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Instrumentation System Of Flavonoid Compounds Of Moringa Leaf Using Ultrasound Assisted Extraction (UAE)

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Abstract - In this study, a computer interface-based temperature monitoring system was built in the Moringa Olivera Lamk leaf extraction process using Ultrasound Assisted Extraction (UAE) to obtain flavonoid compounds. The extraction temperature is monitored during the extraction process. Moringa leaf extraction with UAE was carried out to see the effect of solvent volume and extraction time. The variations carried out are the volume of the solvent in the range 10-30 mL, the extraction time for 10-50 minutes. Methanol was chosen as the solvent in this study using 10 grams of Moringa leaves. Test the total content of flavonoids using UV-VIS spectrophotometry. The temperature monitoring system during the extraction process can be viewed through a computer interface programming. While the results of the extraction of flavonoids from Moringa leaves using UAE showed the best results were obtained using a solvent volume of 20 mL and extraction time of 20 minutes. The best flavonoid content obtained was 2.855 / mg Quarsetin. These results indicate that the solvent volume and extraction time affect the extraction yield of flavonoids from Moringa leaves using Ultrasound Assisted Extraction (UAE).

Keywords: Temperature Monitoring, Computer Interface, Ultrasound Assisted Extraction (UAE), Moringa Leaves, and Flavonoids.

I. INTRODUCTION

Extraction is a method used to obtain compounds in plants. Extraction is important because the compounds in a plant can be used as traditional medicine [1]. Many conventional extraction methods are often used such as maceration, soxhlet, and heat reflux [2]. There are several disadvantages of these conventional methods such as low extraction yield, long extraction time, requiring a lot of plant material, high concentration of solvents so that it has a negative impact on the environment [3].

Technological development in the extraction process aims to shorten production time, save energy, and improve product quality [4]. There are many modern extraction methods that have been used to overcome the problems of conventional extraction methods such as Ultrasound Assisted Extraction (UAE), Subcritical Water Extraction (SWE), Electric Field Pulse, and Microwave Assisted Extraction (MAE) [5]. Of these methods, the ultrasonic wave extraction method is often used in plant extraction because the Ultrasound Assisted Extraction (UAE) method can accelerate chemical processes through acoustic cavities in the material by spreading pressure waves through the liquid [6]. One of the factors that influence the extraction process is temperature. The extraction process at high temperatures can cause a decrease in the viscosity of the solvent which results in an increase in extraction efficiency.

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However, increasing the extraction temperature needs to be considered because an increase in temperature that is too high can cause damage to the extracted compounds. Therefore we need a monitoring system to monitor the temperature rise in real time during the extraction process. So that in this study a temperature monitoring system was built during the extraction process based on a computer interface. The Moringa plant is a type of plant known as The Miracle Tree because all parts of the Moringa plant have extraordinary benefits. Moringa plants can be used as a traditional medicine for various diseases such as cholesterol, diabetes, gout, high blood pressure, and even cancer [7]. In addition, Moringa leaves also contain antioxidants such as flavonoids in the form of terpenoids which are very effective and safe in reducing blood glucose levels [1] [8].

Therefore, Moringa leaves can be used as a drug for diabetes mellitus. The flavonoid compounds in Moringa leaves can be obtained by extraction [4]. The extraction process of Moringa leaves still uses conventional methods so that the results of the extracted compounds are not optimal. Therefore, this study used the Ultrasound Assisted Extraction (UAE) method to extract the flavonoid content of Moringa leaves by varying the volume of solvent and extraction time.

II. Material And Metode

Ultrasonic Assisted Extraction (UAE) is a method of extraction assisted by ultrasonic waves. The ultrasonic method is a method that uses ultrasonic waves, namely acoustic waves with a frequency greater than 16-20 kHz. Ultrasound is non-destructive and non-invasive, so it can be easily adapted to various applications. One of the benefits of the ultrasonic extraction method is to speed up the extraction process.

The way the ultrasonic method works in extracting is that the ultrasonic waves generated by the transducer are fired into the extracted material. there is a dual effect produced, namely disrupting the cell walls thus freeing the content of the compounds present in them and local heating of the liquid and increasing the diffusion of the extract. The kinetic energy in the extracted material is passed to all parts of the liquid, causing cavitation bubbles to appear. Its mechanical effect is to increase the penetration of the fluid to the cell membrane wall, support the release of cell components, and increase mass transfer [9]. Ultrasonic cavitation generates a fracture force which breaks the cell wall mechanically and increases material transfer [10]. Fig. 1 shows a diagram of the constructed UAE extraction system. The system is built using hardware and software. The hardware consists of an ultrasonic generator, a piezoelectric transducer, a microcontroller and a temperature sensor, while the software is a data acquisition program using the Delphi and Arduino IDE.

The extracted Moringa leaves are mashed so that they become a powder. 10 grams of Moringa leaf powder are mixed with the selected solvent, namely methanol with a volume of 10-30mL. The mixed material is put into the reactor for the extraction process. The extraction time used is 10-50 minutes. The extraction results were analyzed using UV-VIS spectrometry to determine the content of flavonoids. The analysis was carried out to see the effect of each variation applied.

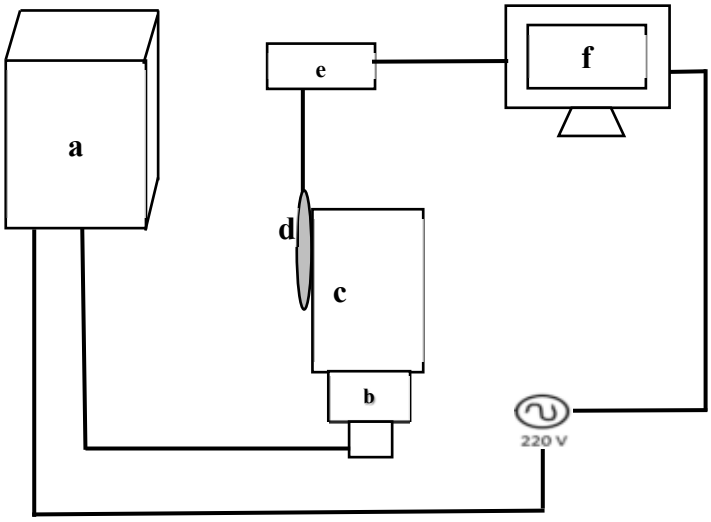

Figure 1. UAE System Design. a: ultrasonic generator, b: transducer, c: reactor tube, d: temperature sensor, e: microcontrpler, f: computer.

The temperature sensor is a sensor that is used to measure the temperature during the extraction process. The temperature sensor converts the amount of heat detected into an electrical quantity so that it can detect symptoms of temperature changes based on the amount of heat detected. The temperature sensor system circuit is shown in Fig. 2.

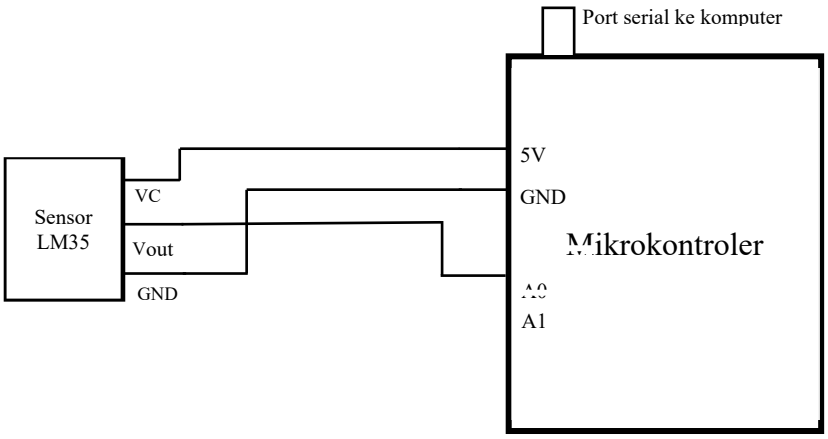

Figure 2. Circuit temperature sensor system

Computer software is used as software for data acquisition systems. This data acquisition system is used to monitor and record system conditions when the extraction process is running. One thing that is monitored in this data acquisition system is the temperature in the reactor tube. This software is connected to a sensor that has been installed in the extraction tool via a computer, so that the data read on the sensor can be sent to the data acquisition system and the data received is stored directly in the form of a txt file.

III. Results And Discussion

The first objective of this study is to build a monitoring system and data acquisition of temperature values during the extraction process. The second objective was to see the flavonoid content of Moringa leaf extract, which was extracted with the help of ultrasonic waves by applying variations in the volume of solvent and extraction time. The results of the temperature monitoring system that has been designed are shown in Fig. 3. using the computer software application.

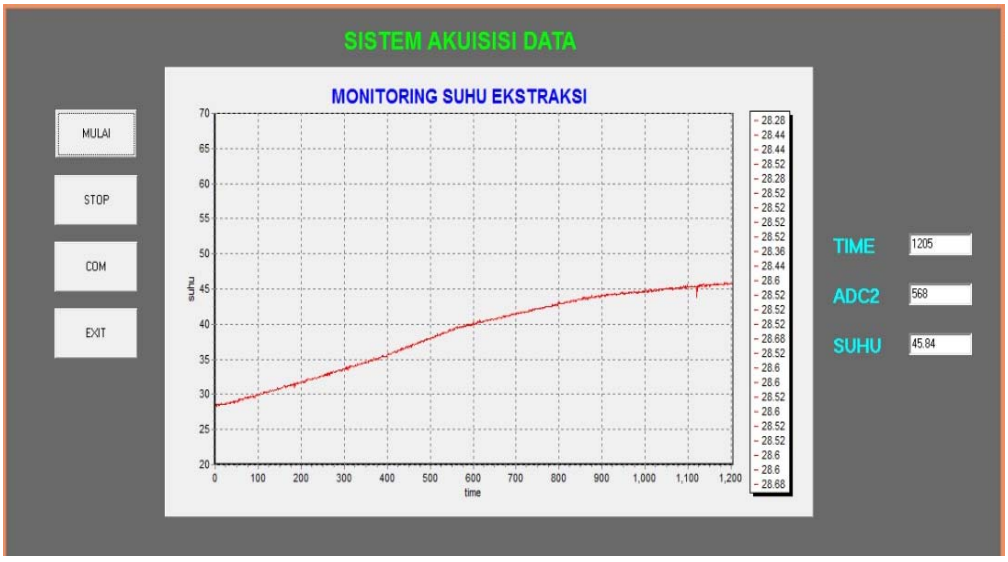

Figure 3. The results of temperature monitoring during the extraction process

From Fig. 3 it can be seen that the temperature monitoring system during the extraction process has been successfully built and is working well. The temperature rise every second can be monitored through this system. The results of data acquisition of temperature values from Fig. 3 obtained 1140 temperature value data for 20 minutes or 1200 seconds. During 20 minutes the increase in extraction temperature was from 29.33 0C to 53.50 oC. While the results of monitoring at different times are shown in Fig. 4.

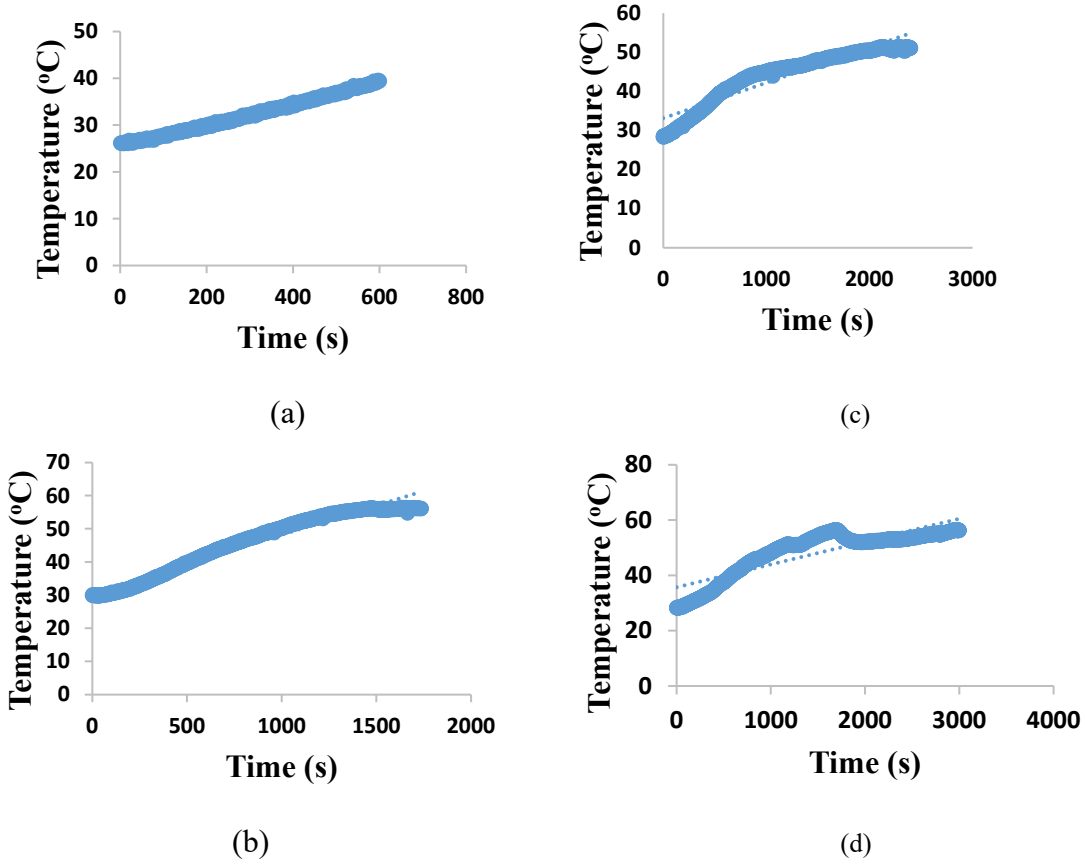

Figure 4. Graphs of temperature monitoring results with different times: 10 minutes, (b) 30 minutes, (c) 40 minutes, (d) 50 minutes.

From all the experiments that have been carried out, it is obtained a different amount of data at each extraction time that is applied. The longer the extraction time, the more data will be obtained. This is because the temperature value data is recorded every second. Every one second increase in time, the amount of data read increases by one. So that the amount of data read and stored is the same as the amount of time applied in seconds as shown in Fig. 4 (a), which is 600 data for 600 seconds. From Fig. 4 (b), the data obtained are 1738 data on temperature values for 1800 seconds. Experiment (c) obtained 2244 data for 2400 seconds. And the last one is experiment (d) obtained 2787 for 3000 seconds. From Fig. 4 it can be seen that the longer the extraction time, the higher the temperature. The highest temperature read from the results of this monitoring is 56.48 0C. The intensity of the ultrasonic waves that propagate the energy in an area per unit time [16]. The ultrasonic wave energy that propagates on the material can release the extract compound. It can also increase the temperature of the material and cause a cavitation effect.

Previous studies have shown that Moringa leaf extract contains antioxidant compounds such as flavonoids in the form of terpenoids which are very effective and safe in reducing blood glucose levels [1]. In addition, Moringa leaves contain vitamin B2 which is useful for treating dry skin, maintaining skin moisture so that regular consumption of Moringa leaves can keep the skin moist [11]. The content of flavonoids from the UV-VIS spectrophotometric test results was analyzed based on the variation in the volume of the solvent and the extraction time applied. The results of the analysis of flavonoids using UV-VIS spectrophotometry are shown in Fig. 5.

Extraction time analysis was performed by adjusting the extraction time from 10-50 minutes. Fig. 5 using 20 mL solvent shows that the content of flavonoids has increased significantly at the initial time (10-20 minutes), but begins to decline at a later time. Whereas in the use of other solvent volumes, it was seen that the flavonoid compounds had decreased at the beginning of extraction and began to increase after 20 minutes. This shows that the extraction time also affects the compounds extracted from. Excessive extraction time can damage the structure and degradation of phenolics [12]. Therefore, the optimal extraction time suitable for the extraction of flavonoids from Moringa leaves in this study was 20 minutes. Meanwhile, another study using guava leaves found the best time to get 30 minutes to get the optimum flavonoid compounds [4].

The solvent used in this research is methanol. The choice of this solvent must be in accordance with the level of polarity of the extracted compound [12] [13] in order to obtain maximum results. In addition, the volume of the solvent is also an important factor to consider, because it can affect the viscosity of the material to be extracted. In this study, the volume of solvent used consisted of three combinations, namely 10 mL, 20 mL and 30 mL. Fig. 5 shows that the use of a solvent volume of 20 mL is the best with a yield of 2.855 / mg Quarsetin.

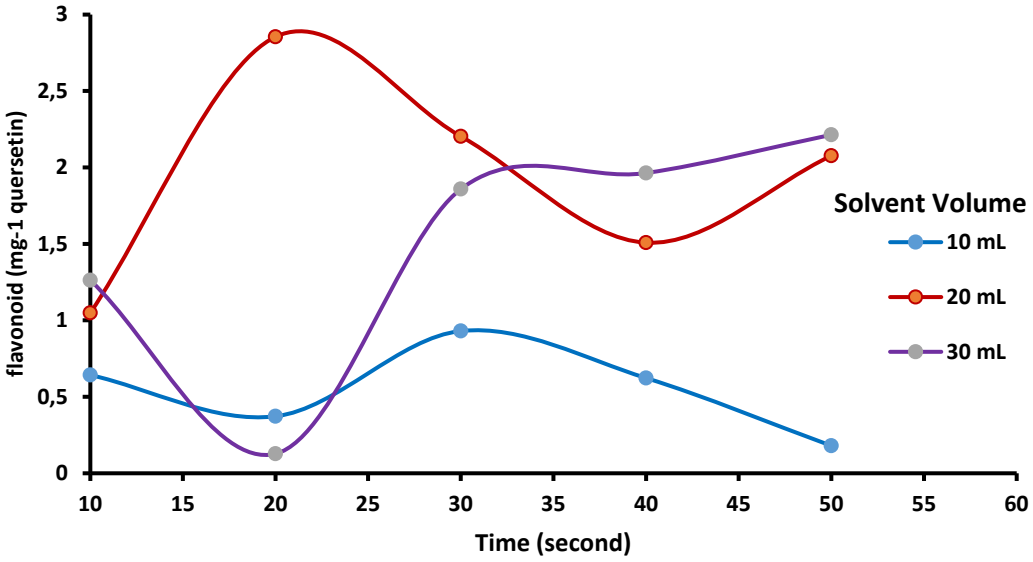

Figure 6. Effect of solvent volume and extraction time on the flavonoid content of Moringa leaf extract.

From the 15 experiments conducted, the results of the analysis showed that the optimal content of the flavonoid compounds from moringa leaf extract using ultrasonic waves was obtained by applying a combination of 20 minutes of extraction time and a solvent volume of 20 mL. From these results, the UAE can help effectively obtain flavonoid compounds from an extracted material. In addition, the use of low solvents can reduce the negative impact on the environment [3] [14]. and can make the extraction process more effective [15]. The main benefit of extraction using UAE compared to conventional extraction methods is that it can shorten the extraction time and can reduce the use of excessive solvents.

IV. Conclusion

From the results of the research that has been carried out, it can be concluded that the temperature monitoring system during the extraction process has been successfully created which is displayed through the computer application software. The optimum yield of flavonoid compound content from Moringa Oleivera L. leaf extract with UAE was 2.855 / mg Quarsetin obtained at 20 minutes extraction time and 20 mL solvent volume. The results of this study indicate that the volume of the solvent and extraction time affect the results of the extraction of flavonoid compounds from Moringa leaf extract. Meanwhile, extraction using the UAE is proven to increase the extraction yield and shorten the extraction time.

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