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Antioxidant Extraction from Purple Sweet Potato (*Ipomea batatas* L.) using Ultrasound Assisted Extraction (UAE)

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Abstract. Ultrasound technology has been used in extracting the antioxidant reserves the Purple Sweet Potato (*Ipomea batatas* L.). Total Phenolic Content was determined using the Folin-Ciocalteu method and Antioxidant Activity was measured using the DPPH method. The extract was also characterized using FTIR. The best results were obtained with the Total Phenolic Content of 51.167 ± 0.2887 mg/g in GAE and value of IC_{50} of 26.7861 mg/L at the extraction temperature of 50⁰ C. These results indicate that the purple sweet potato can be used as an immune system booster foods.

1. Introduction

Antioxidants are a group of chemical compounds that have an important role in the health world. Degenerative diseases can be prevented by the presence of antioxidant compounds that can neutralize free radicals[1]. The content of antioxidants in a plant provides several benefits such as anti-aging, anti-cancer and can reduce the risk of cardiovascular disease [2]. Indonesia is a country with abundant natural resources. Many plants and fruits have high antioxidant content.

Purple Sweet Potato (*Ipomea batatas* L.) Is a plant which is still abundant in Indonesia. This plant has a high anthocyanin content [3]. In addition to anthocyanin content, Purple Sweet Potatoes are rich in dietary fiber, minerals and vitamins[4]. To produce and optimize Purple Sweet Potato extract, a method is needed to obtain the essential content in purple sweet potato, especially the content of antioxidant compounds.

Several methods have been developed to obtain antioxidant content in a natural substance. The method often used is the maceration method by immersing a sample of natural material with a solvent within a certain period[5][6]. This method has several disadvantages such as the use of a lot of solvents and a long time while the components that can be relatively not much. Utilization of ultrasound technology to help the extraction process by maceration has the advantage of a more efficient process, time and cost [7]. Ultrasound is a modified maceration method using ultrasound (high frequency signal, 20 kHz). This ability is caused by the physiochemistry of the ultrasonic wave cavitation phenomenon in the extraction process [8]. Utilization of Ultrasound Technology can also increase levels of polyphenols in extracts[9]. The abundance of Purple Sweet Potato plants in Mare, Bone District, so in this study aims to optimize the content of antioxidant compounds in Purple Sweet Potato using Ultrasound technology.



2. Methodology

2.1 Material

Purple Sweet Potatoes (*Ipomea batatas L.*) obtained in the Mare area, Bone District, South Sulawesi. The skin and flesh of the Purple Sweet Potato are separated and the flesh is ready to be extracted. All the chemicals such as Ethanol (C₂H₅OH), Folin-Ciocalteau Phenol, Sodium Carbonate (Na₂CO₃), Gallic Acid was purchased from Merck, and 2,2-diphenyl-1-picrylhydrazyl (DPPH) was purchased from Sigma Aldrich.

2.2 Procedure

2.2.1 Purple Sweet Potato Extraction. 300 gram sample was added with ethanol solvent and extracted for 45 minutes by sonic power Ultrasound of 405 on a wave of 40 kHz at three temperature variations at temperatures of 40⁰C, 50⁰C and 60⁰C [7]. To obtain thick extract, evaporation was carried out at a temperature not exceeding 45 C in the extract that was filtered with filter paper.

2.2.2 Characterization of Extract using FTIR. The extract was characterized by Prestige-21 Shimadzu Infrared spectroscopy at the range of 400-4000 cm³ using KBr pellets to determine the functional groups contained [10].

2.2.3 Determination of Total Phenolic Content [11]. 1 mL standard gallic acid solution (5, 10, 15, 20 and 25 mg / L) and purple sweet potato extract samples were added with 1 mL of Folin Ciocalteau and 5 mL of 10% Na₂CO₃. measurement at the wavelength of 765 nm by using Orion Aquamate 8000 UV-Vis Spectroscopy after the sample was stored at room temperature for 1 hour.

2.2.4 Determination of Antioxidant Activities (IC₅₀) [12]. 2 mL of Purple Sweet Potato Extract (concentrations of 10, 20, 30, 40 and 50 mg/L) was added with 2 mL DPPH 0.1 M. Then measurement by Orion Aquamate 8000 UV-Vis Spectroscopy at the wavelength of 517 nm. DPPH was used as a control solution. Percent inhibition (IC₅₀) was calculated using the following equation

$$\% \text{ Inhibition} = \frac{\text{Absorbance of Standard} - \text{Absorbance of Extract}}{\text{Absorbance of Standard}} \times 100$$

3. Results and Discussion

The content of phenolic groups in a plant to impact his ability as an antioxidant. Total Phenolic Content in a plant or its extract is directly proportional to its ability as an antioxidant because the ability of phenolic compounds to form phenoxide ions by donating H⁺ ions and then binding to free radicals [13]. The highest total Phenolic Content was obtained in extraction using ultrasound technology at a temperature of 50⁰ C at 51.167 ± 0.2887 mg/g in GAE (Table 1). Total phenolic content on purple sweet potato extract derived from the content of secondary metabolites. Table 2 shows that purple sweet potato extracts were identified as containing O-C-H (phenolic) bonds, Aromatic groups, C = C (stretching of phenyl) and hydroxyl (OH) groups [14][15][16][17].

Table 1. Total Phenolic Content of Purple Sweet Potato Extract

Temperatur of Ultrasound Extraction (°C)	Total Phenolic Content (mg/g in GAE)
40	22,5 ± 0,866
50	51,167 ± 0,2887
60	23,1 ± 0,05

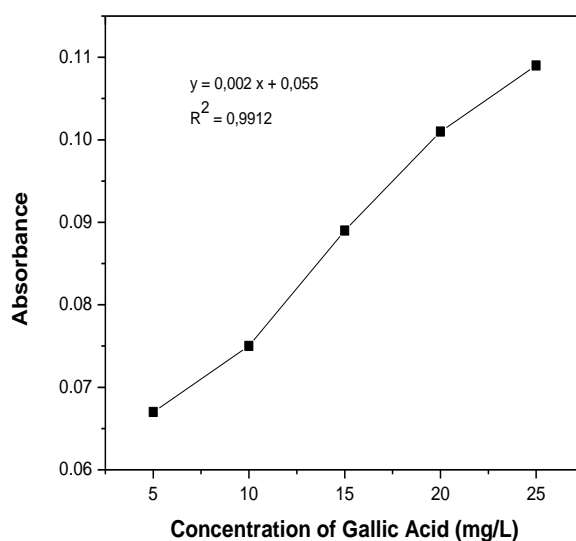


Figure 1. Gallic Acid Calibration Curves at the Various Concentrations

Characterization using FTIR (Fig. 1) obtained several functional groups, especially hydroxyl groups -OH and aromatic groups that indicate the presence of phenolic compounds (Table 2). Three extracts that were characterized showed that there were no differences in the results of FTIR characterization. This means extraction using ultrasound technology at a temperature of 40⁰-60⁰ C does not give effect to the required structure of phenolic compounds in the sample. the phenolic group is characterized by the appearance of wave numbers in the range 1295 - 1232 cm⁻¹. It was also found the presence of an alcohol group (-OH) in the wave number range 3570 - 3200 cm⁻¹ and the C = C group as phenyl in the wave number range 1657-1632cm⁻¹[14][15][16][17].

Table 2. Measurement Spectrum of Purple Sweet Potato Extract

Number of peak	Wavenumber of Extract (1/cm)			Functional Group Prediction [14][15][16][17]
	40 ⁰ C	50 ⁰ C	60 ⁰ C	
1	1267,27	1284,63	1269,20	O-C-H bending (phenolic)
2	1413,87	1415,80	1413,87	C=C-C Aromatic
3	1637,62	1645,33	1635,69	C=C stretching of phenyl
4	3437,26	3477,77	3417,98	Hydroxyl compounds (-OH)

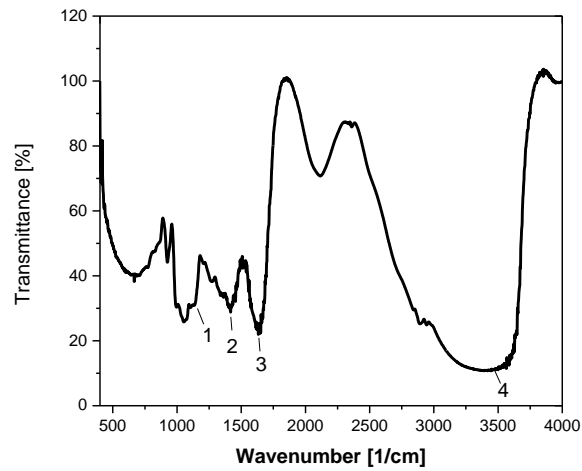


Figure 2. Spectrum of Purple Sweet Potato Extract at 40⁰C

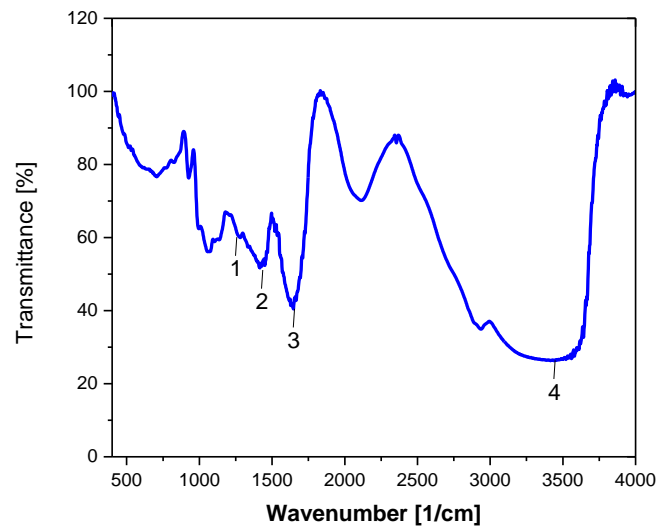


Figure 3. Spectrum of Purple Sweet Potato Extract at 50⁰C

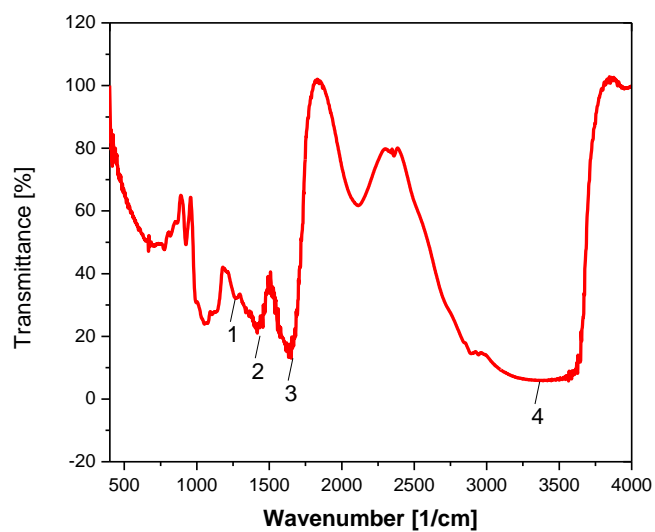


Figure 4. Spectrum of Purple Sweet Potato Extract at 60⁰C

Table 3. Antioxidant Activities of Purple Sweet Potato Extract

Temperatur of Ultrasound Extraction (⁰ C)	Antioxidant Activities (mg/L)
40	49,3473
50	26,7861
60	41,1167

Antioxidants are electron-giving chemical compounds that will inhibit an oxidation reaction by capturing free radicals and reactive molecules. Antioxidants with the ability to capture the strongest free radicals are determined by the IC₅₀ value. IC₅₀ inhibitory values < 50 are classified as strong antioxidants. The highest antioxidant value was obtained at extraction temperature of 50⁰ C with a value of 26,7861 mg/L (Table 3). The higher the total phenolic content, the antioxidant activity produced is also greater because of the large number of electron donors available to capture free radicals[18][19]. Differences in total phenolic content and antioxidant activities because of some phenolic compounds are sensitive to pH and temperature[17].

4. Conclusion

Antioxidant compounds in Purple Sweet Potatoes can be extracted using Ultrasound Assisted Extraction at temperatures of 40⁰ C, 50⁰ C and 60⁰ C with ethanol solvent. Hydroxy and aromatic groups have been identified in each extract. The best results were obtained at extraction at 50⁰ C with IC₅₀ antioxidant activities values of 26,7861 mg/L and total phenolic content of 51.167 ± 0.2887 mg/g in GAE.

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