

# *Extraction And Characterization Of Betacyanins From Beetroot (Beta Vulgaris L.)*

Nia Ananda Putri Utami<sup>1</sup>, Selvi Apriliana Putri<sup>2</sup>, Minda Azhar<sup>3</sup>

Department Chemistry  
Universitas Negeri Padang  
Padang, Indonesia

<sup>1</sup>Pniaa1407@gmail.com

<sup>2</sup>Selviapriliana09@gmail.com

<sup>3</sup>minda@fmipa.unp.ac.id



**Abstract** – Beetroot has a characteristic red-violet color. This color comes from betacyanins compounds that can be used in food and pharmaceutical products. This study aimed to characterize the betacyanins extracted from beetroot. The extraction process was carried out by maceration method using ethanol and water in a ratio of 1:1(v/v). The extraction results were characterized using FTIR and UV-Vis spectrophotometry. Characterization of the extraction results using FTIR showed the presence of functional groups C-H, O-H, N-H, C-O, and C=C. This indicates that the extraction result is a betacyanins compound that consists of betalamic acid and cyclo DOPA groups. The UV-Vis spectrum showed three wave peaks at absorbances of around 300 nm, 480 nm, and 530 nm. Absorbance at wavelengths of 300 nm and 530 nm indicates the presence of betacyanins compounds contained in beetroot, while  $\lambda$  480 nm identifies the presence of compounds betaxanthins which is a derivative of betalains. Higher absorption of betacyanins than betaxanthins showed that the main component of beetroot is betacyanins.

**Keywords** – beetroot; betacyanins; Beta vulgaris L.

## I. INTRODUCTION

Beet Plant (*Beta vulgaris L.*) is a plant native to North Africa. This plant has dark red roots. Beetroot color is due to two main groups of water-soluble nitrogen compounds[1]. The main group of these compounds is derivatives of betalains with the classification of betacyanins (red-violet,  $\lambda_{\max}$ 540 nm) and betaxanthins (yellow-orange,  $\lambda_{\max}$ 480 nm) [2]. The betacyanins content in beetroot ranges from 40 to 200 mg/100 g, which is not present in other plants [1].

Betacyanins are a type of natural pigment that has many beneficial effects on health such as antioxidant, anti-cancer, anti-inflammatory, antimicrobial, and neuroprotective [3]. In addition, the red color produced by betacyanins can also be used in food products [1]. Betacyanins can be found in several natural ingredients that have different levels. Betacyanins can be characterized by the method spectrophotometer UV-Vis and FTIR [4].

Previous studies have carried out several variations in extracting betacyanins from beetroot. Betacyanins can be extracted with the help of ultrasonic (ultrasonic-assisted extraction) [5]. Research using this method requires high costs and high electrical voltage to produce wave vibrations and the optimal time is difficult to control [6]. Betacyanins can also be extracted with the help of a microwave (Microwave assisted extraction). This method requires quite complex tools [7].

Therefore, the researchers chose to extract betacyanins by the maceration method. The maceration method, which is carried out with slight modifications, uses a simple tool, the cost is quite cheap, and can be carried out at room temperature. This study

aims to extract betacyanins content from beetroot and to characterize it using FTIR and UV-Vis.

### II. MATERIALS AND METHODS

#### A. *Materials and Tools*

Red beetroot (*Beta vulgaris L.*), distilled water, distilled technical ethanol. Blender, knife, beaker, analytical balance, oven, magnetic stirrer, centrifugation, rotary evaporator, sieve mesh 30 (particle size >60mm), Free-drying, wattman paper (no. 4), FTIR, UV-Vis spectrophotometer.

#### B. *Beetroot Sample Preparation*

The beetroot (*Beta vulgaris L.*) used in this study was obtained from a supermarket in Padang City. The beetroot was washed with running water, cut into pieces (*slices*) then oven at 42°C for 24 hours. The dried beetroot samples were ground and sieved through a 30-mesh sieve [8].

#### C. *Betacyanin Extraction from Beetroot*

Beetroot powder 50 g was extracted by maceration method for 16 hours using ethanol and equates to solvents. The solvent used was 400 mL with a ratio of 1:1 (v/v) with a stirring magnetic stirrer. The result of maceration is filtered with paper wattman no.4. The filtered solution was centrifuged at 4°C at 1000 rpm for 15 minutes. The supernatant results were vacuumed using a rotary evaporator at 35°C. Then the sample was dried using freeze-drying until thickened [8].

#### D. *Betacyanin Characterization FTIR and UV-Vis Spectrophotometry*

The results of the betacyanins extract obtained were carried out testing characterization using FTIR (Fourier transform infrared) at wave number 4000-600 cm<sup>-1</sup> and UV-Vis spectrophotometry with a wavelength of 400-600 nm [8].

### III. RESULTS AND DISCUSSION

#### A. *Extraction and Identification of Betacyanins from Beetroot*

Betacyanins have a subgroup consisting of betanin, amaranthine, gomphrenin, and bougainvillein [9]. Betacyanins compounds are the highest bioactive compounds in beetroot content [10]. Betacyanins are polar compounds with a hydroxyl group (-OH). Therefore, the solvents used are ethanol and distilled water. Ethanol is a polar solvent that can extract betacyanins. The addition of equates solvent aims to attract more betacyanins extract because betacyanins compounds are hydrophilic [11]. Research on betacyanins extraction has been carried out previously from dragon fruit. Extraction of 5 g dragon fruit obtained 28.44 mg/100mL of betacyanins [8]. The extraction process from the beetroot was carried out as much as 50 g, and the results obtained from the betacyanins extract were as much as 3 g/400 mL. This shows that the betacyanins obtained from the beetroot extract are more than the dragon fruit peel extract that has been carried out.

The characterization of betacyanins compounds from beetroot extract was carried out using FTIR instruments and UV-Vis spectrophotometry. FTIR analysis was used to determine the functional groups contained in the extract of beetroot. UV-Vis spectrophotometry was used to determine the maximum wavelength of the betacyanins compound contained in the beetroot extract sample. The results of the characterization obtained are discussed as follows.

#### B. *Identification of Betacyanins with FTIR*

Betacyanins characterization from beetroot extraction was carried out at a wave number of 4000-600 cm<sup>-1</sup>. The spectrum of betacyanins FTIR results from beetroot extract can be seen in Figure 1.

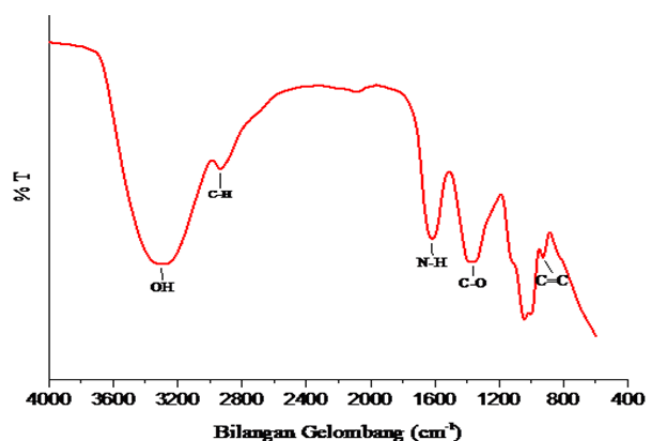


Fig. 1. Betacyanins extract results from beetroot.

The FTIR spectrum of betacyanins in Figure 1 is shown at a wave number of 4000-400  $\text{cm}^{-1}$ . Broad absorption band around the wave number 3400-3200  $\text{cm}^{-1}$  associated with the O-H strain vibration. At wave number 2935-2915  $\text{cm}^{-1}$  associated with both asymmetric and symmetrical C-H stretching of the aromatic ring. The wave number 1650-1550 shows the N-H strain vibration of the betalamic acid compound contained in betacyanin. At wave number 1473-1344  $\text{cm}^{-1}$  stretching of the C-O functional group. The absorption band in wave number 995-850 is associated with the C=C group [12]. The infrared spectrum in Figure 1 shows a wave number similar to the research results as in Tang et. Al 2021 [13], although there is a slight difference, it is still in the same wavenumber range.

### C. Identification Extract Betacyanins with UV-Vis Spectrophotometer

Betacyanins characterization of roots bit with the use of UV-Vis spectrophotometry was carried out at a wavelength of 200-600 nm. The results of the spectra can be seen in Figure 2.

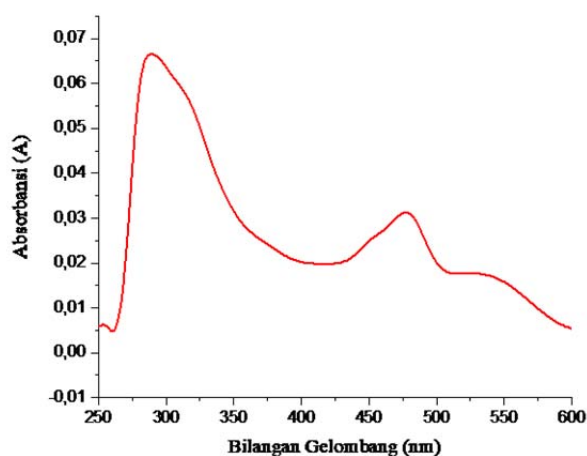


Fig. 2. UV-Vis Spectra of Betacyanins Extract from beetroot

Absorbance Spectra of beetroot extract (*Beta vulgaris*) by UV-Vis spectrophotometry displayed at a wavelength of 250-600 nm. The UV-Vis spectrum showed three wave crests. The wave peaks around 300 nm and 530 nm identify betacyanins compounds. Wave crests around 480 nm identify the presence of the compound betaxanthins. The absorbance peaks at 300 nm and 530 nm showed the characteristics of red-violet betalains derivatives, namely betacyanins. Wave peaks around 280 and 480 nm identify betalains derivative compounds, namely betaxanthins [14].

#### IV. CONCLUSIONS

From the research that has been done on the extraction of Betacyanins from beetroot, it can be obtained results of the spectrum using FTIR obtained functional groups O-H, N-H, C-H, and C=C. The functional group that indicates the presence of betacyanin compounds is the N-H group which identifies betalamic acid. Test results with UV-Vis spectrophotometry showed three wave peaks contained in the betacyanins extract from beetroot. The wavelengths of 300 and 530 nm are the wave numbers of betacyanins (red-violet color) and a wavelength of about 480 nm identifies betaxanthins (yellow-orange color).

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