and vitamins. Siger rice is certainly expected to have better glycemic index and other advantages. Common rice has IG = 80-90 (high), potato IG = 70 (high), corn IG=60 (middle) cassava IG = 55 (low), taro IG = 54 (low), tuber IG = 50 (low), so it is necessary to develop food ingredients made from cassava, tuber, and other carbohydrate sources. Siger rice is expected to have low glycemic index which can help cure diabetics [2,3].

MATERIALS AND METHODS

Manufactured of cassava flour and tapioca

The raw materials used were 11 waxy cassava clones result from screening, iodine screening method in Lampung. Peeled the cassava skin, washed clean and then grated with a grater machine. Then, soaked the grated cassava in the running water for 12 h then washed with water 3 times and squeezed until obtained filtrate and pulp cassava. The filtrate was allowed to stand for 1 h to obtain tapioca precipitation. Then, washed the tapioca precipitation with water 3 times and dried in oven at 60 °C. The cassava pulp was dried in an oven at 60 ^{o}C until dry and milled into cassava pulp flour.

Manufacture of Siger Rice

The manufacture of Siger rice was done by mixing the cassava flour and tapioca. The ingredients were mixed using mixer until evenly distributed then steamed at 90 ^{o}C for 30 min. Then, the ingredients were added to the mixer and added 100 mL solution

containing palm oil 1 %, glycerol monostearate 0.6 %, CMC 1.5 %, ascorbic acid 0.2 %, and salt 0.4 % and homogenized for 10 min. Next, the ingredients were added to a single screw extruder machine on the screw rotation 45 rpm, cutting knife rotation 40 rpm, with ellips shaped rice molding roller with 6 mm length and 2 mm thick until obtained Siger rice grains. Next, dried in oven at 60 ^{o}C until dry with water content was less than 10 %.

Chemical and organoleptic analysis

HCN Analysis on Siger rice conducted based on Bradbury method. Siger rice will be analyzed for chemical and organopletic properties. Organopletic test was conducted using scorring test including color, texture, taste, and flavour, as for overall acceptance was carried out with a hedonic test. Then, Siger rice was conducted proximate analysis including water content, ash, crude fiber, protein, fat, carbohydrate, and glycemic index using AOAC method [4]**.**

RESULTS

Parameter of texture, color, taste and flavour

Parameter of texture, color, taste and aroma, and the best overall acceptance were determined based on the highest value of each parameter. The result of texture sensory test showed that the best Siger rice was Siger rice with addition of 45 % water. The treatment resulted in texture score of 3.35 with the same texture criteria as the reference. Reference which used in texture sensory test was white rice. The best color sensory test result of Siger rice was addition of 45% water with color score 3.50 with criteria was slightly yellowish-white. The color score was not significantly different from the treatment of adding 40%, 35 %, and 30 % water. The best taste and aroma sensory test result, and overall acceptance was in the treatment of adding 30 % water with taste and aroma score 3.32 with rather-like criteria, and overall acceptance score 3.53 with rather-like criteria. While the treatment of adding 45 % water**.**

Table 1. The recapitulation of Siger rice sensory test

Observation results	Treatment of water addition						
	L0	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**
Texture	1.52d	1.86c	2.08c	2.79b	2.95b	2.97b	3.38a*
Color	1.99c	2.79b	2.87b	3.27a*	3.29a*	3.42a*	3.53a*
Taste and flavour	2.68d	2.95bc	3.11ab*	3.35a*	2.99b	2.75cd	2.41e
Overall acceptance	2.46c	2.86b	2.99b	3.56a*	2.88b	2.96b	2.43c
Information			*	***	*	*	**

Exp: (*) The best treatment on the parameters. L0 = Addition of 15% water; L1 =Addition of 20 % water; L2 = Addition of 25 % water; L3 = Addition of 30 % water; L4 = Addition of 35 % water; L5 = Addition of 40 % water; L6 = Addition of 45 % water.

Parameter of sensory test

The result of sensory test showed that Siger rice with addition of 30% water was the most preferred and accepted by panelists. The choice of adding 30% water as the best treatment was based on the nature of Siger rice which was most preferred by panelists of all parameters. However, Siger rice which had the best texture (equal to IR 64) was the treatment of adding 45% water. Siger rice with the addition of 45% water produced rancid taste and flavour that affected panelists acceptance of the other parameters. The recapitulation results of Siger rice sensory tests with various water additions are presented in Table 1.

Nutritional content of Siger rice

The nutritional content of Siger rice was analyzed including proximate and HCN analysis. Siger rice proximate analysis including water content, ash, fat, protein, crude fiber, and carbohydrate. Nutrition and HCN analysis of the best treatment of Siger rice can be seen on Table 2.

Table 2. The results of nutrient, HCN and glycemic index analysis of the best treatment of Siger rice

Parameters	Siger rice	IR 64 Rice
Water (%)	9.81	9.23
Ash (%)	0.47	0.35
Protein (%)	2.13	8.25
Fat (%)	0.90	0.29
Crude fiber (%)	4.79	0.09
Carbohydrate (%)	81.90	81.88
HCN (mg/kg)	17.00	-
Glycemic Index	29	-

DISCUSSION

This study aimed to obtain Siger rice with the best quality that consumers like. Determination of the best treatment from this study was more focused on the results of sensory test on the parameters of texture, color, taste, and flavor, and overall acceptance. The determination was based on the assumption if the panelists like a particular product because of its sensory properties, then the product can be well-received by other consumers. The best physical and chemical properties of Siger rice followed its best sensory properties.

Water content in food materials determined the acceptance and durability of the ingredients [3]. Siger rice with the addition of 30 % water had water content of 9.81%. This result was lower than Subeki research result (2016), Siger rice from various types of age of cassava were 10.815 % [5] and Al-Rasyid et al. (2017), Siger rice with ascorbic acid fortification was 10.62 % [6]. The water content of IR 64 rice is 9.23 % relatively similar compared to the water content of Siger rice was 9.81 %, but the water content of this Siger rice is still fulfilling the SNI 6128-2015 that is the water content of rice is less than 14 %. Water content less than 14 % (bb) will

prevent the growth of mold which often interferes in cereals/seeds during the storage [7].

Ash content of Siger rice was 0.47 %, higher than Subeki's research (2018) that was 0.23 % [8] and lower than Al-Rasyid et al research (2017) that was 0.88 % [6]. Siger rice had 0.47 % ash content, not much different from IR 64 rice ash content that was 0.35 %. Ash content is closely related to the mineral content of an ingredient [9]. The higher ash content of a food indicates the higher minerals contained in the food [10]. However, ash content is not always equivalent to all mineral content available in the ingredients, because there are some minerals that are lost during combustion and evaporation.

Protein content in Siger rice was 2.13 %, higher than Subeki's research (2018) that was 1.22 % [8] and lower than Al-Rasyid et al. research (2017) that was 3.82 % [6]. Siger rice in this research had 2.13 % protein contentlower compared to IR 64 rice that was 8.25 %, so Siger rice can't be used as a food source of protein. Protein content produced depends very much on the operating conditions of the extruder and the ingredients that are used [11]. Protein content also was caused by drying temperature. The more increased of temperature, the denatured protein will increase [12].

Fat content in Siger rice was 0.90 %, higher than Subeki's research (2018) that was 0.88% [8] and lower than Al-Rasyid et al. research (2017) that was 2.42 % [6]. It was because of the additional ingredient was water, while in Al-Rasyid et al. (2017) researches, the additional ingredient that used was vegetable oil [6]. The addition of vegetable oil in a material can increase its fat content. Fat content from Siger rice was 0.90 % still higher than IR 64 rice that was 0.29 %.

Crude fiber content in Siger rice was 4.79 %, higher than Subeki (2018) that was 1.18 % [8] and Al-Rasyid et al researches (2017) that was 1.13 %. [6] Siger rice had 4.79% crude fiber content which was much higher compared to IR 64 rice that was 0.9 %. The source of fiber is mainly obtained from waxy cassava flour which is the constituent of Siger rice. Dietary fiber has necessary characteristics and considered as an important element in functional food formulations [13]. Soluble dietary is associated with decreased glycemic response [14]. The fiber contained in food in the intestine will inhibit the activity of the alpha amylase enzyme which digests the starch so that the amount of sugar produced is less [15].

Carbohydrate content in Siger ricewas 81.90 %, lower than Subeki's research (2018) [8] that was 85.69 % and relatively the same with Al-Rasyid et al research (2017) that was 81.11 % [6]. Carbohydrate content of Siger rice was relatively the same compared with IR 64 rice carbohydrate which was only 81.88 %. The starch in rice isa type of starchthat has undergone a process of heating and cooling at a certain time. The process can cause the formation of resistant starch in Siger rice, which is included in resistant starch 3. Resistant starch 3 is a retrogated starch that has undergone heating and cooling at a certain time. Resistant starch is a type of starch which is difficult to digest by digestive enzymes. Resistant starch was standed to human digestive enzymes and slow in the release of glucose so that energy intake is reduce in intestial cells [16]. According to Liu *et al.*, resistant starch has properties and functions such as food fiber, which contains a low energy value, can reduce cholesterol levels in the blood, reduce the risk of colon cancer and can reduce the glycemic index [17]. This is proven by the low glycemic index in Siger rice.

Our reseach show that Siger rice had GI levels of 29. This is shows that Siger rice is classified in foods with low GI levels (<55). This result is similar to the Satyajaya *et al.* which found that Siger rice had a GI level of 31 [1]. Carbohydrates in foods that are broken down quickly during digestion have a high GI, but foods that have low GI will be broken down slowly so that it releases glucose into the blood slowly [18]. Therefore, Siger rice has the potential to be used as an anti-diabetic food.

Siger rice's HCN content in this research was 17 mg/kg. Siger rice is expected to have a low HCN content so that it is not harmful if consumed. The average cyanide levels in sweet cassava is below 50 mg/kg initial weight, while bitter/poison cassavais above 50 mg/kg. According to FAO (2013), sweet waxy cassava that is suitable for consumption is waxy cassava which contains <50 mg/kg HCN. Siger rice's HCN content in this research can be said to be low, so it is safe for consumption. These results are in line with our previous study which showed that Siger rice does not have a negative effect on mice. Previous study has also shown that The processing of waxy cassava into Siger rice can reduce levels of raffinose, stachyose, verbascose, and oligosaccharides 81.4, 92.1, 79.2, and 83.9 %, respectively [19].

CONCLUSION

Addition of water had a very significant effect on texture, color, taste and flavor, and overall acceptance of Siger rice. Addition of 30 % water produced the best sensory properties of Siger rice with texture score 2.79 (same like white rice), color 3.27 (slightly yellowish-white), taste and aroma 3.35 (rather-like), and overall acceptance 3.56 (rather-like). This Siger rice contained water content 9.81 %, ash 0.47 %, protein 2.13 %, fat 0.90 %, crude fiber 4.79 %, carbohydrate 81.90 %, glycemic index 29, and HCN 17 mg/kg. The very low glycemic index of Siger rice with IG 29 can help cure diabetes mellitus.

ACKNOWLEDGMENT

The researchers would like to thank ministry of research, technology and higher education for funding the 2019 WCR grant.

REFERENCES

[1]. Satyajaya W, Subeki, Utomo TP, Al Rasyid, Diniarti S. 2015. Pengaruh konsumsi beras siger dari ubi kayu terhadap kadar glukosa darah manusia. *Prosiding Pertemuan Tahunan dan Seminar Nasional APTA*. 2015; 1(1): 272–81.

[2]. Marsh K, Barclay A, Colagiuri S. 2011. Glycemic index and glycemic load of carbohydrates in the diabetes diet. *Curr Diab Rep*. 2011; 11: 20–22.

[3].Winarno FG. 2008. Kimia Pangan dan Gizi. Jakarta: PT. *Gramedia Pustaka Utama;* 2008; 94–99.

[4]. AOAC. Official methods of analisis. Washington DC, USA: *Association Official Anal. Chem*; 1990.

[5]. Subeki, Utomo TP, Muhartono. 2016. Effect of Siger rice from cassava on blood glucose level and the pancreas in mice induced alloxan. *The USR Inter Seminar on Food Security (UISFS)*. 2016; 1(1): 23–24.

[6]. Al Rasyid H, Subeki, Satyajaya W, Saptomi A. Kajian penggunaan asam askorbat untuk fortifikasi beras siger. *J Agroindustri*. 2017; 7(2): 72–83.

[7]. Noviasari S, Kusnandar F, Budijanto S. Pengembangan beras analog dengan memanfaatkan jagung putih. *J Technol Indust Pangan*. 2013; 24(2): 92–101.

[8]. Subeki W, Satyajaya, Murhadi, E. Yuliadi. Effect of Siger rice from

cassava on blood glucose level and the pancreas in mice induced alloxan. *Proceding The USR Inter Seminar on Food Security (UISFS)*. Bandar Lampung, Indonesia, 2018.

[9]. Sudarmadji, Haryono SB, Suhardi. Prosedur analisa untuk bahan makanan dan pertanian Edisi Keempat. Yogyakarta: *Liberty;* 1997; 160.

[10]. Sediaoetama AJ. Ilmu gizi untuk mahasiswa dan profesi. *Jakarta: Penerbit Dian Rakyat;* 1986; 266.

[11]. Akdogan H. High moinsture food extrusion. *Inter J Food Sci Technol*. 1999; 34(11): 195–207.

[12]. Vera L. 2008. Pengembangan beras artificial dari ubi kayu (Manihot esculenta crant.) dan ubi jalar (Ipmoea batatas) sebagai upanya diversifikasi pangan. Bogor; *Fakultas Technol Pertanian IPB*; 2008.

[13]. Cuenca AR, Suarez MJV, and Aparicio IM. Soy bean seeds by product okara as sources of dietary fibre. Measurement by AOAC and Englyst Methods. *J Food Chem*. 2008; 8 (3):1099–1105.

[14]. Elleuch M, Bedigian D, Roiseux O, Besbes S, Blecker C, Attia H. Dietary fibre and fibre rich by products of food processing: characterisation, technological functionality and commercial applications: a review. *J Food Chem*. 2011; 124(8): 411–21.

[15]. Ito Y, Mizukuchi A, Kise M, Aoto H, Yamamoto S, Yoshihara R, Yokoyama. Postprandial blood to pregerminated brown rice in healthy subjects. *J Med Invest*. 2005; 52(3): 159–64.

[16]. Ekafitri R. Pati resisten pada beras: jenis, method peningkatan, efek untuk kesehatan, dan aplikasinya. Jawa Barat: Pusat Pengembangan Technologi tepat Guna Lembaga Ilmu Pengetahuan Indonesia; 2018.

[17]. Liu F, Romanova N, Lee EA, Ahmed R, Evans M, Gilbert EP, Morell MK, Ernes MJ, and Tetlow IJ. Glucan affinity of starch synthasella determines binding of starch synthase l and starch-branching enzyme starch granules. *Biochem J*. 2012; 448(4): 373–87.

[18]. Rimbawan dan Siagian A. Indeks Glikemik Pangan. Jakarta: *Penebar Swadaya;* 2004; 53.

[19]. Subeki, Ibrahim GA, Utomo TP, Yuliadi E, Adawiyah R. Effect of Siger rice from waxy cassava on

oligosaccharide levels and chemical blood profiles in mice. *J Physics*. 2019; 1467(2020): 1–11.