Comparison Physico-chemical properties Anthocyanin solution Extraction of Red Rice and Black Soybean

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Abstract. This research was carried out to determine the comparison of anthocyanin extraction of red rice and black soybean regarding density, turbidity, viscosity, pH and color changes. Further studies could be conducted after knowing several properties of the two anthocyanin extractions. The results showed that the density of black soybean anthocyanin solution was 0.95 gram/mL higher than 0.92 gram/mL ofosian red rice solution. The viscosity value of 0.91 cP red rice anthocyanin solution is more significant than 0.72 cP black soybean. Analysis of turbidity in both black and red soybeans showed clarity, under LOD Sulphate. The color of the red rice anthocyanin solution is red when it is in a strong acid state, orange when it is neutral, and brown when it is in the healthy alkaline state. Meanwhile, the color of the black soybean anthocyanin solution is red, when it is in a weak acid, brown when it is the neutral state, and dark-green when the alkaline condition is weak.

1. Introduction
Rice is a staple food in Indonesia. This food has many nutritional benefits needed by the human body. The nutrients contained in the rice include carbohydrate, fats, vitamins, and others. Several varieties of rice are available in Indonesia, i.e., Pandan Wangi, Sintanur, Cisandane, Cihang, and IR 64. Based on the color, the rice is black, red, and some are white. Indonesian people commonly consume white rice. Meanwhile, black or red colored rice contain anthocyanins [1][9][6].

Soy is a food ingredient containing a source of protein. Indonesian people make some food from soybeans such as tempeh, tofu, and soy sauce. Soy has yellow and black colors. Black soybeans contain anthocyanins [4][5]. Table 1 illustrates the chemical composition of the black soybeans.

| No. | Composition     | Level        |
|-----|----------------|--------------|
| 1   | Water content  | 10.57± 0.17  |
| 2   | Protein levels | 39.09± 0.11  |
| 3   | Fat level      | 14.47± 0.22  |
4 Ash content 4.12 ± 0.05
5 Anthocyanin content (mg / 100gr) 222.49 ± 22.62
6 Isoflavone levels
   a. Genistein (mg / g) 0.65 ± 0.07
   b. Daidzein (mg / g) 3.67 ± 0.41

Source: Nurrahman, 2015

Anthocyanin is a natural coloring substance in plants. This substance can color leaves, flowers, fruit, and tubers. The varieties are red, purple, blue and yellow depending on the pH environment [3]. This study tries to compare the values of density, viscosity, turbidity and color changes of anthocyanin extraction solvent from red rice and black soybean.

2. Research Methods
This research was conducted from March to August 2018. The samples were anthocyanin extracts from red rice and black soybeans. The place of analysis and characterization was carried out at the Chemistry Laboratory of the Chemistry Department of the University of Indonesia.

2.1 The Production of Anthocyanin Extraction Samples
The researcher also used the same method in making anthocyanin extraction from both ingredients. The production of red rice anthocyanin extraction begins with washing and soaking it. After 12 hours, the rice is added with alcohol and water in a ratio of 7:1 and blended until the ingredients become smooth.

After that, the mixture is added with HCL until the pH became 2 and stored in the refrigerator for 24 hours. Then, the mixture is filtered with Whatman paper and added with NaOH until the pH becomes 7.

2.2 The density of anthocyanin solution
A material density can bring information on the physical and chemical properties [7]. In general, the density can be calculated using the following equation:

\[ \rho = \frac{m}{v} \]  

The \( \rho \) is the ratio of mass with a volume of the objects represents the density. While \( m \) is the mass of the object and \( v \) is the volume of the object calculated by how high its density.

In this study, the measurements of density were carried out by using the density of Kamba. The first step is weigh the 50 ml cup (a). After that, poured as much as 50 ml of anthocyanin solution (b), then weighed. After obtaining the value of the scales, then the density value is calculated using the following equation:

\[ \rho = \frac{b - a}{50 \text{ ml}} \]  

2.3 The measurement of viscosity and turbidity of anthocyanin solutions
These measurements were carried out at the Chemical Laboratory, Department of Chemistry, University of Indonesia. The Oswald viscometer method is used to measure the viscosity while a spectrophotometer method is applied to measure viscosity.
3. Results and discussion

3.1. Measurement of the density and viscosity of anthocyanin solution

The anthocyanin solution of red rice and black soybean is in the form of liquid. It has several properties, including viscosity, density, pressure, and temperature [2]. This study measures the value of density, viscosity, and turbidity of anthocyanin solutions, both from red rice and black soybeans. Table 2 are the results of density value measurement. The density value of the black soybean anthocyanin solution was higher than the red rice anthocyanin solution. The measurements utilize Kamba density equation, where the average value of several repetitions for the black soybean remedy is 0.95 gr/ml while the density value for red rice anthocyanin solution is 0.92 gr/ml. The results indicated that in an equal volume, the mass of black soybean anthocyanin solution is greater than the mass of brown rice anthocyanin solution.

Table 2 Measurement Results of the density of black soybean anthocyanin solution and red rice anthocyanin solution.

| No. | Material                        | Density (gram/ml) |
|-----|---------------------------------|-------------------|
| 1   | Black Soybean Anthocyanin Solution | 0.95              |
| 2   | Red Rice Anthocyanin Solution    | 0.92              |

The measurement of viscosity is carried out using Ostwald viscometer. The results found that the viscosity value of red rice anthocyanin solution is higher than that of black soybean. The viscosity value of the black soybean anthocyanin solution was 0.72 cP while the viscosity value of the red rice anthocyanin solution was 0.91 cP. The results concluded that red rice anthocyanin solution has a higher viscosity compared to black soybean anthocyanin solution.

Table 3 Measurement results of the viscosity of black soybean anthocyanin solution and red rice anthocyanin solution.

| No. | Material                        | Viscosity (cP) |
|-----|---------------------------------|---------------|
| 1   | Black Soybean Anthocyanin Solution | 0.72          |
| 2   | Red Rice Anthocyanin Solution    | 0.91          |

Based on the measurement results of turbidity showed that both anthocyanin solution of brown rice and black soybean solution added with HCl and NaOH were clear. Using LOD Sulphate 5.00 mg/L, no turbidity was detected.

3.2. The color of red rice anthocyanin solution and black soybean anthocyanin solution

Each solution is divided into three parts and put into a vial glass. One glass sample is added with NaOH, and another glass with HCl as shown in the figure below. In the red rice anthocyanin solution, after adding NaOH, its color (red with a little orange) changes to a slightly brownish red (left image). On the contrary, when adding HCl, the color changes to more red (Figure 1, right side). Mahmudatussa'adah [3] states that the pH influences anthocyanin color. The red rice anthocyanin solution is alkaline after adding NaOH. Meanwhile, the solution is acidic after adding HCl.
PH measurements were carried out to know acid-base levels of the three red rice anthocyanin solutions, Table 4. The pH of the initial red rice anthocyanine solution is 6.8. The pH changes to 12.3 after adding NaOH. The pH value of the initial anthocyanin solution turns to 1.7 after adding a large HCl. Red rice anthocyanin solution when it is in strong acid, the color turns red. When the pH of the neutral solution, it changes to red slightly orange. If the solution have strongly alkaline pH, the color turns brown.

Figure 1. Extraction of anthocyanin solution from Red Rice. The left side is red rice anthocyanin added with NaOH. The middle part is red rice anthocyanin solution added with HCl. Meanwhile, red rice anthocyanin solution is on the right.

Figure 2 shows three vial bottles filled with black soybean anthocyanin solution. In the middle, the color of a black soybean anthocyanin solution is a little brownish before being added with HCl and NaOH. On the left, the color of a black soybean anthocyanin solution is red after being added with HCl. On the right, the color of the anthocyanin solution added with NaOH turns green. From the three black soybean anthocyanin solutions, the writer measured the pH value. Table 4 shows the results. The black soybean anthocyanin solution added neither with HCl nor NaOH; the pH value is 7.0. The pH value of the black soybean anthocyanin solution after adding HCl is 4.0. However, the pH value turns to 9.0 after being added with NaOH. So, the color of the black soybean anthocyanin solution turns red when it is in weak acid. When it is at a neutral pH, the color is brown. Moreover, when it is at a weak base, it turns into dark green.
Figure 2. Extraction of anthocyanin solution from Black Soybean. On the left is an anthocyanin solution added with HCl. In middle part is a black soybean anthocyanin solution and the right part is a black soybean anthocyanin solution added with NaOH.

### Table 4

| No. | Sample                                           | pH  |
|-----|--------------------------------------------------|-----|
| 1   | Black Soybean Anthocyanin Solution               | 7.0 |
| 2   | Black Soybean + NaOH Anthocyanin Solution        | 9.0 |
| 3   | Black Soybean Anthocyanin + HCl Solution         | 4.0 |
| 4   | Anthocyanin Red Rice Solution                    | 6.8 |
| 5   | Red Rice Anthocyanin solution + NaOH             | 12.3|
| 6   | Anthocyanin Red Rice + HCl Solution              | 1.7 |

### 4. Conclusion

Based on this research, it is found that the density and viscosity values of the anthocyanin solution of brown rice and black soybean anthocyanin solution were not comparable. The density of black soybean anthocyanin solution is higher than the red rice anthocyanin solution. The viscosity value of the red rice anthocyanin solution is higher than that of black soybean anthocyanin solution. The measurement results of turbidity of each anthocyanin solution sample depict that the solution is clear. Meanwhile, the color of the red rice anthocyanin solution is red when it is in the state of strong asthma. The color changes to orange when it is in the neutral state. Moreover, it possibly turns to brown when it is in the strong alkaline state. The shifting color also occurs in the case of the black soybean anthocyanin solution. The color is red in a weak acid condition, but it turns to brown in the neutral state. The color also shifts to be dark green when the alkaline condition is weak.

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