
Rotary Evaporator Design And Equipment Performance To Increase The Concentration Of Moringa Leaf Extract

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ABSTRACT

The process of extracting active compounds from Moringa leaves requires efficient techniques so that active compounds can be isolated in high concentrations without damaging the chemical structure. The tool commonly used is a rotary evaporator. This research analyzes the percentage of solvent evaporation using a Rotavap Extractor and a conventional rotary evaporator. Both tools aim to maximize solvent evaporation by retaining active compounds from the extract. This research compares the effectiveness of the two tools based on the percentage of solvent evaporated and the viscosity of Moringa leaf extract with different time variations (40, 60, 80 minutes). The percentage of solvent that evaporates has an important role in determining the concentration and viscosity of Moringa leaf extract. As more solvent evaporates, the extract becomes more concentrated, increasing the viscosity due to the high concentration of active compounds. The percentage of solvent evaporated and viscosity show the same trend between the conventional rotary evaporator and the rotavap extractor, this indicates that both devices work with similar efficiency in evaporating solvent from Moringa leaf extract.

KEYWORDS

Rotary Evaporator, Rotavap Extractor, Moringa olifera Extract



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INTRODUCTION

The *Moringa oleifera* leaves has long been recognized as a rich source of bioactive compounds, such as flavonoids, polyphenols, and vitamins (Nurjanah et al, 2022). These compounds possess potential antioxidant, anti-inflammatory, and various other health benefits, making Moringa leaves highly valuable in the development of health and

nutritional products (Sa’adah and Ovikariani, 2023) (Mashamaite *et al*, 2022). Moringa oleifera has many applications in the field of medicine (Susanti and Nurman, 2022).

The extraction process of active compounds from *Moringa oleifera* leaves requires efficient techniques to ensure that these compounds can be isolated in high concentrations without damaging their chemical structure. One commonly used tool in this process is the rotary evaporator (Bennour *et al*, 2020).

The rotary evaporator is designed to harness the force generated by rotation to minimize impact, ensuring smooth and efficient solvent evaporation. The modern rotary evaporator combines robust features with user-friendly operation, allowing even relatively inexperienced users to achieve quick, gentle evaporation of solvents from most samples. After the rotary evaporation process, any residual solvent can be effectively removed by exposing the sample to a deeper vacuum within a tightly sealed system, at ambient or elevated temperatures. This combination of characteristics ensures that the process remains efficient, precise, and adaptable to a wide range of applications(Gade *et al*, 2020).

This research aims to evaluate the efficiency of a specially designed rotary evaporator (Rotavap Extractor) compared to conventional rotary evaporators in enhancing the concentration of Moringa leaf extract, as well as to identify the optimal operational conditions. The findings of this study are expected to make a significant contribution to improving the extraction process, making it more effective and efficient while preserving the quality of bioactive compounds that are beneficial for health.

RESEARCH METHOD

This study employs an experimental method to determine the effectiveness of a specially designed Rotary Evaporator (Rotavap Extractor) compared to a conventional rotary evaporator, measured based on the evaporation rate of Moringa leaf extract over varying time intervals. An experiment using moringa leaf extract was conducted with a maceration method and 96% ethanol as the solvent. The resulting moringa leaf extract was then evaporated using a Rotavap Extractor and a conventional Rotary Evaporator at various evaporation times (40, 60, and 80 minutes). The data processing method aims to evaluate the percentage of solvent that evaporates, viscosity, and phytochemistry of moringa leaf extraction using a Rotavap Extractor and a conventional rotary evaporator.

Table 1. Desain Experimental method

	Rotavap Extractor	Rotary Evaporator Konvensional
Fixed variable		
Sampel (mL)	100	100
Temperature (°C)	70	70
Rate (rpm)	60	60
Independent variable		
Time (minutes)	0; 40; 60; 80	0; 40; 60; 80
Dependent variable		
Evaporated Solvent (% w/w)	Identified	Identified
Viscosity (cp)	Identified	Identified
phytochemical analysis	Identified: Alkaloid, flafanoid, tanin, saponin, terpenoid	Identified: Alkaloid, flafanoid, tanin, saponin, terpenoid

RESULT AND DISCUSSION

The process of evaporating the solvent from Moringa leaf extract is an important stage in obtaining a more concentrated extract. After the extraction process uses a solvent such as ethanol, the solvent needs to be evaporated to separate it from the active compound being extracted. The percentage of solvent evaporated can be calculated by comparing the initial mass of solvent with the mass of solvent remaining after evaporation.

This process can be carried out using techniques such as a rotary evaporator or evaporation under low pressure to minimize the risk of damage to the active compound due to heat. Optimal evaporation ensures that the resulting extract has a high and stable concentration of bioactive compounds, important in pharmaceutical and cosmetic applications. The correct solvent percentage also influences the quality and purity of the final extract, making it essential in quality control of Moringa leaf extract-based products.

The percentage of solvent that evaporates from the extract greatly affects the quality and final characteristics of the extract itself. If the percentage of solvent that evaporates is high, the resulting extract will be more concentrated because the amount of solvent remaining is less, so the concentration of the active compound will be higher. This concentrated extract is generally desired in various applications, such as pharmaceuticals or cosmetics, because it is more effective in providing the desired benefits. However, if too little solvent evaporates, the extract will become watery and the active compounds will not be properly concentrated, which can reduce the effectiveness of the extract. On the other hand, if too much solvent evaporates, the extract can become too thick or even cause degradation of the active compound if the evaporation process is not carried out properly. Therefore, controlling the percentage of solvent that evaporates is important to ensure that the resulting extract is of high quality and meets the needs of its use.

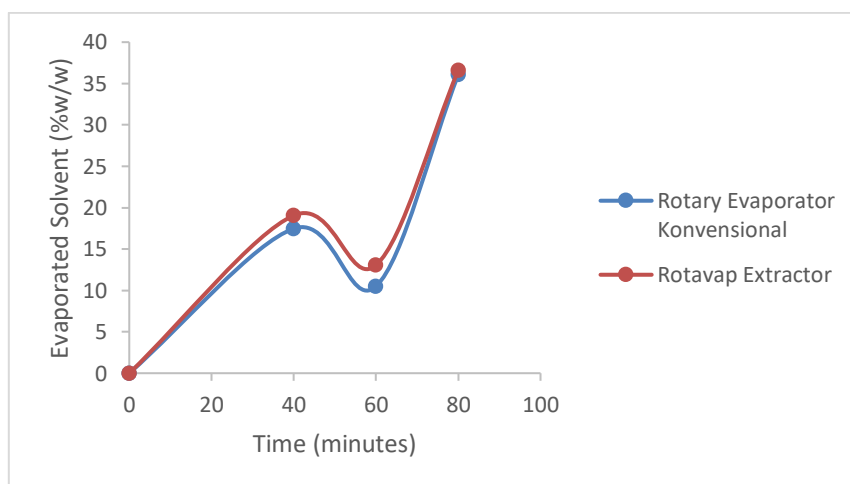


Figure 1. Evaporated Solvent (% w/w) of extract *Moringa oleifera* leaves

Evaporated solvent (% w/w) can be seen in Figure 1 which shows the same trend. The same trend could mean that at comparable temperature, pressure, and evaporation time, the percentage of solvent evaporated in the conventional rotary evaporator and rotavap extractor moves in parallel. This indicates that the evaporation efficiency and control variables of the two devices are similar, so users can choose one device based on preference or availability, without worrying about significant differences in solvent evaporation

results. If the percentage of solvent evaporated shows the same trend between a conventional rotary evaporator and a rotavap extractor, this indicates that both devices work with similar efficiency in evaporating solvent from the extract. Although there are differences in design and some technical aspects, such as pressure adjustment capabilities or rotation speed, both devices aim to maximize solvent evaporation while retaining the active compounds of the extract. However, if there is a small difference in evaporation rate, it could be attributed to specific technical factors of the respective equipment, such as pressure drop efficiency or condenser design, although the trend remains the same.

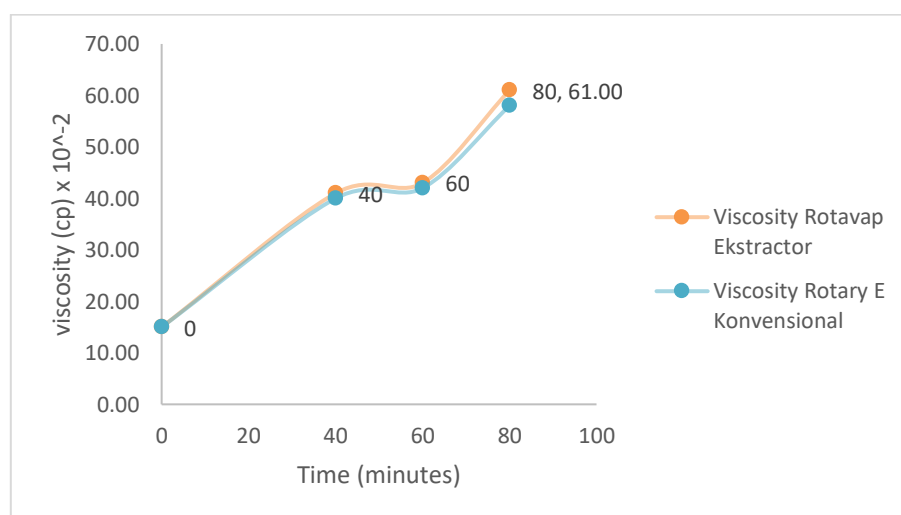


Figure 2. Viscosity (cp)x10⁻² of extract *Moringa oleifera* leaves

The amount of solvent that evaporates has a direct relationship with the viscosity of Moringa leaf extract. As more solvent evaporates, the resulting extract becomes more concentrated because the concentration of bioactive compounds increases and the amount of solvent decreases. This increase in the concentration of active compounds and soluble solids causes an increase in the viscosity of the extract, namely the texture becomes thicker and more difficult to flow. On the other hand, if the amount of solvent that evaporates is small, the viscosity of the extract will be lower because the extract still has a high solvent content, making it thinner and easier to flow. In other words, the lower the solvent content in the extract, the higher the viscosity, and conversely, the higher the solvent content, the lower the viscosity. It is important to control the amount of solvent evaporated to achieve the correct viscosity, according to application requirements. In the pharmaceutical or cosmetic industry, the proper viscosity of an extract can influence the stability, processing and effectiveness of the final product.

The viscosity trend seen in Figure 2 shows the same trend. If the extract viscosity shows the same trend between a conventional rotary evaporator and a rotavap extractor, this indicates that both devices work effectively with comparable results in terms of solvent evaporation and its effect on extract viscosity. Similar viscosity trends mean that under the same operating conditions, such as temperature, pressure and evaporation duration, both devices produce almost the same solvent evaporation rate, resulting in identical extract viscosity. In other words, although there may be technical differences in the design or setup of the two tools, the final results in terms of extract viscosity remain consistent. This shows

that both conventional rotary evaporators and rotavap extractors are able to achieve the same level of extract concentration, so users can choose one of the devices without worrying about significant changes in the viscosity or characteristics of the Moringa leaf extract produced.

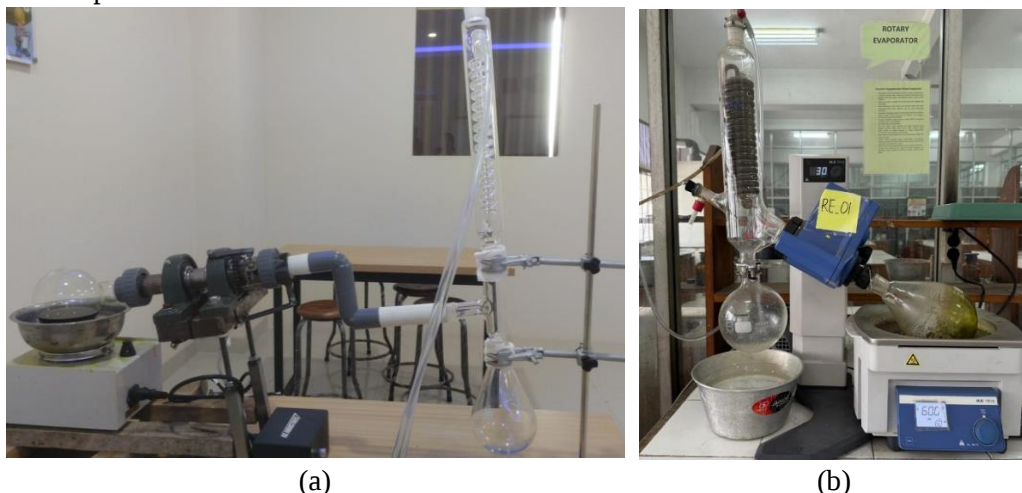


Figure 2. (a) Rotavap Extractor; (b) Rotary Evaporator Konvensional

Phytochemical test results provide important information about the chemical composition of plant extracts, which can then be used to understand their pharmacological or therapeutic potential. Based on these results, extracts that show the presence of bioactive compounds can be explored further for the development of drugs or health supplements.

Table 2. phytochemical analysis

Phytochemical analysis	Rotavap Extractor	Rotary Evaporator Konvensional
Alkaloid	Positif	Positif
Flavanoid	Positif	Positif
Tanin	Negatif	Negatif
Saponin	Negatif	Negatif
Terpenoide	Negatif	Negatif

Larasati et al, (2021) have conducted research on the extraction of Moringa leaves with various solvents. The research results showed that ethanol and methanol solvents produced more extracts than other solvents including ethyl-acetate, n-hexane and distilled water. Based on the results of UV-Vis analysis of Moringa leaf extract samples with methanol solvent, the flavanoid content was 3.4%.

The method of extracting Moringa leaves affects the total phenolic content and antioxidant activity of Moringa leaf extract. One method that has an effect is the addition of ultrasonic treatment. The antioxidant activity and phenolic content of Moringa leaf extract using the ultrasonic method was at a value of 85.71 ($\mu\text{g/mL}$) antioxidant and 82.87 (mg/g GAE) phenolic content (Verawati et al, 2020).

Susanty et al, (2019) conducted an experiment by comparing several methods of extracting Moringa leaves with maceration, percolation, soxhletation, ultrasonic extraction

and boiling. The experimental results showed that the soxhletation method produced the highest flavonoid levels, reaching 98.3 mg/kg.

CONCLUSION

The percentage of solvent that evaporates has a significant influence on the concentration and viscosity of Moringa leaf extract. The higher the percentage of solvent that evaporates, the more concentrated the resulting extract, increasing the concentration of active compounds and viscosity of the extract. Conversely, if less solvent evaporates, the extract will be more diluted with a lower concentration of active compounds. This trend applies to both conventional rotary evaporators and rotavap extractors, both of which work effectively to evaporate solvents with comparable results. If operating conditions, such as temperature and pressure, are set equally, both devices will produce similar trends in terms of solvent evaporation, concentration, and extract viscosity. This shows that the performance of the two tools in the process of evaporating Moringa leaf extract is not significantly different, so it can be chosen according to operational needs without sacrificing the quality of the extract produced.

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