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The Changes On Dietary Fiber And Starch Digestibility Of Various Rice Varieties From West Sumatera Through Parboiling Process.

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ABSTRACT

The purpose of this study was to determine the effect of process parboiled on dietary fiber content and digestibility of starch by various varieties from West Sumatra Indonesia. The varieties used are based on the local yield rice issued by BalaiPengkajianTeknologiPertanian (BPTP) West Sumatra in 2010 that had the high amylose (pera. The varieties used are the Anak Daro, KuriakKusuik, Junjung, CeredekMerah. Each of these varieties will be compared the nutritional value and digestibility of starch between milled rice and parboiled rice.The result showed an increased occurrence of the water level of milled rice11.40 % -12.45 % and parboiled rice 13 % -13.85 %, elevated of dietary fiber contentwas 1.51 % -1.88 % to 5.59-7.91 %, the decline the starch content was from 61.12 % -61.66 % to 59.30% - 59.72%. and digestibility of starch from 62.91-75.50 % to 29.14-31.79 %. The enhancement of value content was caused soaking and steaming proccess in the form of rice, resulting in dispersion of dietary fiber in aleurone layer and embryo into endosperm.

Keywords: dietary fiber, milled rice, parboiled rice, starch digestibility

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INTRODUCTION

In everyday sense, rice is the rice grain from rice plant that the crust has been disposed of and Polished, white milled using a peeler and grinder (huller) and also the polisher. If grain is simply peeled part of the outer skin (husk), it called brown rice. While brown rice, whole or part of the husk has been separated in the milling process, called milled rice.

According to Patiwiri (2006) although milling is a physical process, grinding also effect the nutritional content of rice. This is caused by the release and polish parts of grains of rice during the milling process that caused some nutrients wasted. Carbohydrate accumulated in the endosperm, which is the biggest part of a rice grain. Proteins are the most numerous compound in embryo, pericarp and aleurone layer. In the endosperm layer also contained protein, but further and further into the center of the endosperm the protein is decreased. Vitamin and fat also accumulated specifically in the pericarp and aleurone layer. For the nutritional content of rice is not wasted, its necessary to do improvement of grain processing methods include using technology of parboiled rice. The steps of parboiling rice include cleaning, soaking, steaming, drying and milling.

The purpose of doing parboiling treatment is to obtain a change in the grain so that increase the nutritional value, quality and shelflife of the rice. The main changes of parboiling treatment resulting dispersion of vitamins and minerals from the aleurone layer and embryo into the endosperm, the dispersion of the lipid layer of aleurone and embryo, inactivation and destruction of fungi and insects. Parboiled rice has a higher nutritional value than ordinary rice, because during the soaking and steaming process a lot of vitamin B, minerals and water-soluble nutrients diffused into the endosperm (Betchel and Pomeranz, 1987 in Haryadi, 2006).

Based on research by Widowati, Santosa, Astawan and Akhyar (2009) on reducing the glycemic index of various varieties of rice through the parboiling process by using two varieties of low amylose (Sintanur and Gilirang), three varieties of medium amylose (IR 64, Mekongga and Ciherang) and two varieties of high amylose (IR 42 and BatangLembang), showed that the impact on the process of parboiled rice was the changes n chemical composition, especially the increase in amylose, decreased protein, and functional properties of the rice. This process can increase the dietary fiber content and lower starch digestibility in vitro as well as lower glycemic index value.

Based on existing research, which generally use low amylose rice (pulen), then the researchers will test the rice with a high amylose (pera) that are generally widely consumed by people of West Sumatra through the parboiling process. So that it can be seen the changes in nutritional quality and digestibility of starch and rice using parboiled rice according to customer wishes.

METHODOLOGY

This research had conducted in the Laboratory of Agricultural Technology Faculty of Andalas University.

Materials and Tools

The materials include of four varieties of rice grains obtained from farmers in West Sumatra and water. Chemicals such as diethyl ether, amylose standard, 95% ethanol, 1N NaOH, a solution of iodine, acetic acid, solvents, diethyl ether or petroleum ether, K_2SO_4, HgO, H_2SO_4, H_3BO_3, HCl, $Na_2S_2O_3$, boiling stone, distilled, indicator MM-MB , indicator phenolftalin 1%, 0.1 M phosphate buffer, amylase enzyme solutions, DNS, standard maltose, pure starch, selenium mix, a saturated solution of boric acid, sodium hydroxide-sodium thiosulfate.

The tool used were moisture meter, cups, incineration, hot plate, furnace, clamp the cup, bath steam, test tube, flask, pipette, pressure cooker, soxhlet complete with condenser, oven, filter paper, cotton, centrifuges, burettes, erlenmeyer 250 ml, spectrophotometers, electric heating, and an analytical balance

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Research methods

The method used in this study is exploratory consists of four treatments and three replications. The treatments used are varieties of rice from West Sumatra to be made into parboiled rice and milled rice. The varieties used are based on the local yield rice issued by Institute for Agricultural Technology (BPTP) of West Sumatra in 2010 that had pera texture. Rice varieties used are varieties of Anak Daro, Kuriek Kusuik, Junjung, dan Ceredek Merah

Implementation

Making of Parboiled Rice (Rice parboiling)

The following parboiling process is a method developed by Widowati et al., (2009). Grain cleaned of impurities, such as straw, gravel and soil, then soaked in water (temperature 60-70 ° C, 4 hours). Grain moisture content soaking the expected result is 30%. Furthermore, steamed rice (1 atm) for 20 minutes. Then do the two-phase drying. The first phase at a temperature of 100 ° C for one hour (18-20% moisture content) and the second phase at 60 ° C for 25minutes (maximum moisture content 12%). Grain parboiled resulted then milled into parboiled rice.

Observation

Observations were conducted to compare the nutritional value of parboiled rice with milled rice, the observations consist of chemical analysis of water content (Sudarmadji et.al, 1997), dietary fiber content (Yenrina et.al, 2011), starch content (Yenrina et.al, 2011) and amylose content (Yenrina et.al, 2011) and the functional propertyof digestibility of starch by *in Vitro* (Muchtadi et.al, 1992)

RESULTS AND DISCUSSION

Chemical Analysis

Water Content

Water content of parboiled rice and milled rice can be seen in Figure 1. As we can see in Figure 1 that the water content of parboiled rice was higher than the milled rice, this due the process of making parboiled rice which is a process of soaking and steaming. In the process more water absorbed and bound resulting in high levels of water than milled rice.

The water content increasment ranged from 1.20% to 1.60%. According to research Widowati et al., (2009), which uses low amylose rice varieties, parboiled rice has a moisture content of 11.23-11.99%. The difference may be due to the percentage change in amylose content and fiber content. The lower levels of amylose (high amylopectin), the water content in rice will be higher, since amylopectin is hydrophilic (Rauf, 2015).. High water levels in rice can reduce the quality of the rice. At SNI 01-6128: 2008 maximum water content of the rice is 14%.

Temperature and drying process of rice grains can effect the mechanical properties of rice that determine suitability for grinding. The unselective drying can result cracked grain and lowering the yield of head rice or increased the amount of broken rice, which in turn will lower the quality. Drying process also effecting the texture and color of milled rice, the darker color on rice mainly due to the browning reaction (Haryadi, 2006).

Amylose Content

Amylose content in parboiledrice and milled rice can be seen in Figure 2. Parboiled rice has a lower amylose content than milled rice. In parboiled rice, amylose content ranged between 19.02-21.97% while in milled rice ranged between 22.35-24.72%. Meanwhile, according to research by Widowati et al., (2009) amylose content ranged from 19,35 to 20,32%.

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Classification of amylose according to Winarno (2004), rice with a high amylose of 25-33%, rice with medium amylose of 20-25%, rice with low amylose (9-20%) and rice with very low amylose content (<9%). Parboiled rice can be classed into medium amylose, as well as milled rice classed into medium amylose. The highest percentage of change was in Junjung varieties of 4.63%, then KuriakKusuik of 3.30%, then AnakDaroof 2.97% and Ceredek Merah of 2.75%. Differences in the percentage of change in the amylose content persumably due to the different of amylase solubility during heating process.

Decreased of amylose contentcaused by the processing of parboiled rice during soaking and steaming which used heat. According to Rauf (2015), the hotter the water, the starch granules become more soluble. Amylose more easily into components that are water soluble than the amylopectin when heated. It is associated with a molecular weight of the two types of starch. Amylose has smaller molecules than amylopectin. The higher the solubility of the starch, the greater the swelling. Because amylosehas a greater solubility in hot water than amylopectin, so that amylose had a larger swelling power than the amylopectin.

Swelling of the starch granules as a result of diffusion of water in large quantities at a certain temperature called the gelatinization. Gelatinization process resulted in the release of hydrogen bonds between the starch molecules. Gelatinization of starch requires heat and water, as well as triggered by the presence of alkaline or acidic. The more water available, the less heat needed for gelatinization. The release of hydrogen bonds lead to more and more like-watergroups that is free so that more advanced levels of gelatinization and the more waterabsorbed (Haryadi, 2006)

Food Fiber Content with Acid Detergent Fiber (ADF) Method

In Figure 3 shows that dietary fiber content of parboiled rice was higher than the milled rice. In parboiled rice dietary fiber content ranged between 5.59-7.91% while in milled rice ranged between 1.51-1.88%. The percentage of change was highest in KuriakKusuikvariety of 6.12%, then in Junjung variety of 5.43%, Anak Daro of 4.95% and Ceredek Merah of 3.71%. The different percentage of change caused by the change in water holding capacity of the fiber. The higher the water content, the fiber also higher. According to Inglett and Falkehag (1979), the fiber contains many hydroxyl groups and a large water binding capacity.

Dietary fiber content of parboiled rice was higher because during parboiling process (soaking and steaming) fibers which are in the husk attached to the rice endosperm layer, so that the dietary fiber content increased. Parboiling process also strengthening bond between embryo and endosperm, and thus preventing the release of embryo during milling process. Because endosperm hardens and the adhesionof aleurone and embryo on endosperm become stronger and milling process of parboiled ricebecame more difficult than rice without parboiling process. According to Nursalim and Zalni (2007) the fiber content in the husk of 1.69%.

Based on the solubility, dietary fiber is classified into two types soluble fiber and insoluble fiber. Insoluble fiber include of cellulose, hemicellulose, lignin, resistant starch digestibility, and oligosaccharides. While soluble fiber, include of pectin, inulin, galaktomanan and ß-glucan (Yangular, 2013 in Rauf, 2015).

Starch Content

Differences in starch content of parboiled rice and milled rice can be seen in Figure 4. Figure 4.shows that the starch content of parboiled rice more tranquility than the milled rice, but the decline was not a big impact. Parboiled rice had a starch content between 58.74-60.86% while milled rice ranged between 61.12-61.66%. The greatest decrease level of starch in in parboiled rice was found in Ceredek Merah of 2.63%, Anak Daro of 1.95%, Junjung of 1.82%, and Kuriak Kusuik of 0.64%.

The difference in percentage due to the starch dissolved in hot water during the process parboiling proses. The higher the solubility of the starch, the greater the swelling, because amylose has a greater solubility in hot water than amylopectin, so that amylose had a swelling power greater than amylopectin (Rauf, 2015).

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Starch content of parboiled rice was lower than milled rice caused by soaking and steaming process in making of parboiled rice. According to Rauf (2015), starch can not dissolve in cold water but in hot water, the starch granules become soluble.

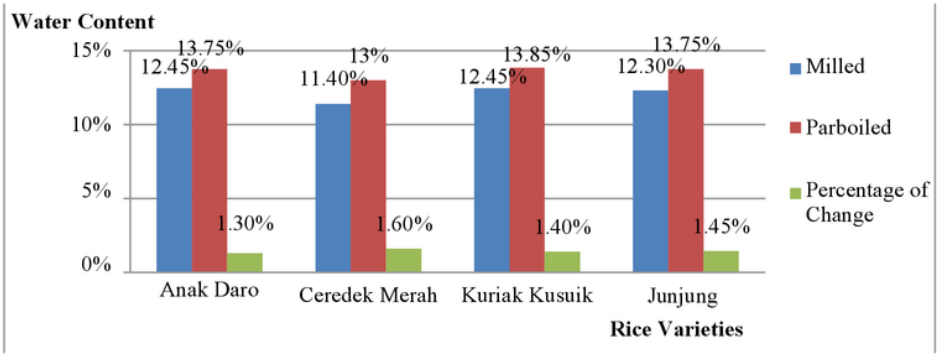

Figure 1. Water Content of Parboiled Rice and Milled Rice

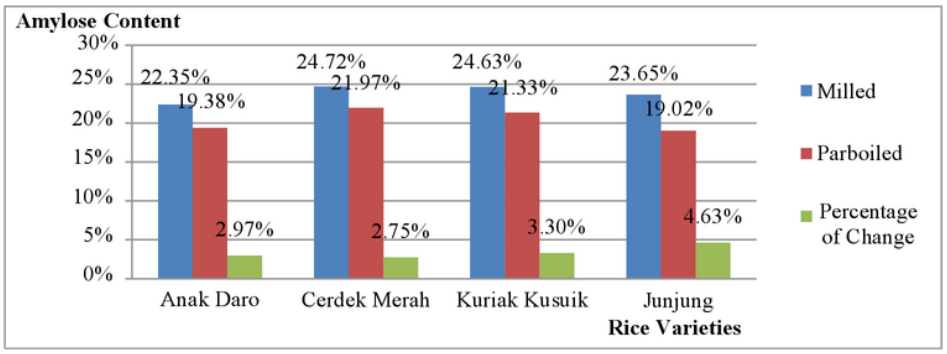

Figure 2. Amylose Content of Parboiled Rice and Milled Rice

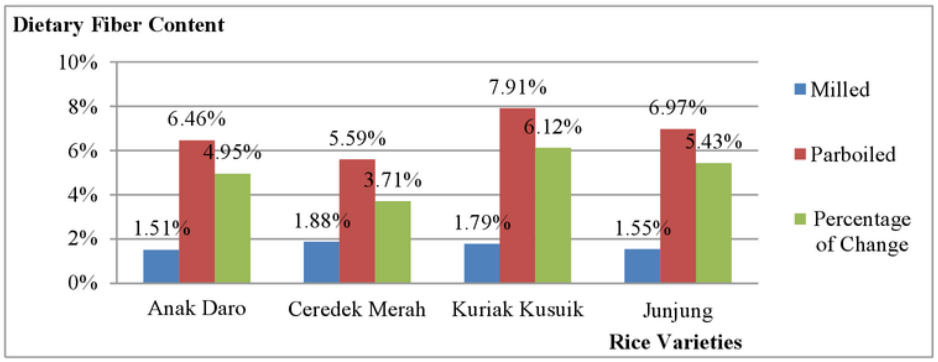

Figure 3. Dietary Fiber Content of Parboiled Rice and Milled Rice

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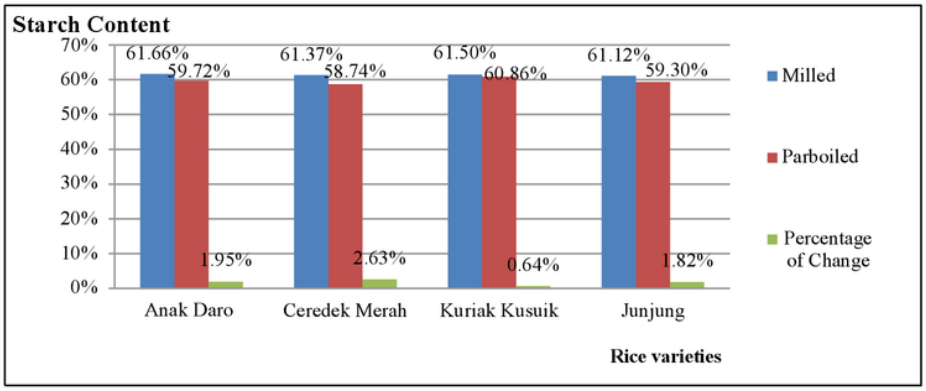

Figure 4. Starch content of Parboiled Rice and Milled Rice

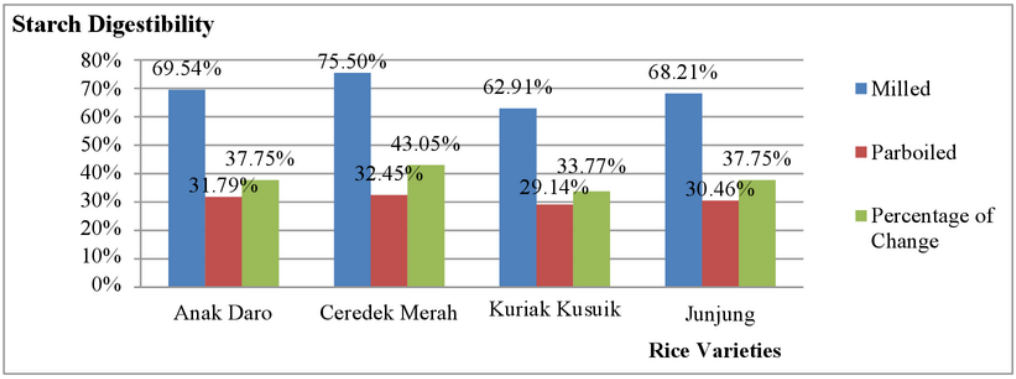

Figure 5. Comparison of Starch Digestibility by In Vitro between Parboiled Rice and Milled Rice

Functional Property Analysis

Starch Digestibility

Comparison of starch digestibility between the parboiled rice and milled rice can be seen in Figure 5.From figure 4 can be seen the comparison between the starch digestibility of parboiled rice and milled rice, it was because the process of soaking and steaming in making parboiled rice, which resulted the dispersion of fiber in embryo and aleurone layer into the endosperm. Thus made the starch digestibility of parboiled rice became low. Starch digestibilityof parboiled rice was lower than milled rice.

The digestibility of starch in parboiled rice ranged between 29.14-31.79%, while milled rice ranged between 62.91-75.50%. The highest percentage of starch digestibility change was found in Ceredek Merah variety of 32.45%, AnakDaro of 31.79%, Junjung of 30.46% andKuriakKusuik of 29.14%. Meanwhile, according to research byWidowati et al., (2009), the digestibility of starch ranged between 36.41-37.25%. The cause of the percentage of change due to different fiber content. The higher the fiber content in the rice, makes lower digestibility of the starch.

Some of the factors that can decrease the digestibility of starch wereantinutritions or anti-amylase (dietary fiber and tannin), the chemical structure of starch (resistant starch). Dietary fiber can physically obstruct α-amylase enzyme, thereby reducing the enzyme's ability to digest starch (Muchtadi et.al, 2010).

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Therefore parboiled rice has lower starch digestibility than milled rice, because parboiled rice had higher dietary fiber content than milled rice.

Based on the speed at which it is digested, starch divided into 3 groups: starches that can be digested quickly or Rapidly digestible starch (RDS), starch that digested slowly or slowly digestible starch (SDS), and resistant starch (RS). Resistant starch is a starch that is resistant to hydrolysis digestive enzymes. No resistant starch found naturally, but some are formed or deliberately formed by a process. Although lowering the digestibility of starch, resistant starch have a positive impact on the environment of the colon (large intestine), among others, can serve as food for probiotics (Kusnandar, 2010).

CONCLUSION

Rice parboiling effect the content of dietary fiber in which the dietary fiber content increased, this was because the parboiling process can difused dietary fiber from aleurone layer into the endosperm, resulting higher dietary fiber in parboiled rice when compared to milled rice. Amylose content and starch digestibility was lowered. Starch content was lowered. The decline occurred due to, starch dissolved during soaking in parboiling process.

The decreased of amylose content caused by the immersion in parboiling process and the decreased of starch digestibilitycausedby the high amount dietary fiber content in parboiled rice.

Suggestions

A proposal for the next study is to analyze biological nutritional value by *in vivo* method and glycemic index of parboiling rice.

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