RiCE: Research in Chemical Engineering

Volume 2 No. 2, 2023

Journal homepage: https://ejournal.ump.ac.id/index.php/rice

Drying Methods Affecting the Antioxidant Activity of Turmeric Crude Drug

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Article Info

Submitted:
11 October 2023

Revised:
19 November 2023

Accepted:
19 November 2023

First Online:
25 November 2023

ABSTRACT

Turmeric is commonly a spice with many benefits in improving health, including antioxidants, anti-inflammatory and antimicrobial properties. The preparation of turmeric crude drug usually uses conventional sun drying. However, the quality of crude drugs is uncontrollable. The alternative using a modern drying process may affect the antioxidant properties of the final crude drug. This research aims to investigate the effect of drying methods (cabinet drying at 30°C and 70°C, infrared (IR), and conventional sun drying) on the antioxidant activity of turmeric crude drugs. The moisture content and its chemical compounds, including Total Phenolic Content (TPC) and Total Flavonoid Content (TFC), were also investigated. Antioxidant activity was measured using DPPH free radical scavenging and Feri Reducing Antioxidant Power (FRAP) method. The results showed that the moisture content of dried turmeric samples from cabinet drying at 70°C and sun drying was less than 10%. TPC of all dried turmeric from modern drying methods was significantly higher than conventional sun drying and the same as TFC results, except for the sample from the IR method. The antioxidant activity of dried curcumin from IR drying was significantly higher than that of another sample in the FRAP method. However, the higher antioxidant of dried turmeric using the DPPH free radical scavenging showed in dried turmeric from cabinet drying at 70°C and sun drying. The results of the antioxidant activity of the dried turmeric crude drug did not correlate with the TPC and TFC data as predicted using Pearson's Correlation. Thus, it can be concluded that the drying methods influenced the antioxidant activity of turmeric crude drug, and it did not correlate with phenolic and flavonoid content.

Keywords: curcumin, cabinet drying, infrared drying, DPPH, FRAP

1. INTRODUCTION

Turmeric is a golden spice obtained from the rhizome of the Zingiberene family plant *Curcuma longa* [1]. Turmeric (Curcuma domestica) is one of the natural ingredients that contains antioxidants. The active compounds are available in turmeric range from 3 to 5 percent. These active compounds include curcumin, bisdes-methoxycurcumine, desmethoxicurcumin, essential oils such as ar-turmeron (31.1%), kurlon (10.6%), curcumin (63%), turmerone (10%), starch, resin, and cellulose [1], [2]. Due to the benefits of turmeric, it has powerful antimicrobial, antifungal, anti-inflammatory, and antioxidant properties [3], [4].

The active ingredient believed to give turmeric's antioxidant activity is curcumin [1], [5]. Turmeric has been used as the main component in recipes from Bangladesh and India from ancient times for its color, flavor, and taste. It is also employed in social and religious ceremonies and Ayurvedic and folk remedies to treat a variety of disorders, such as gastric, hepatic, gynecological, and infectious diseases[6]

The curcuminoid compound is also a secondary metabolite product, which belongs to the phenolic compounds commonly found in plants of Curcuma[7]. Phenolic compounds consist of many aromatic groups of secondary metabolites of plants. Phenolic components are soluble, like phenolic acid, and insoluble, such as lignin[8].

The drying process is a post-harvest process that is very important to determine the quality of the crude drug [9]. The drying process can affect medicinal plants' chemical content and pharmacological effects, especially compounds that act as antioxidants. These include the influence on the crude drug's total phenolic and flavonoid content and antioxidant activity [9], [10].

Improper drying processes will result in loss of shape, appearance, and quality features. Since preserving thermolabile bioactive chemicals is important, a choice of drying method is required to avoid damage to bioactive components, particularly flavonoids and phenolics[11]. Thus, it is necessary to study the effects of the drying method to know the characteristics of turmeric crude drug's chemical composition and antioxidant activity.

2. MATERIALS AND METHODS

2.1 Materials

This experimental work utilizes a range of materials and equipment including java tea leaves, DPPH, ethanol, Trolox, TPTZ, CH3COONa, FeCl3, HCl, Folin Clocalteu, NaOH, gallic acid, AlCl3, Quercetin, Cabinet Dryer, IR Dryer, Incubator shaker, spectrophotometer UV-Vis, analytical balance, and various glassware.

2.2 Drying of turmeric crude drugs.

Turmeric was cleaned from the soil and washed clean until it was free from dirt and dust, then thinly chopped. The turmeric that had been chapped was then dried using conventional sun drying, drying with infrared at ambient temperature, and a cabinet dryer at a temperature of 30^{o}Cand 70^{o}C. Turmeric that had already dried was then smoothed and ground into powder. Turmeric crude drugs were ready for analysis.

2.3 Moisture content measurement

Moisture content was analyzed using the AOAC technique [12]. Approximately 1 gram of dried crude drug was placed in an empty pan, weighed, and then heated at 105 degrees Celsius for four hours. The sample was evaluated with the pan, and the dehydrating process continued until the weight remained constant.

2.4 Antioxidant activity measurement

The preparation of the analysis of antioxidants was followed by a previous study [9]. Approximately 0.4 grams of turmeric crude drug were mixed with 10 ml of ethanol 99%, and conducted the extraction process for 1 hour at 150 rpm using an incubator shaker. The extract was filtered, and the supernatant was utilized to test for further antioxidant activity and chemical analysis.

2.4.1 DPPH free radical scavenging

DPPH free radical scavenging measurement involved combining 500 µl of the supernatant with 5000 µl of a 25 µg/ml DPPH solution in an amber container. The solution was agitated and placed in an incubator for 30 minutes at ambient temperature while ensuring it was shielded from any exposure to light. The absorbance measurement was conducted with a UV-visible spectrophotometer, specifically at a wavelength of 517 nm.

2.4.2 Ferri Reducing Antioksidan Power (FRAP) analysis.

The FRAP procedure combined 210 µl of supernatant with 4000 µl of FRAP reagent. The resulting mixture was agitated and incubated for 30 minutes at ambient temperature. The absorbance measurement was conducted with a UV-visible spectrophotometer, specifically at 594 nm.

The antioxidant activity of the DPPH free radical scavenging and FRAP methods was assessed using the Trolox solution standard curve, with concentrations ranging from 0 to 400 µM. The measurement of mM Trolox equivalent (TE) per gram of crude drug was reported.

2.5 Analysis of Total Phenolic Content (TPC) and Total Flavonoid Content (TFC)

The TPC and TFC methods were conducted using the previous methods [9]. e In the TPC method, 1 milliliter of extract or standard gallic acid solution was mixed with 5 milliliters of 7.5% Folin-Ciocalteu reagent left for 5 minutes. Then, 4 milliliters of 1% NaOH were added. The absorbance of the combination was measured at 740 nm after 60 minutes at room temperature. The standard curve equation was derived from solutions containing 0-50 ppm Gallic Acid, and the TPC was represented in mg gallic acid equivalent (mg GAE)/g dry crude drug.

In the TFC method, 1.5 milliliters of ethanol, 0.1 milliliters of 10% aluminum chloride, 0.1 milliliters of 1M sodium acetate, and 2.8 milliliters of water were mixed with 0.5 milliliters of extract or standard quercetin solution. The absorbance of the combination was measured at 425 nm after 30 minutes at room temperature. The standard curve equation was derived from solutions containing 0-250 ppm Quercetin, and the TFC was represented in mg quercetin equivalent (QE)/g dry crude drug.

2.6 Data Analysis

The one-way ANOVA and Duncan's posthoc test were used to analyze and compare the impacts of drying procedures on turmeric crude drug properties such as moisture content, hygroscopicity, TFC, TPC, and antioxidant activity. The significance level was $p < 0.05$ in IBM SPSS Statistics version 26.0 (IBM, United States).

3. RESULTS AND DISCUSSION

3.1 Moisture content

The moisture content of turmeric crud drug from different drying methods is shown in Figure 1. In this research, turmeric was utilized as the chosen sample. The drying process holds significant importance as it impacts the resulting product's quality. The primary objective of the drying process is to decrease the moisture content of the raw materials, hence impeding the proliferation of microorganisms [13]. The water content of the dried powdered turmeric was quantified using the Association of Official Analytical Chemists (AOAC) method. According to the Indonesian National Standard (SNI) 01-7085-2005 for powder, the upper limit for moisture content in the crude medication is 10% for samples using cabinet drying at 70 ^{o}C and conventional sun drying [14].

3.2 Antioxidant activity of turmeric crude in different drying methods

The antioxidant activity of turmeric crude drug from different drying methods is shown in Figure 2. This result is consistent with a study conducted by Luliana et al., in which all four samples that underwent the drying process had stronger antioxidant activity on the simplicity of fresh leaves than the samples that had been treated [15]. This result is most likely related to the length of the extraction process. The cell walls remain intact in fresh cells, making it difficult for secondary metabolites to enter through the cell walls and limiting the degradation process [16].

3.3 TPC and TFC of turmeric crude drug in different drying methods

TPC and TFC of turmeric crude drug from different drying methods are shown in Figure 3. It showed that temperature and drying methods influence phenolic and flavonoid content degradation [17]. The TPC of the sample from cabinet drying at 30^{o}C is significantly higher than other drying methods. The higher temperature and longest drying will increase the sample's water evaporation rate, resulting in a better physical character of dried turmeric. On the other hand, it will degrade its chemical compounds, such as phenolic compounds [9].

The same phenomenon is shown in the TFC results. The lowest temperature gives more flavonoid content that remains in the turmeric crude drugs. The higher TFC and TPC also resulted in Java tea crude drug drying using cabinet drying at 30 C[9]. However, the result of dried turmeric from cabinet drying at 70 ^{o}C is the same as the sample using 30 ^{o}C. at higher temperatures, and it may contribute to breaking turmeric tissue, releasing flavonoid compounds outside the matrix of the bulk of dried samples.

Pearson's correlation between antioxidant activity in the DPPH free radical scavenging and FRAP method and chemical compounds, including TPC and TFC, is shown in Table 1. The results showed that the DPPH free radical activity of turmeric crude drug y has a negative correlation with TPC and TFC. In addition, the FRAP has a negative correlation with TPC. However, it has a positive Pearson's correlation with TFC but is not significantly correlated. ($p>0.05$). Thus, the antioxidant activity of turmeric crude drug is not associated with the TPC and TFC. The turmeric crude drug contains starch that will contribute to the antioxidant activity during evaporation and drying. The starch has the reducing sugar, contributing to the analysis of DPPH free radical scavenging and FRAP methods[2], [5].

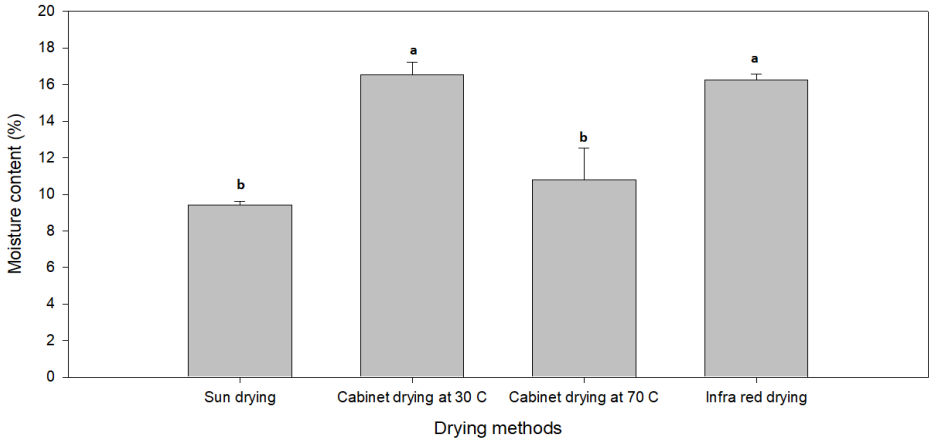

Figure 1. Moisture Content of turmeric crude drug in different drying methods

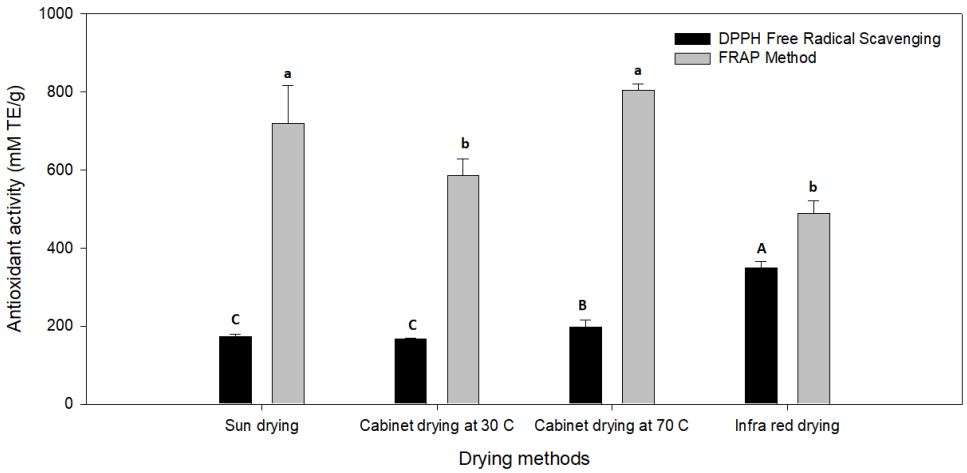

Figure 2. Antioxidant activity using DPPH free radicals scavenging and FRAP method. Different alphabets on each bar represented statistically different values, with $p \leq 0.05$

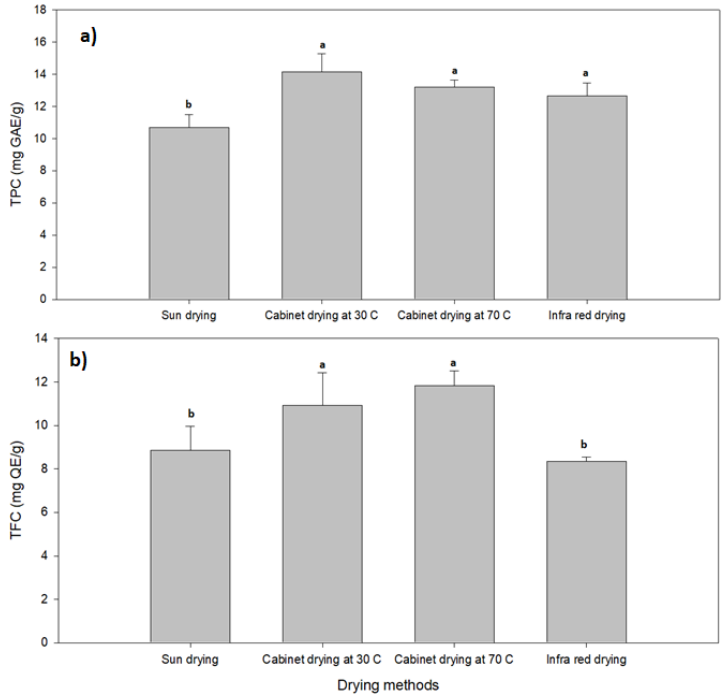

Figure 3. Total Phenolic Content (TPC) (Figure a) and Total Flavonoid Content (TFC) (Figure b) of turmeric crude drug. Different alphabets on each bar represented statistically different values, with $p \leq 0.0$

Table 1. Correlation between antioxidant content and antioxidant activity

Antioxidant content	R-value, p-value between antioxidant content and	
	DPPH	FRAP
TPC	-0.017, 0.960*	-0.247, 0.464*
TFC	-0.482, 0.159*	0.488, 0.152*

Asterix (*) represented it did not have a significant correlation at $p \leq 0.05$.

4. CONCLUSION

It can be concluded that differences in the turmeric drying method (*Curcuma domestica*) have a significant effect on the antioxidant activity measured by the DPPH free radical scavenging and FRAP techniques, as well as a moderate impact on the flavonoid content but no significant effect on the phenolic content. The optimal temperature for cabinet drying is 70 degrees Celsius, providing a high concentration of Flavonoids, phenolics, and antioxidants and having less than 10% moisture content.

ACKNOWLEDGMENT

Authors thank to financial support from DRTPM Kemdikbudristek under contract number 076/E5/PG.02.00.PL/2023; 010/LL6/PL/AL.04/ 2023; A11-III/149-S.Pj/LPPM/V/ 2023

CONFLICT OF INTEREST

No conflict of interest was reported by the author(s).

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