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IMPROVING THE QUALITY OF RICE THROUGH THE PROCESS OF PARBOILED GRAIN TO BE HEALTHY RICE

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ABSTRACT

Rice is one of the staple food in Indonesia which is easy to serve and contain high level carbohydrate, thus influenced the daily activities and human health. The aim of this research is producing low glucose healthy parboiled rice and obtaining the chemical content of Mekongga parboiled rice. This research was held Chemistry Laboratory of Mathematics and Natural Science Faculty, Tadulako University. This research used Mekongga parboiled rice which used completely randomized design with one factor, i.e. kind of treatments, P1 (water soaking with 30^0 C + steaming for 20 min), P2 (water soaking with 40^0 C + steaming for 20 min), P3 (water soaking with 50^0 C + steaming for 20 min), P4 (without water soaking + steaming for 20 min), P5 (without treatment (Control)). Water content, ash content, starch content and sugar reduction were observed in this research. Water soaking with 30^0 C + steaming for 20 min treatment showed the best result if compared with other treatments in water content level (9.28%), ash content (0.798%), starch content (65.71%), sugar reduction (0.71%), and amylose (23.75%).

Keywords: Healthy rice, Parboiled rice, Sugar reduction, Mekongga variety.

INTRODUCTION

Indonesia is agrarian country with the biggest consumption of rice for daily life. Rice is one of the staple food which is easy to serve and contain high level of carbohydrate, thus influenced the daily activities and human health.

Mekongga variety (*Oryza sativa* L) is one of the rice commodity which is commonly cultivated in Central Sulawesi, and preferred by the local residents because it was time harvest for 116 – 125 days after planting. Other than that, this variety has fluffier texture and become the first priority for consumption in Central Sulawesi. Mekongga grain have the clean yellow color and slimmer shapes. Rice from Mekongga grain contain of 23% amylose level and glycemic index to 88 (BBPADI, 2019).

Miller *et al.* (1992) and Pruett (2010) classified 3 levels of glycemix index, i.e. low (<55), medium (55-70), and high (70). The higher level of glycemic index in food, then the alteration of carbohydrate into glucose become faster, then resulted in blood sugar increasing which triggered degenerative disease like diabetes mellitus (Nanri, *et.al.*, 2010).

The increasing of degenerative disease in Indonesia was caused by rice dietary habit with high level of glucose. The result of basic health research in 2018 showed Diabetes Mellitus (DM) prevalence based on doctor diagnose was 1.5% in all ages of residents, which Jakarta was the highest level of DM (2.6%), followed with Yogyakarta (2.4%), East Kalimantan (2.3%), and North Sulawesi (2.3%). DM prevalence based on doctor diagnose on ≥ 15 years old residents is 2%, where the highest level of DM is Jakarta (3.4%), followed by Yogyakarta and East Kalimantan (each 3.1%), and North Sulawesi (3.0%) (Health Research and Development Agency 2018).

Some of cases were reported the influenced between rice consumption and the increasing of diabetes type 2 (Nanri *et al.*, 2010; Villegas *et al*. 2007). This case were done in Japan and Shanghai, respectively. Consumed rice had high level of glycemix index which is originated from low amylose level of rice (Fitzgerald *et al*. 2011). Nanri *et al*. (2010) and Villegas *et al.* (2007) reported that there were correlation between rice consumption with diabetes, which is showed stronger result in human low activity with high consumption of rice. Parboiled rice is one of the processed rice product through soaking and heating/steaming process before grinded. This aimed to avoid the loss and damage in rice nutritional value, rice yield loss, and also the reduction of rice glycemic index.

This problem can be solved with rice processing technology which is resulted in fluffy rice with low glycemix index. There were some rice varieties in Central Sulawesi which can be developed into parboiled rice with low glycemix index, one of them is Mekongga. Therefore it is necessary to conduct preliminary research which can provide information about chemical content of Mekongga parboiled rice.

MATERIAL AND METHODS

Materials

This research used mekkonga varieties of grain from Sidondo III village, Sigi Biromaru district.

Design of research

This research used Mekongga parboiled rice which used completely randomized design with one factor, ie kind of treatments, P1 (water soaking with 30^0 C + steaming for 20 min), P2 (water soaking with 40^0 C + steaming for 20 min), P3 (water soaking with 50^0 C + steaming for 20 min), P4 (without water soaking + steaming for 20 min), P5 (Control without soaking and steaming).

Grain for about 10 kg were soaking in water according to temperature treatments for 60 minutes, then it were steaming (100^0 C) for 20 minutes. Milled dry grain without parboiling was used as control. After the steaming process is complete, grains were dried until it reached water content of 14%. Grains were milled and polished with 2H-2P configuration (twice broken skin and shrouded) until it produced parboiled rice milling (Fadhallah, 2016). This parboiled rice then performed physical analysis of rice and proximate chemical composition analysis (Water content, ash content, starch content and sugar reduction) (AOAC, 2006).

RESULTS AND DISCUSSION

Results

Water Content

Water content is an indicator that showthe feasibility of grain being ground until become rice. Grain water content which used in this research were 11 – 13%. Parboiled rice water content significantly decreased, which was explained in the Table 1.

Table 1. The Percentage of Parboiled Rice Water Content After Grinding

Treatments	Water Content (%)
Control (P5)	12.61 ± 0.93 a
P1	9.28 ± 1.02 b
P2	9.10 ± 0.60 b
P3	8.87 ± 0.75 c
P4	8.32 ± 0.16 c

Note: The number followed by the same letter in same column shows no significant effect on p<0.05 and LSD test at p<0.01.

Table 2. The Percentage of Parboiled Rice Ash Content in all of Treatments.

Treatments	Ash Content (%)
Control (P5)	0.268 ±0.03 e
P1	0.798 ±0.04 a
P2	0.687 ±0.01 b
P3	0.386 ±0.02 d
P4	0.587 ±0.01 c

Note: The number followed by the same letter in same column shows no significant effect on p<0.05 and LSD test at p<0.01.

Table 3. The Percentage of Parboiled Rice Starch Content in all of Treatments

Treatments	Starch Content (%)
Control (P5)	59.98 ±0.67 b
P1	65.71 ±0.18 a
P2	65.27 ±0.44 a
P3	64.79 ±0.66 a
P4	64.04 ±0.30 a

Note: The number followed by the same letter in same column shows no significant effect on p<0.05 and LSD test at p<0.01

Table 4. The Percentage of Parboiled Rice Sugar Reduction in all of Treatments.

Treatments	**Sugar Reduction (%)**
Control (P5)	1.38 ±0.007 a
P1	0.71 ±0.004 d
P2	1.07 ±0.006 c
P3	1.35 ±0.010 b
P4	1.31 ±0.002 b

Note: The number followed by the same letter in same column shows no significant effect on p<0.05 and LSD test at p<0.01

Milled rice from drying is categorized as control. Milled rice which had parboiling process was decreased in water content. The percentage of water content in rice were different. The highest water content was observed in water soaking with 30^0 C + steaming for 20 min (9.28%) but not different with water soaking with 40^0 C + steaming for 20 min. Meanwhile the lowest water content showed in without water soaking + steaming for 20 min (8.32%) which is a treatment without water soaking. LSD test at $p<0,05$ or $p<0,01$ showed significant result between treatments.

Ash Content

Ash is inorganic residue from organic matter burning. Ash content and composition depend on the material characteristics and ashing methods. Parboiled Mekongga ash content were showed in Table 2. The percentage of ash content increased if compared to control in all of treatments. LSD test showed the significant result on ash content due to parboiling process. Material ash content is an indicator which showed amount of fiber in food materials.

The initial ash content in Mekongga was showed in control by 0.268%. The percentage of ash content in P1, P2, P3, and P4 after parboiling process were 0.798%, 0.687%, 0.386% dan 0.587%, respectively. Where the highest percentage of ash content was in P1.

Starch Content

Starch or amylum is complex carbohydrate which is insoluble in water, white powder, tasteless and odorless. Rice starch consists of two kinds of polysaccharide molecules, which were amylose and amylopectin. Amylose is glucose polymer with α-(1-4) glucosidic bonds while amylopectin is α-(1-6) glucosidic bonds. The result of starch content analysis on all of treatments were showed in Table 3.

Parboiled process signicantly affected the parboiled rice starch content (Table 3). ANOVA and LSD test at $p<0.05$ and $p<0.01$ showed that the treatments were affected on starch content.

Sugar Reduction

Sugar reduction is an important compound of various foodstuffs which contain starch in carbohydrates form (glucose dan fructose), have a major role in providing calories for living things, and also the main compounds that can be found in plants. The result analysis of sugar reduction in healthy rice from parboiling process were showed in Table 4.

Parboiled process significantly affected the alteration of rice sugar reduction (Table 4). ANOVA and LSD test at $p<0.05$ and $p<0.01$ showed that parboiled treatments were influenced sugar reduction. The percentage of sugar reduction in P1 resulted the lowest percentage (0.71%) if compared to control and other treatments. Sugar reduction is an indicator of sugar content in food materials.

Discussion

Water content indicates the amount of water contained in material. Parboiled process resulted the changes in rice chemical composition. Parboiled rice has undergone a partially cooked rice. Changes in parboiled rice water content was occurred because of large amount of water which comes out from grain to achieve equilibrium.

Derycke *et al*. (2005) concluded that starch gelatinization, amylose and lipids complex crystals were formed during parboiling process, which level was influenced by temperature and water content.

Texture of food materials were determined by water content, fat content, type of carbohydrates, and the constituent of proteins. Food materials with low water content and high starch content have tougher texture (Singgih and Harijono, 2015). Milled rice water content based on the rice quality requirements according to SNI 6128:2008 is 14%.

The initial ash content in Mekongga was showed in control by 0.268%. The percentage of ash content in P1 (water soaking with 30^0 C + steaming for 20 min), P2 (water soaking with 40^0 C + steaming for 20 min), P3 (water soaking with 50^0 C + steaming for 20 min), P4 (without water soaking + steaming for 20 min) after parboiling process were 0.798%, 0.687%, 0.386% dan 0.587%, respectively. Where the highest percentage of ash content was in P1. Susilo (2013) stated that ash content is an inorganic residue after the process of organic matter removal contained in material.

The increasing of ash content to 7.28-33.58% explained the increasing of mineral material in rice. Ash content reflects the amount of mineral content in foodstuffs, including rice. These minerals are usually available in oxide, sulfate, phosphate, nitrate and chloride. The increasing of ash content in parboiled rice was caused by water imbibition and rehydration, also the temperature pressure during parboiling process. Chukwu (2009) explained that temperature significantly affected the ash content in the first stage of parboiling process. Rice ash content increased gradually, then decreased at higher temperatures during steaming process. In addition, the imbibition process also caused the water mineral content get into the grain. The adding of minerals from aleuron alleged to the increasing of rice ash content.

Widowati (2009) stated that the increasing of ash content during parboiling process due to component dissolution of materials including minerals from bran and husks which attached to rice endosperm. Heinemann *et al*. (2005) added that parboiling process increased the ash content of parboiled rice to 18% if compared to milled rice, especially on K and P elements. Hasbullah *et al*. (2012) stated that parboiling process increased the ash content to 0.32 – 0.33% which caused by the minerals in husk and bran were absorbed into parboiled rice.

The increasing of starch content was caused by heating process during the rice soaking and steaming in parboiling process. This is in line with the result from Haliza *et al*. (2006) which showed the starch gelatinization and structural changes because of heating the starch with excess water. Reheating and cooling of gelatinized starch also changed the starch structure which leads the formation of new insoluble crystals, in form of retrogradated starch which caused a change in glycemix index. Khomsatin (2011) stated that, the higher steaming temperature, the rate of gelatinization is also high.

Parboiling process resulted starch content for about 64.04-65.71%. The results of variance showed the difference between soaking and steaming treatments to parboiling rice starch content. Parboiling process formed resistant starch due to rice soaking and steaming process. This is in line with Widowati (2009) research about resistant starch type III in parboiling rice, which is formed due to retrogradation of starch after gelatinization. Retrogradation caused amylose and amylopectin which previously had an amorphous structure then changed into crystalline structure.

Sugar changes in rice were caused by heating process through grain soaking and steaming during parboiling process. Parboiling process changed polysaccharides into monosaccharides. Polysaccharides breaking down process to monosaccharides occurred during food processing or through hydrolysis, when polysaccharides are being catalyzed by acids and digestive tract enzymes (Wang and Copeland, 2015).

The decreasing of sugar reduction (glucose and fructose) in carbohydrates through parboiling process affected on rice glycemix index. Parboiling process in grain had lower glycemix index value than regular rice. Rimbawan and Siagian (2004) explained that food glycemic index was influenced by several factors, ie. processing method, food osmotic power, fiber content, amylose, protein, fat and the presence of anti-nutritional substances.

This result confirmed the Foster-Powell *et al*. (2002) statement that parboiled rice had lower glycemic index than milled rice. Jenie *et al*. (2012) explained that glycemic index value was influenced by the presence of resistant starch. Resistant starch is type of food starch which is not digested in human digestive tract. This resistant starch is difficult to digest, so the glycemic index is decreasing. In addition, the glycemic index can be affected by amylose levels. Eleazu (2016) stated that high temperature processing resulted in gelatinization, which permanently changes the amylose and amylopectin structure of starch, also made it more accessible for digestive enzymes.

CONCLUSION AND SUGGESTION

Conclusion

Soaking and steaming of unhulled rice parboiling process were affected on changes in rice chemical composition, i.e. water, ash, starch, sugar reduction and amylose content.

Suggestion

Further research need to be carried out using many varieties in order to obtain a lot of information about parboiling process on rice varieties in Central Sulawesi.

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