e-GiGi 2024; Volume 12, Nomor 2: 221-226
DOI: https://doi.org/10.35790/eg.v12i2.49572
URL Homepage: https://ejournal.unsrat.ac.id/index.php/egigi

Effect of Solvent Type on the Amount of Yield from Maceration of Moringa Plants (*Moringa oleifera*)

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Received: July 17, 2023; Accepted: December 28, 2023; Published online: December 30, 2023

Abstract: The use of herbal plants in the field of dentistry has begun to be widely studied, but it is still not widely developed. One of the uses of herbal plants is to make them as raw materials for mouthwash. Moringa plant (*Moringa oleifera*/Mo) is an herbal ingredient that qualified as an alternative antibacterial agent. The type of solvent, extraction temperature and extraction duration are some variables that can affect the extraction yield, but the dominant type of solvent for the extraction of herbal plants, especially Mo, is still not specific. This study aimed to determine the effect of solvent types on the amount of yield of the maceration of Mo plants. This was a true experimental study using a factorial *complete randomized design* with maceration (method of extraction) on *Moringa oleifera* with variations in solvent types. The Kruskall-Wallis test showed that based on the solvent type treatment group, a significant value of 0.003 (<0.05) was obtained, meaning that there was an influence of the type of solvent on the amount of yield from *Moringa oleifera* maceration. In conclusion, the type of solvent has a significant effect on the amount of yield resulting from Mo maceration.
Keywords: *Moringa oleifera*; type of solvent; maceration

INTRODUCTION

The use of herbal plants in the field of dentistry has begun to be widely studied, albeit, it is still not widely developed. One of the uses of herbal plants is to make them as raw materials for mouthwash. This began to be done because the continuous use of synthetic mouthwash can cause negative consequences such as tooth discoloration, bacterial resistance, and unpleasant taste so that, people need other alternatives to mouthwash with minimal side effects.[1]

Moringa plant (*Moringa oleifera/*Mo) is an herbal ingredient that qualifies as an alternative antibacterial agent.[2] According to Garga et al,[3] Mo can be used as herbal raw material for mouthwash because it has important ingredients related to antibacterial property. In particular, Mo contains tannins, alkaloids, saponins, and flavonoids which are polyphenolic compounds with the highest antioxidant potential that can inhibit bacterial cell membrane function and energy metabolism.[4]

Moringa leaf extract contains various active substances such as alkaloids, flavonoids, polyphenols, steroids and glycosides.[5] Mo leaves contain protein, beta carotene, calcium, iron, magnesium, vitamin A, vitamin C, and potassium, hence adding them to daily diet is a good idea.[6-8] Moringa plant has stems that contain active compounds namely flavonoids and polyphenols.[9] Flavonoids and polyphenols in Mo are active compounds that act as antibacterials. The Mo mechanism increases the permeability of bacterial cell walls, and the antimicrobial active components in Mo work to lyse bacteria by damaging their cell membranes.[9] Research by Zakiya et al,[10] states that its anti-inflammatory activity can play a positive role in treatment, and flavonoid chemicals found in Mo, among others, can reduce pain when wounds are swollen and bleeding.

The compounds contained in Mo can be withdrawn by an extraction. The effectiveness of Mo extraction result is determined by the amount of yield. The extraction process aims to create an equilibrium of solvent and compounds concentrations in Mo leaves cells.[11,12] The optimal solvent for the simplicia to be extracted should be used for the extraction procedure in order for the solvent to be maximally productive.[13] The compounds contained in Mo have great potential as a substitute or alternative in the field of herbal medicine. Therefore, it is necessary to conduct research on Mo extraction with the best solvent and the right method; one of the good conventional methods is the maceration method since the working technique is relatively simple.[14] Types of solvents, extraction temperature, and extraction duration are some of the variables that can affect the extraction yield.[15]

Kemit et al reported[16] reported that the yield of avocado leaf extract *(Persea americana Mill*) was particularly affected by the use of solvent types with different variations. Four types of solvents were used in their research. Based on the results, ethanol solvent treatment produced avocado leaf extract with the best yield. According to Noviyanty et al,[17] different types of different solvents affected the yield produced in maceration of red dragon fruit (*Hylocereus polyrhizus*) skin. The study used four different types of solvents. According to research findings, 95% ethanol solvent provided maximum yield value and was the optimum solvent for extracting dragon fruit skin. The type of solvent was very influential on the yield value of herbal plant extraction, but the dominant type of solvent for herbal plant extraction, especially for Mo, was still not specific.[18]

Given the background that has been studied before, the thing stated as problem topic is the type of solvent that affects the amount of yield from maceration of Mo plants, therefore, we are interested to determine the effect of solvent type on the amount of yield from the maceration of Mo plants.

METHODS

This was a true experimental study using a factorial complete randomized design with maceration extraction method on *Moringa oleifera* with variations in solvent types. Samples were Mo leaves and stems obtained from Mo vegetation at Lubuk Minturun, Koto Tangah, Padang, West Sumatra. Based on calculation with the Federer formula, a total of four samples were set per treatment group. There were six treatment groups, so that, 24 samples were needed.

In the manufacture of simplicia powder, Mo leaves and stems were cleaned using running water, so that, it was free from toxic substances and dirt, and then they were aerated slowly at room temperature so that all parts were evenly dry. After drying, the Mo samples were sort again so that the unnecessary parts were separated. Mo samples were ground into powder using a blender to expand the surface so that chemical compounds were easily dissolved in the solvent. Fine Mo powder was sifted to produce granules with a macroparticle size of 10 mesh (1-2 mm), then Mo powder was ground again using a disk mill and sifted until it got microparticle-sized granules of 100 mesh (126-149 μm).

In Mo extraction process by maceration method, the finished material was weighed and filled into the Erlenmeyer flask. Each particle-sized category of material was extracted with three different types of solvents, namely ethanol, dd H_2O, and n-Hexane. The ratio used between Mo and the solution was 1:10 (10 g simplicia: 100 ml solvent) and then stirred. Aluminum foil was applied to cover the Erlenmeyer flask, then the extraction was performed using the maceration method at room temperature for 24 hours. During the process, stirring was done once every six hours, so that the extract obtained was mixed with the solvent. Then the extract was evaporated by solvent with a rotary evaporator resulting a viscous extract which was further weighed and labeled, then the yield was calculated. The resulting extract was weighed in a container, then the weight was compared to the initial weight of the powder and then was clicked 100% with the formula:

$$\text{Yield (\%)} = \frac{B1}{B2} \times 100\%$$

B1 = Weight of the final extract

B2 = Weight of initial raw material

Research data were reviewed using a descriptive analysis approach. Anova's univariate parametric analysis was used to test the hypothesis, provided normally distributed data. The non-parametric Kruskall-Wallis method was used to evaluate the research hypothesis if the data were not normally distributed and were not homogeneous.

RESULTS

The process of making Mo yield treated with three variations of solvents used maceration method. The maceration was carried out using a ratio of material and solvent, which is 1: 10 (10 g: 100 ml), then yield analysis and statistical analysis were carried out.

Table 1 showed the analysis of maceration yield results.The highest Mo yield percentage was obtained from the combination of treatment between the particle size variable of 100 mesh and the type of solvent dd H_2O with the average treatment yielding 29.70% yield. While the lowest Mo yield percentage was obtained from a combination of treatment between a particle size of 10 mesh and an n-Hexane solvent type with an average treatment yielding 0.64% yield.

Table 1. Analysis of yield results

Samples	Solvent	Repetition	Yield (%)	Average (%)
100 Mesh	n-Hexane	1	2.84	2.93
		2	2.91	
		3	3.02	
		4	2.95	
	Ethanol	1	13.57	13.59
		2	13.45	
		3	13.65	
		4	13.70	
	dd H_2O	1	29.87	29.70
		2	29.65	
		3	29.50	
		4	29.77	

Samples	Solvent	Repetition	Yield (%)	Average (%)
10 Mesh	n-Hexane	1	0.66	0.64
		2	0.65	
		3	0.61	
		4	0.66	
	Ethanol	1	1.54	1.58
		2	1.53	
		3	1.58	
		4	1.66	
	dd H_2O	1	12.74	12.78
		2	12.62	
		3	12.77	
		4	12.99	

One important factor in choosing an effective treatment to measure the amount of extracted components in an ingredient is the test result analysis. The Shapiro Wilk normality test on the treatment of ethanol, dd H_2O and N-hexane solvent types obtained significant values of <0.05 (0.001, 0.001, 0.002 respectively), meaning that the data distribution was proved not normal. The results of the homogeneity test using the Levene test in the solvent type group obtained a significant value (0.000) <0.05, meaning that the data were not homogeneous. The use of methods to answer hypotheses using the Kruskall-Wallis nonparametric test. Based on the Kruskall-Wallis test, in the solvent type treatment group, a significant value of (0.003) <0,05 was obtained, meaning that there was an influence of the type of solvent on the amount of yield from the results of Mo maceration. So it can be concluded that the particle size of simplicia, the type of solvent and the combination of treatments have a significant effect on the amount of yield resulting from Mo maceration.

DISCUSSION

This research was initially carried out to make simplicia granules or dry powder from Mo plants measuring macroparticles and microparticles. Because the accuracy of using fine materials would make the dissolving process shorter and better, granules of different sizes were produced. Then, the Mo simplicia granules were macerated with a variation of common solvents that were not toxic or harmful.

n-Hexane solvent include non-polar solvents. This solvent has volatile properties and is stable during the dissolving process. Maceration with n-Hexane solvent resulting in the smallest average yield in this study, because this solvent is a nonpolar compound which results in weak attraction between molecules. Due to its low polarity, n-Hexane cannot produce maximum Mo yield, plus the Mo content compound is dominated by polar compounds which causes the solubility of compounds macerated with n-Hexane to be slower. n-Hexane can be used effectively for the extraction of simplicia which contains compounds that are also nonpolar because the similarity of polarity equilibrium between compounds makes the compounds easily soluble.[19]

Ethanol is a flexible and polar solvent, therefore, ethanol is excellent for pre-extraction. Maceration with ethanol solvent results in a smaller average yield than dd H_2O solvent, because solvent polarity, extracted chemicals and extracted simplicia all have a role in high solubility. Compounds with the same polarity will be more easily attracted or dissolved by solvents with the same level of polarity. The polarity of the Mo compound content is higher than ethanol which makes the solubility rate of symplysis in ethanol less fast.[18,20] Ethanol solvents have two groups that differ in polarity, namely a hydroxyl group that is polar and an alkyl group that is nonpolar. Mo has groups of compounds with high polarity, so the alkyl group in ethanol will require a longer reaction with the polarity group of Mo compounds which makes a decrease in the dissolution rate of Mo simplicia.[21]

The dd H_2O solvent is a polar solvent and purely distilled water. Maceration with dd H_2O

solvent resulting in the largest average yield in this study, because dd H_2O has a higher polarity than ethanol and n-hexane, and the characteristics of Mo compounds have the same polarity as dd H_2O. This polarity makes the dissolution rate in maceration Mo with dd H_2O solvent faster.[22] Moreover, dd H_2O solvent became the dominant solvent of ethanol solvent in this study, this is in line with research by Wicaksono et al,[23] the lower the amount of ethanol and the higher the amount of dd H_2O, the higher the yield of Mo extract. The proper level of solvent polarity used for the Mo extraction process results in many components soluble. The increasingly acidic state of the solvent causes more and more compound walls to break so that more and more yields are extracted.

CONCLUSION

The type of solvent has a significant effect on the amount of yield resulting from Mo maceration. The best combination of simplicia particle size treatment and solvent type in this study was a combination of 100 mesh (126-149 μm) simplicia microparticle size with dd H_2O solvent which produced an average yield of 29.70%.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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