Chemical characteristics and sensory evaluation of local rice (Oryza sativa L.) M5 from Aceh province

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Abstract. The study of chemical characteristics and sensory evaluation of local rice (Oryza sativa L.) M5 from Aceh Province was carried out. The aim of the study was to determine the chemical characteristics and sensory evaluation of local rice M5 from Aceh Province. The results showed that Aceh local rice M5 had a very significant effect on amylose content, amyllopectin content and starch content. The local rice M5 with amylose content were: first elder Sanbei rice, USK-Snb-RGO-S-84 rice, USK-Snb-RGO-CKU-6 rice, USK-Snb-RGO-S-97 rice and USK-Snb-RGO-4F1-B rice. A better amyllopectin content was obtained at USK-Snb-RGO-4F1-B rice (53.49%) and had significantly different from the other rice. Whereas a better starch content was obtained at USK-Snb-RGO-4F1-B (72.23%) and had significantly different from all other rice. While the color test for Aceh local rice M5 showed that the value of L and a had a very significant effect while the value of b had not significant. The average L value obtained by Aceh local rice M5 is 112.36 -124.82, while the a value obtained is 1.01 -2.02 and the resulting b value is 14.17 - 19.71. The sensory evaluation of local rice M5 showed a very significant effect on the attributes of aroma, color, texture, shape and overall acceptance.

1. Introduction

The quality of rice is needed in fulfilling of food needs especially in agricultural, because the rice is a staple food which demand never falls[1]. Determination of quality in rice is largely determined by chemical characteristics and acceptance by consumers. Chemical characteristics are influenced by the content of amylose, amyllopectin and starch in rice; and the acceptance by consumers is known as sensory evaluation.

The rice with high amylose content will produce a dry rice, whereas the lower amylose will produce a sticky and soft rice. Amylose content is related to the amount of water absorption and the development of rice volume during cook rice. The rice is classified into 4 groups based on amylose content, namely high amylose rice (25-33%), medium amylose rice (20-25%), low amylose rice (9-20%) and rice with very low amylose content (2-9%)[2]. Amylose content affects the nature of rice volume expansion, tenderness and fluffier rice. The higher of amylose content, the more bloated the rice is. Conversely, the lower of amylose, the thicker the rice is [3]. Comparison between amylose and amyllopectin can determine the level of fluffier rice.

Consumer food preferences are important, however, because the environmental impact related to nutrition varies considerably depending on the food selected [4]. Therefore, this research is very
important to do in the chemical properties of rice because it affects the subsequent processing operations, storage, grinding, cooking and the quality of food itself.

The purpose of this study was to determine the chemical characteristics and sensory evaluation of local rice (Oryza sativa L.) M5 from Aceh Province. It is expected that the data obtained will be the basic for determining the quality of local rice in Aceh Province.

2. Materials and Methods

2.1. Methods

This research used variety-Sanbei rice which contains of 5 strains, namely: B0 (first elder Sanbei rice), B1 (USK-Snb-RGO-S-84) rice, B2 (USK-Snb-RGO-CKU-6) rice, B3 (USK-Snb-RGO-S-97) rice, B4 (USK-Snb-RGO-4F1-B) rice and as a comparison using first elder Sanbei rice. The rice were obtained from the Faculty of Agriculture at the University of Syiah Kuala which had been cultivated with an organic system in Samahani Aceh Besar rice field with a harvest age 122 days. The chemicals used were H2SO4, HCl, NaOH, CuSO4, Zn, ethanol, iodine, acetic acid, aquades, potato amylose and MR-MB indicators.

2.2. Instrument

In this research, a spectrophotometer was used as an instrument (Thermo spectronic, type 20D+) to measure the absorbance of a solution in measuring amylose levels, Analytical scales (Adventure ™ Pro) with a maximum capacity of 400 gr and accuracy of 0.01 gr for weigh samples, Grinder (Foss A / S-Cemotec1090 Sample Mill) to smooth the samples to be analyzed, Integrated Machine (OMS-3) with specifications 220 V, 2100 W, 50 / 60Hz was used to peel rice into rice and separate the groats, Camera (Nikon D7100 with 18-300mm Nikon AF-S lens), Pumpkin distillation, Sokhlet pumpkin, Desiccator, filter paper and extraction tool (Sokhlet).

2.3. Research Design

On this research used a Completely Randomized Design (CRD) non-factorial with 3 replications. The treatments studied were rice consisting of 5 levels, namely B0 (first elder Sanbei rice), B1 (USK-Snb-RGO-S-84) rice, B2 (USK-Snb-RGO-CKU-6) rice, B3 (USK-Snb-RGO -S-97) rice, B4 (USK-Snb-RGO-4F1-B) rice, so that 15 treatment units were obtained.

2.4. Observation Parameters

2.4.1. Amylose and amylopectin content [5]. Amylose content was tested using the calorimetry iodine method. Amylose content were measured by quantitatively measuring 100 mg of rice flour (particles > 80 mesh) and put in a volumetric flask 100 ml, then 1 ml of ethanol 95% and 9 ml of NaOH 1N were added respectively, and the solution was left for 23 hours at room temperature. The solution then diluted by adding distilled water to a volume 100 ml. The solution was pipetted as much as 5 ml of solution, put in a volumetric flask 100 ml and then added 2 ml of iodine 2% solution and 1 ml of acetic acid 1N then diluted again with distilled water. The absorbance of the solution was measured using a Spectrophotometer at a wave length of 620 nm. The same was done for making standard amylose from potato amylose ingredients and made at several levels of amylose concentration. Amylose rice content are then calculated from the comparison of the absorbance measurements of the sample with standard, multiplied by the dilution factor. Amylose content is calculated using the formula:

$$ Amylose\ content\ (\%) = \frac{AxVt xf p}{ms} x 100 $$

Note: A = the sample of amylose concentration (mg.ml⁻¹), Vt = total volume (ml), fp = dilution factor (20 and 1.000), ms = sample mass (mg)
Amylose content in the sample could be used to estimate the amylopectin content, calculated based on the difference in total starch content with amylose content.

2.4.2. Starch content [5]. The samples as much of 5 gr were put in an erlenmeyer 500 ml and added 200 ml of HCl 3%, then boiled for 3 hours using an upright cooler. The solution is neutralized with NaOH 30% and added CH3COOH 3% so that the solution becomes slightly acidic. The solution was transferred into volumetric flask 500 ml and adjusted until the tera mark with distilled water then filtered. A total of 10 ml of filtrate was pipetted into an erlenmeyer 500 ml and added with 25 ml of Luff solution, boiling stone and 15 ml of distilled water were heated with a fixed flame. After boiling for 10 minutes, erlenmeyer was cooled in a tub of ice then added 15 ml KI 20% and 25 ml of H2SO4 25%. The mixture was titrated using the solution of Na2S2O3 0.1N with 0.5% starch indicator until the end point was obtained. The same analysis procedure were applied to the blank. Calculation of starch content was carried out based on the glucose content measured at the sample titration. The starch content is calculated based on the following formula:

\[ \text{Na}_2\text{S}_2\text{O}_3 \text{ used} = (V_b \times V_s) \times \text{Na}_2\text{S}_2\text{O}_3 \times 10 \]

Note: \( V_b \) = volume of Na2S2O3 used in blank titration, \( V_s \) = volume of Na2S2O3 used in sample titration, \( N \) = concentration of Na2S2O3 used for titration.

2.4.3. Sensory evaluation [6]. Sensory evaluation is known as testing by using senses. The method used in sensory evaluation is by testing descriptions designed to identify and measure sensory properties. In this testing group the quality attributes were categorized by a scale category based on one sample, by a ratio scale method. In sensory evaluation using the panelists as consumers with the aim to know the level of consumer acceptance of a product.

3. Results and discussion

3.1. Amylose content

The analysis results of amylose content of Aceh local rice M5 ranged from 15.20% to 19.43% where a better percentage of amylose content was obtained in USK-Snb-RGO-S-97 was 19.43% which significantly different from all other rice. Aceh Local rice M5 is included in low amylose levels, this is in accordance with Jimenez[7] Amylose levels were classified into 3 groups, namely high amylose content (> 25%), moderate amylose content (20-25%), and low amylose content (<20%).

3.2. Amylopectin content

The analysis results of amylopectin levels in Aceh local rice M5 showed that the percentage of amylopectin levels better obtained by USK-Snb-RGO-4F1-B rice which the percentage of amylopectin levels is 53.49% and significantly different from all of rice. The percentage for amylopectin levels is in line with the research conducted by Lii [8] which states that the greater content of amylopectin (low amylose), the size of the swelling will increase or the greater absorption of water. However, if the absorption of water has reached a maximum, the low amylose of rice actually has higher water content and rice swelling is determined by the content of amylopectin. The ratio between the content of amylose and amylopectin is most important factor in determining the quality of rice texture, both in warm conditions to room temperature.

3.3. Starch content

The analysis results of starch content in Aceh local rice M5 stated that the percentage of better starch content was obtained by USK-Snb-RGO-4F1-B rice, which the percentage of starch content is 72.23% and had significantly different from all other rice. According to Haryadi [9] the main component in rice is carbohydrate. Carbohydrate consists of starch which has the largest part whereas
the smallest part of rice is sugar, cellulose, hemicellulose and pentose. Starch in rice is 85-90% from dry weight of rice, pentose is 2.0-2.5% and sugar is 0.6-1.4% of the weight of a broken rice husk. Therefore, the properties of starch are a factor that can determine the chemical properties of rice. The average chemical properties of rice in amylose, amylopectin and starch content presented in Table 1.

| The Rice            | Amylose Content (%) | Amylopectin Content (%) | Starch Content (%) |
|---------------------|---------------------|-------------------------|--------------------|
| First elder Sanbei  | 15.20\(^{a}\)       | 41.50\(^{c}\)           | 57.02\(^{c}\)      |
| USK-Snb-RGO-S-84    | 17.59\(^{b}\)       | 52.41\(^{d}\)           | 70.16\(^{d}\)      |
| USK-Snb-RGO-CKU-6   | 16.50\(^{b}\)       | 32.05\(^{a}\)           | 48.46\(^{a}\)      |
| USK-Snb-RGO-S-97    | 19.43\(^{d}\)       | 33.41\(^{b}\)           | 52.76\(^{b}\)      |
| USK-Snb-RGO-4F1-B   | 18.42\(^{c}\)       | 53.49\(^{e}\)           | 72.23\(^{e}\)      |
| LSD (0.05)          | 0.23                | 0.42                    | 0.28               |

Note: The numbers followed by the same letters in the same column are not significantly different at the level of 5% (LSD 0.05)

The average preference test for aroma, color, texture, shape and overall acceptance of rice as a sensory evaluations are presented in Table 2.

| The Rice       | Preference Test                   |
|----------------|-----------------------------------|
|                | Aroma | Color   | Texture | Shape | Overall acceptance |
| First elder Sanbei | 13.78\(^{b}\)       | 14.41\(^{bc}\) | 12.83\(^{ab}\) | 14.25 \(^{b}\) | 12.78\(^{bc}\)       |
| S-84           | 14.54\(^{b}\)       | 11.19\(^{ab}\)       | 14.51\(^{b}\)   | 14.13\(^{b}\) | 14.12\(^{c}\)       |
| CKU-6          | 14.39\(^{b}\)       | 12.43\(^{abc}\)      | 11.61\(^{a}\)   | 11.32\(^{a}\) | 11.61\(^{ab}\)      |
| S-97           | 14.83\(^{b}\)       | 14.79\(^{c}\)        | 14.74\(^{b}\)   | 15.60\(^{b}\) | 14.75\(^{c}\)       |
| 4F1-B          | 9.70\(^{a}\)        | 9.73\(^{a}\)         | 10.74\(^{a}\)   | 10.33\(^{a}\) | 9.84\(^{a}\)        |
| LSD (0.05)     | 3.08               | 3.25                  | 2.10             | 1.88             | 2.43                |

Note: The numbers followed by the same letters in the same column are not significantly different at the level of 5% (LSD 0.05)

3.4. Aroma

Sensory evaluation of descriptive tests on aroma preference attributes produced better on USK-Snb-RGO-S-97 rice with a value 14.83 which has not significantly different from first elder sanbei rice, USK-Snb-RGO-S-84 rice, and USK-Snb-RGO-CKU-6 rice, but significantly different from USK-Snb-RGO-4F1-B rice. The lowest rice aroma is USK-Snb-RGO-4F1-B rice with a value of 9.70.

Rice from the results of gamma ray irradiation has different scents from each other based on rice, this is in accordance with the opinion of Juliano [10], that the aroma of rice is influenced by varieties of rice. Besides being influenced by rice, the aroma will also change by the length of storage. The rice which is not refined 100% will has a bad smell after being stored for a long time. Changes in aroma in storage time are faster than changes in color.

The matter things that can be done to resist the occurrence of scent loss is by using a good packaging method by using a type of packaging that has high porosity, temperature and time
of storage, selection of solvent types in the extraction process, and level of polarity. The aroma of rice can survive by coating if using malto-dextrin [11].

3.5. Color
The sensory evaluation results of colour preference attributes between color of the comparable rice and Aceh local rice M5 is on USK-Snb-RGO-S-97 rice, it has a better values (14.79) which significantly different from USK-Snb-RGO-S-84 and USK-Snb-RGO-4F1-B. on the other hand, the lowest colour of rice is on USK-Snb-RGO-4F1-B (9.73).

The results of descriptive test on the colour showed that the panelists tend to prefer Aceh local rice USK-Snb-RGO-S-97. According to Haryadi [11] the colour of rice is influenced by the degree of morphology, amylose content and changes during rice storageing, the higher degree of sosoh causes the more epidermis is released and made the colour of rice becomes whiter. The acceptance of the colour of a material varies depending on natural factors, geographical, and social aspects of society, in appearance colour factors are sometimes more important in determining the nutritional value and quality of food. The food ingredients will not be eaten if have an unattractive colour [12].

3.6. Texture
Sensory evaluation with descriptive tests on texture preference attributes between comparable rice with Aceh local rice M5 better on USK-Snb-RGO-S-97 which has significantly different from USK-Snb-RGO-CKU-6 and USK-Snb-RGO-4F1-B. The lowest rice texture was found in USK-Snb-RGO-4F1-B which has not significantly different from the first elder and USK-Snb-RGO-CKU-6.

Rice from gamma ray irradiation has a different appearance in each rice, this is in accordance with Lewis [13]. Texture is the surface appearance of a food ingredient that is produced through a combination of physical properties and chemical properties that are widely accepted by touch, vision, and hearing. Texture is also defined as the properties of a food that can be observed by the eyes, skin, and muscles in the mouth.

3.7. Shape
Descriptive methods for physical appearance in the highest shape of rice in USK-Snb-RGO-S-97 which has significantly different from USK-Snb-RGO-CKU-6 and USK-Snb-RGO-4F1-B. The lowest form of rice is found in USK-Snb-RGO-4F1-B which has not significantly different from USK-Snb-RGO-CKU-6 but has significantly different from the first elder, USK-Snb-RGO-S-84 and USK-Snb-RGO-S-97. This is in line with Furahisha [14] stated that the difference between the length of rice between varieties was caused by genetic variation. Shape and size are important characteristics that must be possessed in rice.

The size and shape of rice is dominant character which derived from genetic characteristics of its parent and can be used as a parameter for determining the purity of a variety. The character of length and shape of rice are influenced by genetic factors, agroecosystem and soil fertility [15].

3.8. Overall acceptance
The highest overall acceptance is USK-Snb-RGO-S-97 rice which has not significantly different from the first elder Sanbei rice and USK-Snb-RGO-S-84 rice, but has significantly different from USK-Snb-RGO-CKU-6 rice and USK-Snb-RGO-4F1-B rice. The lowest acceptance of rice is in USK-Snb-RGO-4F1-B which has not significantly different from
USK-Snb-RGO-CKU-6 rice, but significantly different from the first elder Sanbei rice, USK-Snb-RGO-S-84 and USK-Snb-RGO-S-97.

4. Conclusion
Based on the results of analysis that has been carried out it can be concluded that the best chemical characteristics on amyllopectin and starch of Aceh local rice are in USK-Snb-RGO-4F1-B rice, while the best amylose content and overall acceptance by panelists in preference test are USK-Snb-RGO-S-97 rice.

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