

# Effects of Varieties and Cooking Methods on Physical and Chemical Characteristics of Cooked Rice



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**Abstract:** To analyze the effect of different lowland rice varieties and different cooking methods on physical and chemical characteristics of cooked rice. A factorial randomized block design with two factors was used and each combination of the factors was repeated three times. The first factor was rice variety (Ciherang and Ciliwung) and the second factor was the cooking method (stovetop, boiling and steaming, and rice cooker). Results showed that Ciherang and Ciliwung varieties were classified into slender grain rice type with yellow-red color. The amylose content of Ciherang was classified as moderate, while the amylose content of Ciliwung classified as low. The most abundant amino acid contained in Ciherang and Ciliwung varieties was glutamic acid. Statistical analysis showed that cooking method had significant effects on texture, lightness, chroma, hue and moisture content of cooked rice. Rice cooked with *liwet* method had the lowest texture value, lowest lightness value, highest chroma value, and highest moisture content.

**Key words:** physical and chemical characteristic; cooking method; rice; variety; amino acid

Rice was one of the most important commodity results in farming systems in the lowland swamp of Indonesia. Lowland swamp land cultivated for rice farming with cropping pattern once a year was 91%, while for rice farming with cropping pattern twice a year was only about 9% (Sudana, 2005). Various rice varieties namely Ciherang, Ciliwung, Mekongga, IR10, IR42, IR64, Ciherang Dempo, Ciliwung Jumbo and Rojo Lele were grown in lowland swamp area (Syafutri, 2015). Ciherang and Ciliwung were varieties widely grown by farmers in lowland swamp land. The difference of rice varieties would affect the characteristics of cooked rice produced. According to Yadav et al (2007), different rice varieties showed significant effects on the physicochemical properties, morphology and cooking properties, but Putri (2012) stated that the starch content of rice was still the same, ie more than 80%. Cooking method also affected the characteristics of cooked rice. According to Han et al (2008), different cooking method would affect the hydrolysis of starch rice. Cooking the raw rice into the cooked rice could be done in various ways. Indonesian people used two ways to cook rice namely conventional and modern ways. The conventional way consisted of *liwet* method using stovetop, and combination of boiling and steaming method. The modern way was cooking rice using electric rice

cooker. Each cooking method used different heat and cooking time. The objective of this study was to analyze the effect of different lowland rice varieties and different cooking methods on physical and chemical characteristics of cooked rice.

## MATERIALS AND METHODS

### Rice materials

Rice varieties Ciherang and Ciliwung were derived from lowland swamp land at East Ogan Komering Ulu, South Sumatera, Indonesia.

### Cooking methods

Factorial randomized block design was used with two treatment factors and three repetitions. The treatment factors were rice variety (A) and the cooking method (B). The first factor consisted of two levels, Ciherang (A<sub>1</sub>) and Ciliwung (A<sub>2</sub>), whereas the second factor consisted of three levels, *liwet* method using stovetop (B<sub>1</sub>), combination of boiling and steaming (B<sub>2</sub>) and rice cooker (B<sub>3</sub>). The data obtained were evaluated using analysis of variance (ANOVA) and honestly significant difference test at the 5% level. Physical and

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chemical characteristics of milled rice and cooked rice were studied.

#### *Liwet method using stovetop*

The procedures of *liwet* method (Deliani, 2004) which have been modified were: first, milled rice with whole grains (100 g) was cleared from foreign objects and dirt. Second, rice was washed with clean water (two times) and drained for 2 min, then put in a regular pot or pan pot. Next step, water (150 mL) was added to the pot containing. Fourth, the rice was cooked in a covered pot until boiling. Then, stirring was alone done 10 times after water boiling (100 °C). Sixth, if the water was up, stirred again (stirring the latter performed 5 times and the pot sealed while the fire diminished). Last, the cooking times of *liwet* method were 10 min.

#### *Combination of boiling and steaming method*

The procedures of boiling and steaming combination method (Deliani, 2004) which have been modified were: first, milled rice with whole grains (100 g) was cleared from foreign objects and dirt. Second, rice was washed with clean water (two times) and drained for 2 min, then put in a regular pot or pan pot. Third, water (150 mL) was added to the pot containing. Next, the rice was cooked in a covered pot to a boil for 5 min, then reduced the heat (during heating stirring 15 times until becoming rice (water absorbed by rice). Fifth, stirring was done 10 times after water boiling (100 °C) to become rice (water absorbed by rice). Then, rice was stirred and moved to the steamer containing boiled water, then waited for 5 min.

#### *Rice cooker method*

The procedures of modern cooking method (rice cooker) (Sutarjana, 2009) which have been modified were: first, milled rice with whole grains (100 g) was cleared from foreign objects and dirt. Second, rice was washed with clean water (two times) and drained for 2 min and put in an aluminum pan on the rice cooker. Then, 150 mL water was added. Fourth, thermostat was clicked and light 'cooking' light up on the rice cooker to cook the raw rice into the cooked rice. Finally, the thermostat button will automatically moved from the position of the light 'cooking' to the position of the lights 'warmer' that shows rice cooked.

### **Measurement of physical and chemical characteristics**

The physical characteristics of milled rice included size (dimensions of rice) and color, whereas the chemical characteristics of milled rice included moisture content, amylose content, protein content and total amino acids. The physical characteristics of cooked rice were color and texture, while the chemical characteristic was moisture content.

Rice dimensions including length and width were measured using calipers. Whole rice intact (10 seeds) was taken from each variety. Texture of rice was measured with 'Brookfield' texture analyzer (Faridah et al, 2006). Brook (cylindrical type) mounted just above the sample. The needle was attached to the tip of the sample. Speed of texture analyzer was set. Brooke

(blade type) pressing right in the middle of the sample. Then, on display listed number of peak load and final load (gram force). Analysis of color was measured using a Konica Minolta Chromameter. Lightness, chroma and hue were measured according to Anonymous (1997). Chemical characteristics were determined using method of AOAC (2006).

## **RESULTS**

### **Dimensions of rice**

Ciherang had length of 7.01 mm and width of 2.04 mm, whereas Ciliwung had length of 6.75 mm and width of 2.10 mm. The ratio of length and width for Ciherang was 3.44, while that for Ciliwung was 3.21.

### **Texture**

Texture indicated the hardness of rice. Physically, hardness of cooked rice defined as rice ability to accept certain load in certain time. Analysis of texture could determine hardness and tenderness of rice. Based on this study, average textures of cooked rice were 25.70 to 33.00 gf (Fig. 1). Analysis of variance showed that cooking method had significant effect on texture of cooked rice, while rice variety and interaction between cooking method and rice variety had no significant effect on texture of cooked rice. The cooked rice with high texture value was harder than that of low texture value.

### **Color**

Color analysis was conducted on milled rice and cooked rice with attributes of lightness, chroma and hue. The maximum value of lightness was 100% that showed very white.

The lightness values of milled rice were 65.97% (Ciherang) and 67.93% (Ciliwung). The lightness values of cooked rice with different varieties and cooking methods ranged from 73.07% to 76.20% (Fig. 1). The highest lightness value (76.20%) was found in rice with A<sub>2</sub>B<sub>3</sub> treatment (Ciliwung variety and cooking method using the rice cooker), while the lowest lightness value (73.07%) was found in rice with A<sub>1</sub>B<sub>1</sub> treatment (Ciherang variety and *liwet* method). The high lightness value of rice indicated that the color of rice was brighter. The analysis of variance showed that cooking method had significant effect on lightness of cooked rice, while rice variety and interaction between cooking method and rice variety had no significant effect on lightness of cooked rice.

The chroma values of milled rice were 12.03% (Ciherang) and 12.00% (Ciliwung). The chroma values of cooked rice with different varieties and cooking methods ranged from 5.63% to 7.10% (Fig. 1). The highest chroma value (7.10%) was found in rice with A<sub>1</sub>B<sub>1</sub> treatment (Ciherang variety and *liwet* method), while the lowest chroma value (5.63%) was found in rice with A<sub>2</sub>B<sub>3</sub> treatment (Ciliwung variety and cooking method using the rice cooker). The analysis of variance showed that cooking method had significant effect on chroma of cooked rice, while rice variety and interaction between cooking

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