STUDY OF DRYING METHODS AND EXTRACTION METHODS ON PHENOLIC CONTENCT

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STUDY OF DRYING METHODS AND EXTRACTION METHODS ON PHENOLIC CONTENCT

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Abstract

Medicinal plants contain secondary metabolites, one of which is phenolic compounds. Phenolic compounds have many pharmacological activities including antioxidant, antidiarrheal and antibacterial. This study aims to determine the effect of drying method and extraction method on phenolic content. The research is compiled based on the journals that have been collected, namely national and international journals. The results showed that the drying method and the extraction method affected the phenolic content. Obtaining the highest phenolic content will provide optimal pharmacologic activity provided by optimal drying and extraction methods. The results of the literature search show that the simplicia drying method and the extraction method affect the % yield of extracts from medicinal plant simplicia. In addition to % extract yield, the simplicia drying method and extraction method also affected the average content of total phenol in medicinal plant.

Keywords: *Drying methods, Extraction methods, Phenolic Content.*

1. INTRODUCTION

Indonesia is dubbed as the land of tropical forests because it is very rich in biodiversity. According to the World Health Organization, IUCN and WWF records, there are more than 20,000 species of medicinal plants used by 80% of the world's population. Until 2001, the Plant Conservation Laboratory, Faculty of Forestry, IPB had collected data from various research reports and literature of no less than 2039 species of medicinal plants originating from Indonesian forests. Tropical forests in Indonesia are an industry of biological diversity of medicinal plants, created in evolution over a very long time and have been related to the socio-cultural behavior of local residents. Every medicinal plant that develops naturally is the simplest unit of the natural industry that produces secondary metabolites of bioactive ingredients that are unique and not easy, and not cheap to imitate by humans.

Medicinal raw materials derived from medicinal plants require proper post-harvest control processes. Proper post-harvest control will maintain the quality of medicinal raw materials after the plants are harvested. The quality of medicinal raw materials is needed to ensure the pharmacological capabilities of the active compounds present in plants. One of the post-harvest processing of medicinal plants is drying medicinal plants into simplicia. Drying is necessary to reduce the water content in the plant material. The

presence of water in restorative raw materials is dangerous because it can cause the growth of fungi and germs that are at risk of pathogens; therefore, it needs to be avoided. However, drying medicinal plants into simplicia is also necessary and must be under controlled conditions to avoid damaging the active compounds present in the plant.

Phenolic compounds extracted from various plant sources have been shown to have various pharmacological activities. The pharmacological activity of phenolic compounds, are prevention of cardiovascular disease, anti-cancer and antidiabetic activity (Abbas et al., 2017), antimicrobial, antiviral, antioxidant, anti-inflammatory and anti-carcinogenic (Kabera et al., 2014), antidiarrheal and antibacterial (Ningsih et al., 2019).

To obtain phenolic compounds from medicinal plants, an extraction process is carried out. The extraction method greatly affects the concentration of phenolic compounds or the loss of these phenolic compounds because some simplicia can be stable and able to decompose depending on the extraction method used (Hasnaeni, Wisdawati, 2019).

Many researchers have conducted research on the effect of drying and extraction methods on the total phenol content. Therefore, it is necessary to study or review both in terms of the effect of the drying method on the total phenol content and the effect of the extraction method on the total phenol content.

2. MATERIALS AND METHODS

This discussion is carried out using the literature study method. Information collection is done by collecting information obtained from some references and scientific posts. Searching for library sources is tried directly through Google Scholar, PubMed, Sinta Ristekbrin. Some of the keywords entered are words alone or a combination of words such as the following: Phenolic Content, Optimization of extraction, Optimization of drying methods. The scope of searching data from the literature includes phenolic content, extraction method used, drying method used, method of measuring phenolic content and results. The libraries collected are libraries published and published starting from 2000-2021.

3. RESULTS AND DISCUSSION

Researchers identified as many as 320 journals. Literature selection using the PRISMA diagram resulted in 8 journals for further assessment of the quality of the journals.

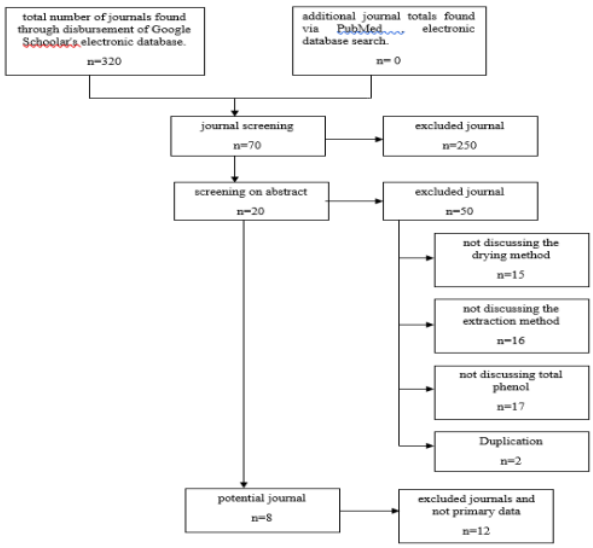

Figure 1. Literature Selection Flow Using PRISMA Diagram

Secondary Metabolites

Secondary metabolites are compounds that are not directly involved in the growth and development of an organism but play an important role in self-protection. In addition, these secondary metabolites greatly affect the relationship of organisms with the surrounding environment, for example, in protecting themselves from pests that can interfere with their survival. These secondary metabolites are produced in a limited way by plants because they are not essential; these compounds are only produced at certain times. This compound is produced as a plant's survival from the surrounding environment. There are several classifications of these compounds, namely alkaloids, flavonoids, terpenoids, and polyphenols.

Phenolic Compound

Phenolic compounds have a characteristic general structure in the form of an aromatic ring with the substitution of one or more hydroxy groups, causing them to tend to dissolve in water. Some of the compounds that are included in the phenolic group are flavonoids, phenylpropane, quinones and anthocyanins, and these phenolic compounds often appear in the form of glycosides. It has been previously reported that the presence of this group of compounds greatly affects the antibacterial and antioxidant activity (Harborne, 1998).

The mechanism of antibacterial activity, phenolic compounds and their derivatives can inactivate enzymes and consequently lead to cell balance problems. At large concentrations, phenolic compounds have toxin activity in protoplasm by depositing cell proteins and can damage by penetrating cell walls and causing cell leakage (Wirasisya, Juliantoni and Hajrin, 2018).

Standardization of Drug Raw Materials

Improving the quality, safety and efficacy of Indonesian natural medicines is carried out by standardizing the raw materials, either in the form of simplicia or in the form of extracts or galenic preparations. One aspect that affects the quality is the drying process of medicinal plants. Therefore, a literature review is needed to ensure the optimum conditions for drying medicinal plants into good quality Simplicia (Rivai, Nurdin and Suyani, 2010).

Simplicia Drying

Wind dry

Before being dried, the parts of medicinal plants are washed thoroughly using running water, chopped, and air-dried for several days. Next, the samples were dried. After drying, simplicia is powdered and stored in a dry and non-humid environment.

Indirect Sunlight

Medicinal plants used can come from leaves, wood, fruit, and so on. After that, the medicinal plants are washed thoroughly and the chopping process is carried out. The chopping process in this case is done to speed up the drying process. The drying process is covered with a dark cloth and dried in direct sunlight (Otaviana, Kawiji and Atmaka, 2011).

Oven Temperature 25 ◦C

Medicinal plants used can come from leaves, wood, fruit, and so on. After that, the medicinal plants are washed thoroughly and the chopping process is carried out. The chopping process in this case is done to speed up the drying process. The drying process was carried out in an oven at a temperature of 25 ◦C.

Oven Temperature 35 ◦C

Medicinal plants used can come from leaves, wood, fruit, and so on. After that, the medicinal plants are washed thoroughly and the chopping process is carried out. The chopping process in this case is done to speed up the drying process. The drying process is done in an oven at a temperature of 35 ◦C.

Oven Temperature 40 ◦C

Medicinal plants used can come from leaves, wood, fruit, and so on. After that, the medicinal plants are washed thoroughly, and the chopping process is carried out. The chopping process, in this case, is done to speed up the drying process. The drying process was carried out in an oven at a temperature of 40 ◦C.

Oven Temperature 50 ◦C

Medicinal plants used can come from leaves, wood, fruit, and so on. After that, the medicinal plants are washed thoroughly and the chopping process is carried out. The chopping process in this case is done to speed up the drying process. The drying process is carried out in an oven at a temperature of 50 ◦C.

Oven Temperature 60 ◦C

Medicinal plants used can come from leaves, wood, fruit, and so on. After that, the medicinal plants are washed thoroughly and the chopping process is carried out. The chopping process in this case is done to speed up the drying process. The drying process is carried out in an oven at a temperature of 60 ◦C.

Extraction

Extraction is the process of withdrawing the active compound or substance from a combination of solids and/or solutions by using a special solvent. Extraction is an important early stage in medicinal plant research, because the preparation of extracts in medicinal plants is an early stage aimed at the withdrawal and purification of chemical compounds present in plants (Febrina, Rusli and Muflihah, 2015).
The extracted compounds contain soluble active compounds and insoluble active compounds such as fiber, carbohydrates, proteins and others. The active compounds contained in various simplicia can be classified into several groups, namely essential oils, alkaloids, flavonoids, phenols and others (Alan Kuspendy, Anita Faoziyah, 2017).

Maceration

Simplicia powder was extracted by maceration method. The principle of maceration extraction is the extraction of the active substance which is carried out by immersing the simplicia powder with a suitable solvent. Then the maserate was evaporated until a thick extract was obtained and the extract yield was calculated (Supriningrum, Fatimah and Wahyuni, 2018).

reflux

The simplicia powder was put into a 1000 mL round bottom flask, added 1500 mL of solvent, refluxed at 40°C for 3 hours, removed and filtered. Then it is concentrated using a rotary evaporator (Hasnaeni, Wisdawati, 2019).

Soxhletation

The simplicia powder which has been wrapped in filter paper, is put into the Soxhlet apparatus, after which the solvent is added in a certain ratio. The soxhletation method was carried out at a temperature of 40°C. The extraction time is carried out until the solvent in the tool is full, or hereinafter referred to as 1 cycle. The liquid extract obtained was then concentrated using a rotary evaporator. The above steps were repeated by changing the extraction time for 2, 3, 4 and 5 cycles (Febrina, Rusli and Muflihah, 2015).

% Yield Analysis

Extract yield is information that can be used to provide an overview of how many compounds can be extracted from the extracted simplicia, where the greater the extract yield, the greater the compound that can be extracted from the simplicia (Wirasisya, Juliantoni and Hajrin, 2018). Calculation of % yield by weighing the weight of the starting material simplicia and the weight of the final extract, then calculate the yield (% w/w) .

Total Phenol Analisis Analysis

The content of total phenolic compounds in the extract solution was analyzed by the Folin-Ciocalteau reagent. Medicinal plant extract solution or gallic acid solution (standard phenolic compound) was mixed with Folin-Ciocalteau reagent and sodium carbonate solution. The combination was left for 15 minutes and the content of phenolic compounds was analyzed by measuring the absorption at a wavelength of 765 nm with a UV-Vis spectrophotometer. Standard curves were made using standard solutions of gallic acid with concentrations of 25, 50, 75, 100 and 125µg/mL in methanol-water (1:1). The content of total phenolic compounds is expressed in milligrams of phenolic compounds equivalent to gallic acid per gram of dry simplicia (milligrams/gram) (Rivai, Nurdin and Suyani, 2010).

Determination of the total phenol content was carried out using the Folin-Ciocalteu reagent with gallic acid as a comparison. Gallic acid is used as the standard because this compound is very efficient in forming complex compounds with Folin-Ciocalteu reagent. The formation of these complex compounds is due to gallic acid having a hydroxyl group and conjugated double bonds in each benzene ring. The phenolic-hydroxy group reduces the heteropoly acid (phosphomolybdate-phosphotungstate) present in the foline reagent to a molybdenum-tungsten complex in the form of a blue color that can be found with a UV-Vis Spectrophotometer. The accumulation of Na2CO3 plays a role in alkalizing the state of the solution so that proton dissociation occurs in phenolic compounds into phenolic ions (Hilma, Putri and Lely, 2021).

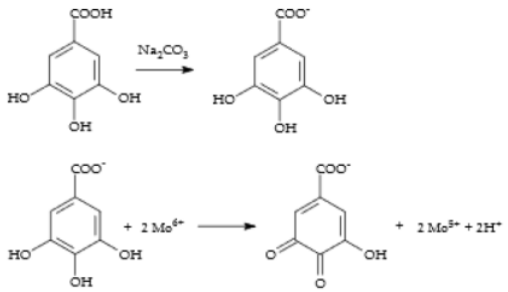

Figure 2. Gallic Acid Reaction with Folin Reagent

The drying of medicinal plants, the heat received or the temperature at different drying methods will produce different contents. Drying with direct sunlight with temperatures ranging between 28- 45 ◦C allowing the formation of degradation of phenolic compounds. This condition causes the low content of phenolic compounds. Phenolic compounds can be degraded due to the influence of pH, temperature and light. Drying with indirect sunlight can maintain the content of phenolic compounds because sunlight does not directly hit the simplicia so that the temperature exposed to the material can be lower than drying in direct sunlight. This lower temperature causes the content of phenolic compounds to be more maintained than drying in direct sunlight. Direct sunlight drying can lead to the formation of degradation of phenolic compounds due to the influence of direct ultraviolet light followed by pale color in simplicia. Not only that, simplicia from sun-drying either from morning to noon or from morning to evening has a darker brownish color (Otaviana, Kawiji and Atmaka, 2011).

Table 1. Average Total Phenol Due to Effect of Drying Method

Number	Plant Part	Drying Method	% Yield	% Average Phenol

1	Ashitaba Leaf Stem (*Angelica keiskei)*	Oven temperature 60 ◦C	17.25	2.98
		Direct sunlight	9.28	1.72
2	Ciplukan leaves (*Physalis angulate L*)	Wind dry	27	6.3
		Oven temperature 50 ◦C	22	4.8
		Fresh	4	5.3
		Indirect sunlight	28	9.8
3	God's Leaf (*Gynura pseudochina* (L.) DC.)	Microwave	33.3	0.016
		Oven temperature 25 ◦C	18.5	0.04
		Oven temperature 40 ◦C	20.8	0.02
		Oven temperature 60 ◦C	19.5	0.016
		Fresh	24.9	0.076
4	*Longan* Leaves (*Dimoncarpus longan Loour*)	Fresh	9.38	7.821
		Direct Sunlight	9.67	10,757
5	Temulawak rhizome (*Curcuma xanthoriza*)	Oven temperature 35 ◦C		2,321
		Direct sunlight		1.068

Drying using an oven has the advantage that the heating temperature in the oven is more thorough and the resulting temperature rotation is more perfect so as to optimize the drying process. The drying method using an oven is a good method for simplicia phytochemical content, not only can it be completed in a short time, but also the temperature used can be monitored. The temperature used to dry the simplicia material uses an oven between 30°C to 90°C with an optimum temperature of 60°c (Supriningrum, Fatimah and Wahyuni, 2018).

Increasing the temperature used in the drying process will affect the decreasing content of phenolic compounds as well. But in most previous studies, a greater phenolic content obtained in the method of drying at temperatures greater is 40 to 60 ◦C by using an oven. Drying by the sunlight method at low temperatures (26-30 ◦C) but in a fairly long drying time will cause catabolic enzyme activity to still run, therefore it reduces the content of secondary metabolites, including phenol (Wirasisya, Juliantoni and Hajrin, 2018).

The results of oven drying have the lowest total phenol content compared to other drying methods. This is because the high and continuous heating temperature can damage the phenolic compounds, which are not heat resistant. The results of wind drying have a higher total phenol content than the oven but lower than the indirect sun. This is because the higher the temperature and the longer the drying time can reduce the total phenol content in the drying sample. The condition of the sample during wind drying is that the drying temperature is lower than oven drying, but the drying time is longer than indirect sun drying, so the total phenol content of the sample wind drying is in between indirect sun drying and oven. The results of the total phenol content of fresh samples showed lower yields than indirect sunlight. Several studies also reported that fresh samples had lower phenol levels than dried samples. This is related to the extraction process. The extraction process on phenolic compounds, including flavonoids, will be optimal if the cells in the leaves have been damaged. Cells can be damaged through drying; thus the yield of the dried extract, which is greater than that of the fresh sample, will also contain more phenolic compounds.

The results of indirect sun drying showed the highest total phenol content compared to other drying because the use of black cloth in indirect sun drying could maintain the presence of phenolic compounds. This is supported by research on meniran plants which showed the results that the levels of

flavonoid compounds that were dried using direct sunlight were smaller than if they were dried using indirect sunlight (Pujiastuti and Saputri, 2019).

Drying in direct sunlight is the most economical and simple drying method, but it has drawbacks, it can cause leaves to lose color, taste and content (nutrients) when exposed to ultraviolet light directly because temperature control during exposure to sunlight is difficult (Amedorme *et al.* ., 2013). Oven drying is a drying method that is widely used today for the purpose of analyzing the content in organic simplicia, in addition to not requiring a lot of special equipment, this method is faster than drying with direct sunlight (Arifiyana and Dipahayu, 2018).

The drying process can open the cell walls of the extracted plant so that a lot of phenol content is extracted. Not only that, the water and moisture content that is still large in plant simplicia can cause the loss of phenolic compounds through a large enzymatic degradation process in plant simplicia as well. By carrying out drying, the water content in the simplicia will decrease and this process affects the bioactive components present in the simplicia. Optimal drying will create a long-lasting quality of simplicia in the storage process and does not change the content of the active ingredients in the simplicia (Samosir, Tafzi and Indriyani,

Table 1. Average Total Phenol Due to Effect of Extraction Method

Number	Plant Part	Extraction Method	% Yield	% Average Phenol
1	Beta-Beta Trunk (*Lusia amara blanco*)	Maceration	2,352	6.6548
		Reflux	1,611	7.3654
		Soxletation	0.96	7.4806
2	Bay Leaf (Syzygium polyanthum (Wight) Walp.)	Maceration	4.16	1.1
		Soxletation	18.8	2.8
3	Corn cobs (*Zea mays L*)	Maceration	7.83	0.0312
		Reflux	13.17	0.0397

Solid-liquid extraction carried out using hot and cold methods. Maceration represents the cold way while Soxhlet and reflux represent the hot way. The reason for choosing maceration, reflux and Soxhlet is because it has many advantages over other methods. The main advantage of the maceration extraction method is that the procedures and equipment used are simple, this method is not heated so that the natural ingredients it contains do not decompose. Cold extraction allows many compounds to be extracted, although some compounds have limited solubility in the extraction solvent at room temperature, while the hot extraction method (Soxhlet and reflux) has the advantage of using less solvent (efficient material), faster time used, sample which is extracted perfectly because it is done repeatedly.

The maceration method is a cold extraction method and this method is the simplest where the liquid filter will penetrate the plant cell wall and will enter the cell cavity containing the active substance, so that the active substance which is the concentrated solution will be forced out of the cell due to the difference in concentration between the solute solution. active inside the cell and outside the cell (Wahyulianingsih, Handayani, S., & Malik, 2016).

The reflux method is an extraction method with the help of heating. The thing that greatly affects the extraction using reflux is the addition of heating and the solvent used will remain fresh because of the re-evaporation that is submerged in the material. Reflux extraction is used to extract materials that are resistant to heating and have a rough texture such as stems, seeds, roots.

The soxhlet method is a hot-cold extraction method. In this extraction, the solvent and sample are placed separately. The principle is that the extraction is carried out continuously using a relatively little

solvent. When the extraction is complete, the solvent can be evaporated so that the extract will be obtained. Usually, the solvents used are solvents that are volatile or have low boiling points. (Hasnaeni, Wisdawati, 2019)

Several studies produced the highest percentage yield of simplicia extract using the Soxhlet method compared to the maceration method. This is because the Soxhlet extraction method always uses a solvent that is always new which is generally carried out with special tools so that continuous extraction occurs with a relatively constant amount of solvent in the presence of reverse cooling. Thus the solvent used will experience circulation compared to the maceration method (Febrina, Rusli and Muflihah, 2015).
The yield results have something to do with the active compounds from a sample so that if the amount of yield increases, the number of active compounds contained in the sample also increases. Harbone (1987) reported that the high amount of yield produced indicates the high active compound contained in a sample.

CONCLUSION

The literature search results show that the simplicia drying method and the extraction method affect the % yield of extracts from medicinal plant simplicia. In addition to % extract yield, the simplicia drying method and extraction method also affected the average content of total phenol in medicinal plant sim.

AUTHORS' CONTRIBUTIONS

Authors collaborated with each other in completing this article.

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