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The Effect Of Drying Method On The Yield Of Kecombrang Leaves *(Etilngera Elatoir)* Using The Maceration Method With 70% Ethanol Solvent

Pengaruh Metode Pengeringan Terhadap Hasil Rendemen Daun Kecombrang (*Etilngera Elatoir)* Menggunakan Metode Maserasi Dengan Pelarut Etanol 70%

Tuti Alawiyah[1], Dwi Yuliani[2]

[1,2] Mitra Karya Mandiri Polytechnic

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Correspondence:
Tuti Alawiyah
tutial761@gmail.com

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Abstract

Kecombrang leaves *(Etlingera elatior)* have potential as traditional medicinal materials due to their secondary metabolite content, which exhibits antioxidant and antibacterial activities. Drying is an important step in the processing of plant simplicia. This study aimed to determine the effect of different drying methods (sun drying, drying cabinet, and shade drying/room temperature) on moisture loss and extract yield of kecombrang leaves using the maceration method with 70% ethanol as the solvent. This study employed a completely randomized design with 18 samples. The simplicia were dried according to each method, macerated for 3 days, filtered, and concentrated using a water bath. Data were analyzed using normality and homogeneity tests, followed by One-Way ANOVA and Post Hoc Tukey HSD. The results showed that all methods met the acceptable moisture loss requirement (<10%), with the lowest values obtained from the drying cabinet method (6.53–8.02%) and the highest from shade drying (9.67–9.99%). The highest extract yield was obtained from the drying cabinet method (12–18%), followed by sun drying (8–16%), while shade drying produced the lowest yield (4–12%). One-Way ANOVA indicated a significant difference among the drying methods (p = 0.001). Post Hoc Tukey HSD showed that the drying cabinet method was significantly different from sun drying (p = 0.031) and shade drying (p = 0.002), while no significant difference was found between sun drying and shade drying (p = 0.411).
In conclusion, the drying cabinet method is the most effective method for producing higher extract yield of kecombrang leaves.

Abstrak

Daun kecombrang (Etlingera elatior) memiliki potensi sebagai bahan obat tradisional karena kandungan metabolit sekundernya yang menunjukkan aktivitas antioksidan dan antibakteri. Pengeringan merupakan langkah penting dalam pengolahan simplisia tanaman. Penelitian ini bertujuan untuk menentukan pengaruh berbagai metode pengeringan (pengeringan matahari, pengeringan kabinet, dan pengeringan di tempat teduh/suhu ruangan) terhadap kehilangan air dan rendemen ekstrak daun kecombrang menggunakan metode maserasi dengan etanol 70% sebagai pelarut. Penelitian ini menggunakan rancangan acak lengkap dengan 18 sampel. Simplisia dikeringkan sesuai dengan masing-masing metode, dimaserasi selama 3 hari, disaring, dan dipekatkan menggunakan penangas air. Data dianalisis menggunakan uji normalitas dan homogenitas, diikuti dengan ANOVA Satu Arah dan Post Hoc Tukey HSD. Hasil menunjukkan bahwa semua metode memenuhi persyaratan kehilangan air yang dapat diterima (<10%), dengan nilai terendah diperoleh dari metode pengeringan kabinet (6,53–8,02%) dan nilai tertinggi dari pengeringan di tempat teduh (9,67–9,99%). Hasil ekstrak tertinggi diperoleh dari metode lemari pengering (12–18%), diikuti oleh pengeringan matahari (8–16%), sedangkan pengeringan di tempat teduh menghasilkan hasil terendah (4–12%). ANOVA Satu Arah menunjukkan perbedaan signifikan di antara metode pengeringan (p = 0,001). Post Hoc Tukey HSD menunjukkan bahwa metode lemari pengering berbeda secara signifikan dari pengeringan matahari (p = 0,031) dan pengeringan di tempat teduh (p = 0,002), sedangkan tidak ditemukan

perbedaan signifikan antara pengeringan matahari dan pengeringan di tempat teduh (p = 0,411). Kesimpulannya, metode lemari pengering adalah metode yang paling efektif untuk menghasilkan hasil ekstrak daun kecombrang yang lebih tinggi.

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INTRODUCTION

Indonesia is a country with high biodiversity, one of which is the kecombrang plant *(Etlingera elatior)*, which is widely utilized by the community as a food ingredient and traditional medicine[1]. Kecombrang leaves are known to contain various secondary metabolite compounds such as flavonoids, phenolics, and tannins that have the potential to be antioxidants and antibacterials[2]. This potential makes kecombrang leaves attractive to be developed as raw materials for pharmaceutical preparations based on natural ingredients. The processing of natural materials into simplicia, the drying process is an important stage that aims to reduce moisture content, prevent the growth of microorganisms, and maintain the stability of active compounds[3]. Different drying methods, such as sun drying, drying in the shade, and drying using a dryer, can have different influences on the characteristics of simplicia[4]. Differences in temperature and drying time have the potential to lead to degradation of the active compound or changes in the physical properties of the material, which can further affect the extraction results[5]. The drying process of simplicia plays a very crucial role in the herbal medicine production chain because it functions to stop enzymatic activity that can degrade active compounds, while lowering the moisture content to a minimum limit to prevent the growth of contaminant microorganisms during the storage period[6]. In addition to ensuring the chemical stability and microbiological safety of raw materials, optimal drying also changes the physical characteristics of the plant to be more fragile, thus simplifying the pollination process and maximizing the efficiency of the filtration of active substances during extraction[7].

Extraction is the process of separating active compounds from natural materials using certain solvents. The maceration method with 70% ethanol solvent is widely used because it is relatively safe, easy to apply, and able to extract polar and semipolar compounds optimally[8]. One of the important parameters in the extraction process is yield, which describes the efficiency of the extraction process and is influenced by the quality of the simplicia, the drying method, as well as the extraction conditions. Some previous studies have reported that drying methods can affect the active compound content and yield of medicinal plant extracts[9].

Research on post-harvest optimization of Etlingera elatior has been conducted by Firdhauzi *et al.* (2024)[10] and Alwi *et al*. (2025)[11], but the focus of the evaluation of the drying method is still limited to flower organs. On the other hand, Sartono *et al.* (2025)[12] have extracted the leaf part using 70% ethanol and obtained a fairly high yield (15.94%), but the simplicia used have not been evaluated based on the variety of drying methods. Although some previous studies have reported on the pharmacological activity of the kecombrang plant *(Etlingera elatior)*, most of these studies are still limited to the use of flower and rhizome parts. Research on post-harvest optimization of leaves, especially related to the effect of drying methods on extraction efficiency, is still very rare. Based on this description, this study was conducted to examine the effect of the drying method on the yield of kecombrang leaf extract (*Etlingera elatior*) using the maceration method with 70% ethanol solvent, so that it is expected to provide scientific

information as a basis for selecting the right simplicia processing method in the development of natural medicinal materials.

METHODS

Tools and Materials

This study uses the following laboratory equipment, namely, YATT® brand analytical digital scales with an accuracy of 0.01g/ 0.001 oz, Pyrex® brand beaker glass (50 mL, 100 mL, and 250 mL), maceration containers made of glass covered with Iwaki® brand filters and Whatman® No.1 filter paper, heating devices in the form of manual water baths (no brand) with a temperature range of 30–100°C; Samsung® Galaxy A-series digital camera for documentation, AND® MX-50 brand moisture analyzer with a moisture content measurement range of 0–100%, Pyrex® brand measuring cups (100 mL and 500 mL); National omega® brand blender with 220W power, GEA® brand chemical thermometer with temperature range of 10^{0C} up to 110°C; as well as porcelain cups (no brand) 50ml, 60ml 75ml and 100ml[13].

The materials used in this study include fresh kecombrang leaves (Etlingera elatior), 70% technical ethanol brand JK CARE,® Whatman® No.1 filter paper, and aluminum foil.

Classification

The following is a complete scientific classification of kecombrang plants :

Kingdom : *Plantae*

Divisi : *Magnoliophyta*

Class : *Liliopsida*

Ordo : *Zingiberales*

Family : *Zingiberaceae*

Genus : *Etlingera*

Species : *Etlingera elatior* [14]

Research Procedure

Preparation of Kecombrang Leaf Sempel *(Etilngera elatior)*

The research began with the preparation of samples in the form of fresh kecombrang leaves *(Etlingera elatior)* selected based on bright green and undamaged criteria. The sample was then wet sorted to remove impurities, washed using running water, drained, and cut to a uniform size to speed up the drying process[15].

Simplicia Drying Process

The drying process of simplicia is carried out using three different methods, namely, Drying sunlight is carried out by drying kecombrang leaves in direct sunlight at 11.00–15.00 WIB with an average temperature of ±37°C until the leaves are dry. Wind drying is carried out at a room temperature of around ±27°C without exposure to direct sunlight for 3-10 days. Meanwhile, drying using a dryer is carried out at a temperature of ±60°C for 1–2 days until a constant weight is obtained. Each drying method was carried out six times[16].

Determination of Simplisia Moisture Content

The resulting dry simplicia was then analyzed for moisture content using a moisture analyzer. Prepare the moisture analyzer tool and click the tare button on the tool. Then the simplicia sample is weighed as much as 1 gram, placed evenly on the weighing container, and then set the heating temperature (105) by the automatic stop method.

It is then analyzed until the moisture content is automatically displayed by the appliance as the drying shrinkage value[17].

Simplisia Powder Manufacturing

The dried simplicia is then mashed using a blender until a homogeneous powder is obtained. Simplicia powder was weighed as much as 5 grams and extracted using the maceration method with 70% ethanol solvent at a material-to-solvent ratio of 1:20 (b/v). The maceration process is carried out for 3×24 hours in a closed container and protected from light, with stirring every 24 hours to improve contact between the sample and the solvent[18].

Filtration and Thickening of Extracts

After the maceration process is complete, the solution is filtered using filter paper to obtain the extracted filtrate. The filtrate is then evaporated using a water bath until a thick extract is obtained.

Extract Yield Calculation

Extract yield is calculated based on the ratio of the weight of the thick extract to the weight of the initial simplicia powder and is expressed in percent (%), according to the method of determining the yield of natural material extract[19].

Data Analysis

The data obtained from this study were in the form of drying shrinkage value, simplicia moisture content, and yield of kecombrang leaf extract after drying treatment with different methods. All data were analyzed using the IBM SPSS Statistics statistical application version 26 (IBM Corp., Armonk, NY, USA) which is commonly used in quantitative research to test differences between treatments.

Data analysis begins with testing the normality and homogeneity of the data to ensure the suitability of basic statistical assumptions. Once met, the statistical test used is *Analysis of Variance* (ANOVA) one-way to determine whether there was a significant difference between the three drying methods to the response variables (drying shrinkage, moisture content, and extract yield). In ANOVA, the significance level is $\alpha = 0.05$. The P-value < 0.05 indicates a significant difference between the treatments, while the P-value > 0.05 indicates no significant difference between the drying methods[20].

RESULT AND DISCUSSION

This study aims to determine the effect of different drying methods on the yield of kecombrang leaf extract (Etlingera elatior) extracted using the maceration method with 70% ethanol solvent. The drying methods used include sun drying, shade drying, and dryer cabinets. The results of the study show that the whole drying method meets the moisture content requirements, a good requirement for drying shrinkage is less than 10%[9], with the lowest moisture content obtained in the dryer method (6.53–8.02%) and the highest in the shade drying method (9.67–9.99%). The yield of kecombrang leaf extract from each drying method can be seen in figure 1.

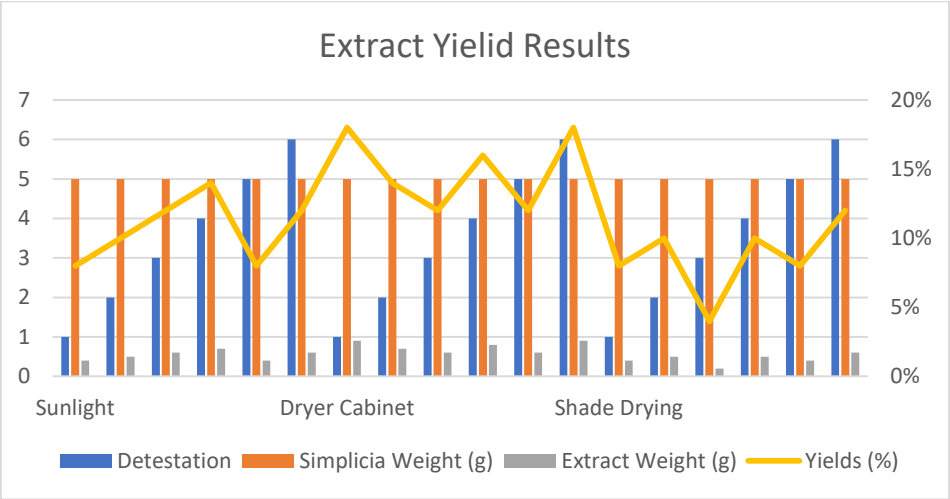


Figure 1. Yield of Kecombrang Leaf Extract Based on Drying Method

Based on the data presented in Figure 1, the average yield of kecombrang leaf extract is different in each drying method. The dryer method produced the highest average yield (15%), followed by sun drying (10.67%), and shade drying (8.67%). The difference in average values is quite clear showing that drying conditions affect the amount of extracts obtained. Drying using a dryer is carried out for 2 days at a temperature of 60°C and produces the highest yield. Stable temperatures and shorter drying times allow for more optimal moisture content reduction, thereby increasing the efficiency of the extraction process using 70% ethanol[9].

Sun-drying is carried out for 3 days at temperatures ranging from 27–31°C and results in lower efficiency than a dryer. This is likely due to uncontrolled environmental conditions as well as temperature fluctuations. Meanwhile, drying the shade is carried out for 10 days at a temperature of 22–27°C and produces the lowest yield. Longer drying times at lower temperatures are thought to lead to less effective dehydration reductions, thus impacting extraction efficiency. Therefore, the difference in temperature and length of drying time contributed to the variation in the average yield of the extract, with the dryer method showing the most optimal results in this study[21].

Table 1. Statistical test results

Perlakuan	Normalitas(p-value)	Homogenitas(p-value)	*Anova*(p-value)
SL	.415	.871	.003
DC	.191		
SD	.554		

Description :

SL : Sunlight

LP : Dryer cabinet

SD : Shade Drying

Normality test: p-value exceeding 0.05 indicates a normal distribution

Homogeneity test: p value exceeding 0.05 indicates homogeneous data

ANOVA test: p-value less than 0.05 indicates significant differences between data

Based on the results of the data analysis that has been carried out, the first stage is a normality test to find out whether the research data is normally distributed as one of the conditions for using parametric tests. The normality test was carried out using the Shapiro-Wilk test because the number of samples in each group was less than 50. The test results showed that the significance value *(Sig.)* was greater than 0.05, so it can be concluded that the data on each treatment were normally distributed[22]. The variance homogeneity test was carried out using the Levene test to find out whether the variance between treatment groups had similarities (homogeneous). Based on the results of the Levene test, a significance value of 0.871 was obtained. Since the significance value is greater than 0.05 (0.871 > 0.05), it can be concluded that the variance between treatment groups is homogeneous[23]. The results of the analysis showed an F value of 17.432 with a significance value of 0.000. Since the significance value is less than 0.05 (0.000 < 0.05), it can be concluded that there is a significant difference in mean between the treatments given. This shows that different treatments have different effects on the value produced[24].

Multiple Comparisons

Dependent Variable: Turkey HSD Value

Table 2. Results of post hoc analysis

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Sunlight	Dryer Cabinet	-4.33333*	1.52510	.031	-8.2947	-.3719
	Shade Drying	2.00000	1.52510	.411	-1.9614	5.9614
Dryer Cabinet	Sunlight	4.33333*	1.52510	.031	.3719	8.2947
	Shade Dying	6.33333*	1.52510	.002	2.3719	10.2947
Shade Drying	Sunlight	-2.00000	1.52510	.411	-5.9614	1.9614
	Dryer Cabinet	-6.33333*	1.52510	.002	-10.2947	-2.3719

Sunlight Drying Method vs Dryer Cabinet Drying Method, the average sunlight method value is lower by -4.33333 than the dryer method. This difference is statistically significant with a p value = 0.031 (< 0.05). The 95% confidence interval is in the range of -8.2947 to -0.3719, which does not go past zero, thus reinforcing the existence of a real difference[25]. Sunlight Drying Method vs Shade Drying Method, the average value of the sunlight method is higher by 2.00000 than the Shade Drying method. However this difference was not significant (p = 0.411), with a 95% confidence interval between -1.9614 to 5.9614, which passed zero. Dryer Cabinet Drying Method vs Sunlight Drying Method, the average value of the dryer method is higher at 4.33333 than the sunlight method. This difference was significant (p = 0.031) with a 95% confidence interval between 0.3719 to 8.2947, which did not go past zero[26]. Dryer Cabinet Drying Method vs Shade Drying Method, the average value of the dryer method is higher by 6.33333 than the Shade Drying method. This difference was statistically significant with a value of p = 0.002 (< 0.05). The 95% confidence interval is in the range of 2.3719 to 10.2947, which does not cross the zero mark[27]. Shade Drying Method

vs Sunlight Drying Method, the average value of the room temperature method is lower by -2.00000 than the sunlight method. However this difference was not significant (p = 0.411), with a 95% confidence interval between -5.9614 to 1.9614, which passed zero.

Shade Drying Method vs Drying Cabinet Drying Method, the average value of the Shade Drying method is lower by -6.33333 compared to the dryer method. This difference was significant (p = 0.002) with a 95% confidence interval between -10.2947 to -2.3719, all of which were below zero. Based on the results of the Post Hoc Tukey HSD test, significant differences were found in:

Sunlight vs Dryer Cabinets → Sunlight is lower

Dryer Cabinet vs Sunlight → Dryer Cabinet is higher

Dryer Cabinet vs Shade Drying → Dryer Cabinets are higher

Shade Drying vs Dryer Cabinet → Shade Drying is lower

From these results, it can be concluded that the drying method of drying the dryer produces the highest value and is significantly different from the sunlight and room temperature methods. Meanwhile, the sunlight and room temperature methods did not differ significantly from each other, so they had relatively equal but lower results than the dryer method.

Limitation

This study has several limitations that need to be considered in interpreting the results of the study. The parameters analyzed were only limited to the moisture content and yield of the extract, so they did not fully represent the overall quality and content of specific bioactive compounds of kecombrang leaf extract[28]. In addition, stability testing of active compounds during the drying process was also not carried out. In addition, the environmental conditions in the sunlight drying and shade drying methods, such as temperature, humidity, and light intensity, are not strictly controlled, which can affect the consistency of the research results[29]. This study used only one extraction method (maceration) and one type of solvent (70% ethanol), thus limiting the generalization of results to extraction methods or other types of solvents. Further research is recommended to include phytochemical analysis, stability tests, and comparisons with various extraction methods to obtain more comprehensive and representative results[30].

CONCLUSION

Based on the results of the study, the drying method affects the moisture content and yield of kecombrang leaf extract *(Etlingera elatior)*. All drying methods meet acceptable moisture content requirements (<10%); However, the dryer method produced the lowest moisture content and highest extract yield (15%), compared to sun drying (10.67%) and shade drying (8.67%). The difference in temperature and length of drying time affects the efficiency of the extraction process. Drying using a dryer for 2 days at 60°C gives the most optimal results compared to drying in the sun for 3 days (27–31°C) and drying in the shade for 10 days (22–27°C). Therefore, the dryer method is considered the most effective approach to increase the yield of kecombrang leaf extract by using the maceration method and 70% ethanol solvent.

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AUTHOR CONTRIBUTION STATEMENT

TUTI ALAWIYAH: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing—Original Drafts, Writing—Review and Editing, Visualization, Supervision, Validation.

CONFLICT OF INTEREST DECLARATION

The author states that there is no conflict of interest.

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