Effect of heating and electric conductivity of anthocyanin extract from red dragon fruit (*Hylocereus polyrhizus*) as a sensitizer material

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Abstract. Research on the Effect of Heating and Electrical Conductivity of Anthocyanin Extract from Red Dragon Fruit (*Hylocereus polyrhizus*) as a sensitizer has been conducted. Red dragon fruit (*Hylocereus polyrhizus*) was macerated extracted with a solvent ratio of 1:2. The absorbance was measured at a wavelength of 300 - 700 nm using a UV-Vis spectrometer with a dilution of 25 times. Extract stability test due to heating was carried out at temperatures of 40 °C, 50 °C, 60 °C, 65 °C, 70 °C and 80 °C. The results showed that heating temperature causes a decrease of absorption, the sensitizer material of extract was unstable at high temperatures ranging from 70 °C and above, it was observed with the occurrence of color changes and the wavelength and absorbance were not measured. The electrical conductivity in bright conditions of the extract also decreased due to the effect of heating. Electrical conductivity in bright conditions Anthocyanin extract at temperatures: 32 °C, 40 °C, 50 °C, 60 °C, 70 °C, and 80 °C are 1569 µS/cm, 493 µS/cm, 592 µS/cm, 526 µS/cm, 474 µS/cm, 544 µS/cm, 494 µS/cm respectively.

1. Introduction

Sunlight received by the earth's surface reaches $3 \times 10^{24}$ Joules per year, the energy is equivalent to $2 \times 10^7$ Watts [1]. This enormous amount of energy encourages researchers to look for ways to convert solar energy into alternative energy, one of the alternative energies is solar energy conversion technology that uses other organic materials in the form of dye sensitive solar cells (DSSC). DSSC is a type of solar cell that is environmentally friendly, low production costs, dyes are available in large quantities, easy to extract and biodegradable in the environment and no further purification is required [2].

The development of plant pigments as a sensitizer for Dye-Sensitized Solar Cell (DSSC) solar cells is a promising option because these pigments are available in abundant quantities in nature. One of the potential plants that produce coloring pigments is dragon fruit. The dye produced by dragon fruit is a pigment called betalain [3-5]. Research shows that dragon fruit dye can be used as a dye in Dye-Sensitized Solar Cell (DSSC) types of solar cells that affect current and voltage [5-6].

The problem with natural pigments is that they are unstable due to the influence of temperature, light and pH [5,7,8,9]. In this research, we observed the effect of temperature and electrical conductivity of dragon fruit extract to the absorbance properties for DSSC.
2. Materials and method

The materials used in this study were red dragon fruit flesh, 96% ethanol, and aquades. Meanwhile, the equipment used includes a blender, beaker, analytical balance, filter paper, aluminium foil, thermometer, magnetic stirrer, UV-Vis spectrometer.

Selection of fresh red dragon fruit is an important step to do when choosing the fruit to be extracted. The fresh red dragon fruit can be seen from its red color. Fresh red dragon fruit greatly affects the quality of the extraction results. Red dragon fruit extraction is done by separating the flesh from the skin. The flesh of the red dragon is cut into small pieces and then blended. Red dragon fruit flesh that has been blended is extracted by soaking in 1:2 solvent (100 grams of dragon fruit dye: 200 ml 96% ethanol) for 24 hours. Then it is evaluated to get the concentrated extract.

The concentrated red dragon extract was then diluted with 25 times distilled water. Red dragon fruit extract was heated at temperatures of 40°C, 50°C, 60°C, 65°C, 70°C and 80°C each with a volume of 10 ml for 1 hour. Which was then ready for absorbance measurement using a UV-Vis spectrometer. The samples were scanned at a wavelength range of 300-700 nm.

Electrical properties of the samples were carried out by measuring the electrical conductivity of red dragon fruit pigments at temperatures using a conductivity meter.

3. Results and discussion

3.1. Effect of temperature

The absorption of fresh extract from red dragon fruit was measured at length waves from 300 to 700 nm. The absorption spectrum shows that the peaks formed indicate the presence of betalain (Figure 1). Figures 1 show the absorbance spectra for the samples prepared from the red dragon solution. The UV-Vis spectra show that each solution has a peak at a wavelength between 520-570 nm, which shows the characteristic of anthocyanin [2]. The extracted anthocyanin pigments appear optimally at the temperature of 32°C-65°C, while at temperatures of 70°C and above, the red color of samples has disappeared so that the wavelength of the pigment cannot be read by UV-Vis.

![Figure 1. Result UV-Vis wavelength vs absorbance](image)

Heat is a very important factor for pigment stability betalain. During the heating process, the possibility of breaking the bonds occurs causing a reduction in red color to pale red or turns bright yellow. The first step of degradation of the pigment betalain by temperature is the effect of hydrolysis by water on betasianin compounds. This step resulted in cyclo-DOPA-5-O-β-glucoside and betalamic acid.
acid. This compound can experience regeneration at low temperature, but at high temperature, regeneration cannot occur because betalamic acid is not resistant to heating. It is clear that increasing heating temperature causes a decrease of absorption, which is indicated by the reduction in the color of dragon fruit pigments. Even at temperatures of 70°C and above the red pigment has disappeared [5,8,9].

3.2. Electrical conductivity properties
The electrical conductivity of dragon fruit pigments was measured to determine the effect of heating process on the quality of pigments produced from red dragon fruit. The conductivity measurement of the dragon fruit dye was obtained as shown in Table 1

| NO. | Concentration | Temperature (°C) | Electrical Conductivity (µS/cm) |
|-----|--------------|-----------------|-------------------------------|
| 1   | 1/2          | 32              | 1569                          |
| 2   | 1/2          | 40              | 493                           |
| 3   | 1/2          | 50              | 592                           |
| 4   | 1/2          | 60              | 526                           |
| 5   | 1/2          | 65              | 474                           |
| 6   | 1/2          | 70              | 544                           |
| 7   | 1/2          | 80              | 494                           |

Table 1 shows that the addition of temperature treatment greatly affects the electrical conductivity of dragon fruit pigments. At 32°C, the dragon fruit pigment reads an electrical conductivity of 1569 µS / cm, at a temperature of 40°C the pigment of dragon fruit reads 493 µS / cm of electrical conductivity. It shows that there is a decrease in conductivity of 318.3%. Likewise, the electrical conductivity of dragon fruit pigments is strongly influenced by changes in temperature, and it is stable at room temperature [5].

4. Conclusion
The anthocyanin content, which is indicated by the absorbance of dragon fruit pigment, is influenced by temperature. The decrease in absorbance intensity is caused by changes of the red color which is relatively faded even at a temperature of 70°C and above. The red color has disappeared. While the electrical conductivity of dragon fruit pigments is strongly influenced by changes in temperature and is stable at room temperature.

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