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The Impact of Time and Temperature of Drying on the Functional Composition of Kencur (*Kaempferia galanga)* var. Gading Powder

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ABSTRACT*: Kencur or Kaempferia galanga is a source of bioactive compounds that can be used as a functional food. One of the varieties of K. galanga in Indonesia is K. galanga var. Gading. This cultivar originates from Nogosari, Boyolali, Central Java, an area recognized for its relatively high K. galanga production. Data from the Central Bureau of Statistics (BPS) of Boyolali Regency (2024) show that the productivity of K. galanga in Nogosari District exceeds 8 tons per hectare, making this cultivar one of the promising and widely cultivated varieties in Indonesia.. K. galanga has a short shelf life due to its moisture content; therefore, drying is considered an effective method to reduce its moisture content. This research aimed to determine the effect of drying time and temperature on the quality of K. galanga powder. This research used a factorial design with two factors: drying temperature (50°C and 60°C) and drying time (4, 6, 8 hours). K. galanga was washed, sliced, dried, ground, and analyzed for its chemical and microbial properties. The chemical properties included total phenolic content and antioxidant activity, while the microbial property was evaluated based on the total plate count. The The results showed that drying temperature at 60 °C for 6 h provided the highest total phenolic content (1.45 mg GAE/100 g w.b.), with antioxidant activities respectively from the tests using DPPH 1.47 mg Trolox/100 g w.b. and 7.90 mg Trolox/100 g w.b. by ABTS, which indicated a moderate antioxidant activity. Moreover, that treatment showed a reduction of 15.93% and a total plate count of 120 CFU/g.*

Keywords: *Antioxidant activity, drying, K. galanga, total plate count*

1. INTRODUCTION

The rhizome of *Kaempferia galanga*, commonly known as aromatic ginger, belongs to the Zingiberaceae family and represents a significant medicinal plant for communities across Asia, including Indonesia (Silalahi, 2019). Due to its considerable economic value as a medicinal plant, aromatic ginger is extensively cultivated (Hasanah et al., 2011). The utilization of aromatic ginger, in both industrial and household settings, extends beyond its medicinal use to include its application as a health-rich ingredient in food and beverages (Soleh & Megantara, 2019). In developing nations like Indonesia, herbal raw materials are increasingly common due to their lower cost and abundant growth in tropical regions (Triyono, 2019). Herbal preservation are also generally perceived as safer, more effective, and having fewer side effects than chemical components in pharmaceutical formulations (Soleh & Megantara, 2019).

There are several superior varieties of *K. galanga*, namely Galesia-1, Galesia-2, and Galesia-3. Galesia-1 is characterized by its large rhizomes and positive response to fertilization. Galesia-2 has a high rhizome weight and a significant essential oil content, while Galesia-3 produces a considerably high yield of rhizomes (Triyono, 2019). In Indonesia, a *K. galanga* variety lacks scientific literature research: *K. galanga* Gading (*K. galanga* L. var. Gading) originates from Nogosari, Boyolali, Central Java. This variety originates from Nogosari, Boyolali, Central Java, an area known for its relatively high *K. galanga* production. According to the Central Bureau of Statistics (BPS) of Boyolali Regency, the productivity of *K. galanga* in Nogosari District exceeds 8 tons per hectare (BPS Boyolali, 2024).Various empirical studies indicates that aromatic ginger is therapeutic in managing conditions such as gastritis, otitis, influenza, the common cold, headache, cough, diarrhea, irregular menstruation, eye strain, and sprains (Subaryanti et al., 2020). Furthermore, Hasanah et al. (2011) documented the potential of *K. galanga* rhizomes for treating hypertension, rheumatism, and asthma. This is attributed to several compounds within aromatic ginger, such as essential oils, saponins, flavonoids, and polyphenols, which possess numerous benefits (Soleh & Megantara, 2019). In the fresh tubers of *K. galanga* contained total phenolic compound 2.97 – 5.35 mg GAE/100g w.b. with antioxidant activity 68.6 – 80.13% expressed by ABTS (Puyanda et al., 2025). *K. galanga* also contains a chemical composition consisting of 4-14% starch, 13-37% minerals, and approximately 0.02% essential oil. This essential oil comprises compounds such as cineol, methyl cinnamic acid, and pentadecane, along with synodic acid, ethyl ester, borneol, camphene, paraeumarin, abietic acid, alkaloids, and gum (Azharia & Cahyanto, 2023). However, the fresh form of aromatic ginger rhizome has a limited shelf life due to its susceptibility to physical damage and microbial contamination from its high water content.

Nevertheless, the availability and quality of fresh *K. galanga* L. var. Gading are susceptible to seasonal variations and limitations in storage conditions. The inherent high moisture content of fresh *K. galanga* L. var. Gading rhizomes restricts their longevity. It renders them prone to physical degradation and microbial proliferation (Subaryanti et al., 2020). A potential remedy for these challenges is transforming *K. galanga* L. var. Gading into a powder (Pratiwi, 2018). Converting *K. galanga* into flour helps to decrease its moisture content, thus hindering the development of microorganisms and enzymatic degradation (Ayustaningwarno et al., 2020). Moreover, *K. galanga* flour provides enhanced practicality for storage and pakaging. It is efficiently utilized in diverse food applications and instant herbal preservation (Fajriati et al., 2023). *K. galanga* flour possesses advantages in its versatility. This can be applied to food products such as cooking spices, instant beverages, and modern herbal remedies (Utami et al., 2020; Yati et al., 2022). With suitable processing methods, *K. galanga* flour can keep its distinctive scent, flavor, and medicinal benefits, which are its main strengths. This creates significant possibilities for novel herbal products sold reasonably within the country and overseas (Nasution & Siregar, 2024).

Turning *K. galanga* into flour extends its shelf life. It aims to preserve its valuable active compounds such as essential oils, flavonoids, and phenolic compounds (Lesmana et al., 2022). The drying methods must be carefully designed to avoid damaging or reducing the effectiveness of the bioactive compounds contained within the *K. galanga* rhizome. Therefore, this research aimed to determine the impact of drying time and temperature on the chemical and microbiological properties of *K. galanga* powder.

2. MATERIALS AND METHODS

2.1. Materials

The material used in this research was *K. galanga* L. var. Gading, obtained from the traditional Boyolali, Central Java market. Chemical reagents for analysis included

DPPH, ABTS, Na_2CO_3, Folin-Ciocalteu reagent, gallic acid, methanol, and Trolox PCA agar were purchased from Sigma-Aldrich.

2.2. Equipment

The equipment used included a cabinet dryer, Erlenmeyer flasks, micropipettes, test tube racks, test tubes, a spatula, a glass stirrer, cuvettes, a measuring cylinder, beakers, a moisture analyzer, tweezers, aluminum plates, a weighing balance, and a UV-Vis spectrophotometer.

2.3. Drying Conditions

The research procedure involved cleaning the K. galanga L. var. Gading rhizomes to remove dirt and slicing them into approximately equal thicknesses of ±3.5 mm. The *K. galanga* L. var. Gading slices were dried using a cabinet dryer at 50 °C and 60 °C for 4, 6, and 8 hours. The dried *K. galanga* L. var. Gading slices were subsequently ground using a grinder for 3 minutes. The resulting *K. galanga* L. var. Gading powder was then analyzed for yield, total phenolic content, DPPH antioxidant activity, ABTS antioxidant activity, and total plate count.

2.4. Analyzed Method

1. Yield Analysis Method

To determine the yield of the *K. galanga* L. var. Gading powder, the standard procedure involves comparing the mass of the *K. galanga* L. var. Gading powder produced with the initial mass of fresh *K. galanga* L. var. Gading or the *K. galanga* L. var. Gading that has been dried before the grinding process into powder. Simply put, the yield of *K. galanga* L. var. Gading powder is calculated by dividing the mass of the *K. galanga* L. var. Gading powder obtained after the grinding and sieving process by the initial mass of *K. galanga* L. var. Gading, and then multiplying by one hundred percent to get the value in percentage that can be seen in equation (1) (Septiana et al., 2016).

$$\text{Yield (\%)} = \frac{\text{Dried } K.galanga\text{(g)}}{\text{Fresh } K.galanga\text{ (g)}} x\ 100\% \quad (1)$$

2. Extraction Method

The extraction method was adopted from Puyanda et al. (2025), where five grams of *K. galanga* L. var. Gading powder were dissolved in 50 ml of heated distilled water and soaked for 10 min. The process was finished with filtration using a Whattman filter.

3. Total Phenolic Analysis

a. Gallic Acid Standard Curve Preparation

The gallic acid stock standard solution was prepared by weighing 0.004 g of gallic acid, dissolving it in 10 mL of Analytical Reagent (AR) grade methanol, and storing it in a dark bottle. Subsequently, 3.75 g of sodium carbonate was weighed and diluted using 50 mL of distilled water. Gallic acid solutions with concentrations of 0, 0.5, 0.1, 0.2, 0.3, 0.4, and 0.5 µL were then added to 2.5 mL of 2N Folin-Ciocalteu reagent and 2 mL of 7.5% sodium carbonate. The mixture was allowed to stand at 50 °C for 5 minutes and then measured at a wavelength of 760 nm (Mustafa et al., 2010 with some modifications).

b. Determination of Total Phenolic Content

Five grams of the *K. galanga* L. var. Gading sample were weighed and then diluted to 100 mL. Subsequently, 300 µL was taken and added to 2.5 mL of 2N Folin-Ciocalteu reagent, followed by 2 mL of 7.5% sodium carbonate. The sample was then incubated for 5 minutes at 50 °C and then measured at a wavelength of 760 nm (Mustafa et al., 2010 with some modifications).

4. ABTS Antioxidant Activity Analysis

For standard curve purposes, 0.006 grams of Trolox standard was weighed and dissolved in 10 mL of Pa grade methanol. Then, a dilution series of 0, 0.5, 0.18, 0.24, 0.30, 0.36, and 0.40 µL was prepared. Each solution was added to 3 mL of working ABTS reagent, then incubated for 10 minutes in the dark and measured at a wavelength of 734 nm. Subsequently, 100 µL of the sample was added to 3 mL of working ABTS reagent, incubated for 10 minutes, and measured at a wavelength of 734 nm (Dudonne et al, 2009 with some modifications)

5. DPPH Antioxidant Activity Analysis

To analyze antioxidant activity, 5 g of the sample was dissolved in 100 mL of distilled water, and then a volume of 400 µL was taken. Subsequently, a series of standard solutions was prepared with concentrations of 0; 0.12; 0.24; 0.30; 0.36; 0.42; and 0.60 ppm. Each standard solution was then reacted with 2 mL of 0.2 mM DPPH and 1.6 mL of distilled water. After incubation for 30 minutes, the absorbance of each mixture was measured using a UV-Vis spectrophotometer at a wavelength of 517 nm (Untea et al., 2018).

6. Total Plate Count Analysis

A 1 ml sample was introduced into a 10^{-1} dilution, followed by homogenization. Subsequently, 1 ml from the 10^{-1} dilution was transferred to a 10^{-2} dilution and homogenized. This process was repeated until a 10^{-5} dilution was reached. The sample underwent a serial dilution up to 10^{-5}, with a sample-to-diluent ratio of 1:9 at each step. Subsequently, plating was performed in duplicate on PCA (Plate Count Agar) media for each dilution. The samples were inoculated using the pour plate method. This involved transferring 1 ml of each dilution into sterile Petri dishes, then adding approximately 15 ml of sterile molten PCA medium. Homogenization was achieved by gently swirling the Petri dish in a figure-eight motion until the agar solidified. Finally, all Petri dishes containing the inoculated samples were incubated for 24 hours at 37°C (Sari et al., 2024).

2.5. Experimental Design

The experimental design carried out in this study was a Completely Randomized Design (CRD) using 2 factors. The first factor was the drying temperature (50 °C and 60 °C), and the second was the difference in drying time (4, 6, and 8 hours). The data obtained were analyzed using analysis of variance (ANOVA) using SPSS software. If significant differences were found, Duncan's test was conducted to determine the essential differences between treatments at a 5% significance level.

3. RESULTS AND DISCUSSION

3.1. Yield

The yield of flour from the Gading variety of *K. galanga* exhibits considerable variation depending on the drying temperature and time combination. Yield is percentation of sample after dring to the initial fresh sample (Saumi & Widyasanti, 2024). Results in Figure 1 demonstrate that the optimal yield of 63.00% was attained through drying at 50°C over 4 hours; in contrast, further extension of the drying period to 6 hours and 8 hours triggered a marked decline, producing yields of 55.32% and 18.11%, respectively. An analogous decrease was evident at 60°C, with overall yields inferior to those at 50°C: 40.12% after 4 hours, followed by a steep fall to 15.93% at 6 hours and 2.42% at 8 hours. This pattern suggests that more intensive drying conditions—characterized by elevated temperatures and extended drying periods—tend to degrade or remove specific components contributing to the flour yield, thereby reducing the final output (Warren-Walker et al., 2025).

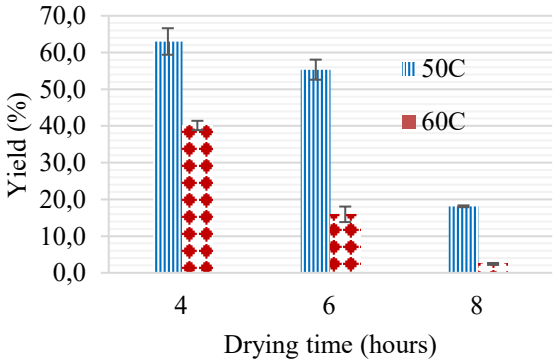

Figure 1. Yield (%) in the *K. galanga* powder

The decrease in yield (Figure 1) observed under high temperature and prolonged drying conditions is likely due to several mechanisms. These include thermal degradation of organic components such as starch, phenolic compounds, and other substances caused by extended heat exposure; evaporation of water and volatile compounds lost during the drying process; and chemical interactions or bond formations that prevent some compounds from being separated as part of the final flour (ElGamal et al., 2023; Narra et al., 2024).

Additionally, structural damage to the cells within the rhizome tissue may reduce the efficiency of material release during drying, resulting in some mass remaining in unused fractions (Zang et al., 2024).

Recent studies on herbal flour products have also reported a decrease in yield caused by drying treatments. Research by Mustofa et al. (2024) on pumpkin showed that both the pumpkin variety and drying temperature significantly affect the flour yield, with the highest yield of 14.34% obtained from the honey pumpkin variety dried at 50°C. Similarly, a study by Nasution et al. (2023) on red ginger (Zingiber officinale var. Rubrum) confirmed that higher drying temperatures reduce flour yield, with 50°C producing the best result of 17.64%. These findings indicate that increasing the drying temperature leads to cell structure damage and evaporation of essential compounds, which significantly lowers the flour yield (Mustofa et al., 2024; Nasution et al., 2023).

3.2. Chemical properties

Table 2 summarizes the chemical characteristics of *K. galanga*'s (*K. galanga* L. var. Gading) powder when subjected to different drying temperatures (50°C and 60°C) and drying times (4, 6, and 8 hours). It particularly evaluates the total phenolic compound (expressed in mg GAE/100g w.b.), antioxidant activity by DPPH method (mg Trolox/100g w.b.), and antioxidant activity by ABTS method (mg Trolox/100g w.b.).

3.3.Total phenolic compound

The largest compounds that function as natural plant antioxidants are phenolic compounds. Phenolic compounds have one (phenol) or more (polyphenol) phenol rings, which are hydroxyl groups attached to an aromatic ring. This makes the compounds easily oxidized by donating hydrogen atoms to free radicals (Dhurhania & Novianto, 2019). Total phenolic content is often used as an indicator of the antioxidant potential of a natural material, for example, in ginger plants (Jauharotus et al., 2023). This study used UV-Vis spectrophotometry and the Folin-Ciocalteu colorimetric method to determine total phenolic content. Absorbance was measured at a wavelength of 760 nm, and the results are presented in milligrams of Gallic Acid Equivalent (GAE) per 100 mg of ginger sample (Puyanda & Gibran, 2024).

Table 1 showed that the total phenolic compound in the *K. galanga* powder was significantly different between drying time and among drying temperatures. Still, there was no interaction on those factors. It indicated that the drying time and temperature affected the powder's total phenolic compound without interaction. Many phenolics are bound in the cell wall, esterified or complexed with protein, polysaccharides, etc. Heat can help disrupt cell walls or break the phenolic bond, releasing these bound phenolics into more extractible forms, thereby increasing measured TPC. Conversely, the higher drying temperature will decrease the total phenolic compounds due to the degradation reaction. Those statements were supported by Patrón-Vázquez et al. (2019), who studied the effect of drying temperature on the phenolic content and functional behavior of flours obtained from lemon wastes.

The total phenolic compound ranged between 0.053 – 1.45 mg GAE/100g w.b. in Table 2. The total phenolic compound showed that a higher drying temperature (60°C) generally increases phenolic content. At 60°C and 6 hours, the phenolic content peaks at 1.45 mg GAE/100g. Lower temperature (50°C) results in significantly lower phenolic content. Mean values suggest phenolic content is highest at 6 hours of drying. Drying at 60 °C yielded a higher measured TPC in the final powder than at 50 °C. It is similar to research conducted in *Phaleria macrocarpa* that drying at 60 °C gave higher TPC than at 50 °C, as long as the temperature stayed moderate and drying times were controlled (Stephenus et al., 2023). Phenolic compounds bound to the cell wall or matrix may get more fully released at 60 °C due to cell wall breakdown, which increases extractable phenolics. According to Cherrat et al. (2019), higher heat helps release bound phenolics and inactivate enzymes, but at the

cost of possibly degrading sensitive phenolics or aroma.

The drying time significantly differed in total phenolic compounds (Table 2). The total phenolic compound increased considerably during 4 to 6 hours of drying and decreased in 8 hours. The increasing bound phenolic can be released from 4 to 6 hours, which might partially offset losses. Meanwhile, the degradation will likely dominate in 8h drying, causing a net decline in TPC. It was similar to the study by Pham et al. (2020), which showed that TPC increased with drying time up to a certain point. Still, beyond that point, TPC decreases due to oxidation or thermal degradation. The other studies reported that *K. galanga* L. var. Gading powder has TPC 3.55 mg GAE/g d.b. (Nonglang et al., 2022) up to 50.35 mg GAE/100 g d.b (Julianti et al., 2022). This research showed that the TPC was lower than in other studies due to the different drying methods and conditions. In addition, this research showed the value in a wet basis sample.

Table 1. Test of between-subject effects

Source	Total Phenolic Compound		Antioxidant activity by DPPH		Antioxidant activity by ABTS	
	F	Sig.	F	Sig.	F	Sig.
Time	11.219	0.000	2.485	0.164	0.254	0.784
Temperature	89.712	0.000	1.334	0.292	35.020	0.001
Time*Temperature	2.719	0.144	0.174	0.844	0.635	0.562

3.4.The antioxidant activity of DPPH

The antioxidant activity by DPPH showed that 60ºC results in significantly higher antioxidant activity than 50ºC. At 60ºC and 8 hours, the antioxidant activity peaks at 1.59 mg Trolox/100g. The antioxidant activity increases with drying time. Table 1 showed that antioxidant activity expressed by DPPH was not significantly different between time and temperature. According to Julianti et al. (2022), the antioxidant activity DPPH IC_{50} in fresh *K. galanga* was 626.308 µg/ml. Moreover, the crude *K. galanga* extracted with ethanol gave antioxidant activity 26.16 µM Trolox/g using the DPPH method (Panyakaew et al., 2021). After drying, the cabinet dryer was used for 4 to 8 hours, and the antioxidant activity became 0.33 – 1.59 mg Trolox/100g w.b., expressed by DPPH. A study on coffee leaves showed that high-temperature short-time drying helped retain bioactive compounds better than lower temperature but long durations (Huang et al., 2023).

3.5.The antioxidant activity of ABTS

ABTS's antioxidant activity was higher than DPPH's (Table 2). It can be caused by the ABTS, which can accept electrons more flexibly and may detect both hydrophilic and lipophilic antioxidants, as Nonglang et al (2022) proved. Raw *K. galanga* contained 53.39 µM Trolox/g using the ABTS method (Panyakaew et al., 2021), while in the dry *K. galanga,* the antioxidant activity changed to 3.77 - 8.11 mg Trolox/100g w.b. (Table 2). The change in antioxidant activity was affected by the drying treatments. In bioactive compound studies in *K. ceratophylla,* the hot-air drying degraded phenolics compared with freeze drying (Manalu et al., 2025). This research was in line with Supriyanto et al (2024) which stated the drying process can have an effect in the antioxidant activity in the food product.

Table 2. The chemical characteristics of *K. galanga*'s powder

Temperature (ºC)	Time (hours)		
	4	6	8
Total Phenolic Compound (mg GAE/100g w.b.)			
50	$0.53^{Aa} \pm 0.04$	$0.69^{Ba} \pm 0.03$	$0.54^{Aa} \pm 0.00$
60	$0.98^{Ab} \pm 0.13$	$1.45^{Bb} \pm 0.21$	$1.03^{Ab} \pm 0.03$
Mean	$0.76^{x} \pm 0.27$	$1.07^{y} \pm 0.46$	$0.79^{x} \pm 0.28$
Antioxidant activity (mg Trolox/100g w.b.) by DPPH			
50	$0.33^{Aa} \pm 0.05$	$0.91^{Aa} \pm 0.12$	$1.45^{Aa} \pm 0.91$
60	$0.81^{Aa} \pm 0.50$	$1.47^{Aa} \pm 0.24$	$1.59^{Aa} \pm 0.67$
Mean	$0.73^{x} \pm 0.30$	$1.19^{x} \pm 0.36$	$1.52^{x} \pm 0.66$
Antioxidant activity (mg Trolox/100g w.b.) by ABTS			
50	$4.63^{Aa} \pm 0.29$	$4.98^{Aa} \pm 0.47$	$3.77^{Aa} \pm 1.11$
60	$7.62^{Ab} \pm 0.82$	$7.90^{Ab} \pm 1.45$	$8.11^{Ab} \pm 1.30$
Mean	$6.12^{x} \pm 1.80$	$6.44^{x} \pm 1.90$	$5.94^{x} \pm 2.69$

Notes: Superscript capital letter (AB) indicated a significant difference between drying time with a significant 5% using Duncan's test.Using Duncan's test, superscript lowercase (ab) indicated a significant difference among drying temperatures, with a significance of 5%. Mg GAE/100g w.b. indicates mg Gallic Acid Equivalent per 100g sample on a wet basis. Mg Trolox/100g w.b. indicates mg Trolox equivalent per 100g sample on a wet basis.

3.6. Microbial property

This study's total plate count analysis (Figure 2) showed that microbial colony numbers generally increased with higher drying temperatures and longer drying times. However, the pattern was not always linear. At 50°C for 4 hours, the total plate count was relatively low (22 CFU/g), corresponding with a low phenolic content (0.53 mg GAE/100 g w.b.). Even though the overall phenolic content was low, this does not automatically mean that antimicrobial effectiveness is diminished, since other types of polyphenols, especially flavonoids, can play a major role in antibacterial properties. As noted by Pham et al. (2020), the effects of drying conditions vary between phenolics and flavonoids. Specifically, total phenolics tend to decrease at lower temperatures, whereas flavonoids are generally more resistant to heat and maintain their biological activity. Flavonoids operate through different antimicrobial pathways than phenolics, such as altering bacterial membrane permeability, blocking enzymes, and interfering with nucleic acid production (Ecevit et al., 2022; Lobiuc et al., 2023). As a result, the notably reduced microbial levels seen at 50°C for 4 hours could partly stem from the persistence of heat-stable flavonoids, despite the low levels of total phenolics.

However, after 6 hours at the same temperature, the total plate count decreased slightly (20 CFU/g) despite increased phenolic content (0.69 mg GAE/100 g w.b.). This can be attributed to the antimicrobial properties of phenolic compounds, which can damage bacterial cell membranes, disrupt enzyme functions, and cause leakage of intracellular components, thereby inhibiting microbial growth (Ecevit et al., 2022; Lobiuc et al., 2023; Oulahal & Degraeve, 2022).

At 60°C, phenolic content increased significantly, especially after 6 hours of drying (1.45 mg GAE/100 g w.b.). Still, the TPC also tended to be higher (120 CFU/g). This suggests that although phenolic compounds act as antimicrobial agents, their effectiveness may be influenced by other factors such as tissue structure damage caused by high temperatures, the formation of heat degradation products that may serve as nutrients for microbes, or possible secondary contamination during drying. Therefore, the relationship between phenolic content and total plate count is complex: while higher phenolic levels generally reduce microbial counts, the actual outcome depends heavily on drying conditions,

residual moisture, and environmental factors throughout the process.

The total plate count results in this study (Figure 2) can be reinforced by research from Suharti et al. (2023) antimicrobial activity of *K. Galanga* againts plant pathogen. Studies on medicinal plants have shown that increasing drying temperature and time generally leads to decreased phenolic content due to thermal degradation, which results in reduced antimicrobial activity (Jiménez-García et al., 2020). This differs from the current study's findings, where phenolic content increased at 60°C up to the 6th hour, despite a higher microbial count. This situation can be explained by releasing bound phenolic compounds from the cellular matrix during heating. At the same time, tissue damage and the formation of heat degradation products may promote microbial growth (Grande et al., 2023). Another study on *K. galanga* rice drink also demonstrated that heat treatment significantly reduced microbial numbers while maintaining phenolic activity (Riyanto et al., 2023), emphasizing that the antimicrobial effectiveness of phenolics is strongly influenced by processing conditions. Therefore, the relationship between phenolic content and total plate count is complex, as it is affected not only by the concentration of bioactive compounds but also by the drying method, residual moisture content, and post-drying environmental factors.

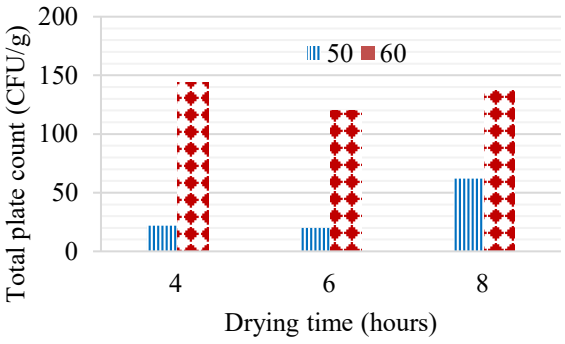

Figure 2. Total plate count in the *K. galanga* powder

4. CONCLUSIONS AND RECOMMENDATIONS

The drying time and temperature affected the chemical and microbiological quality of *K. galanga* powder. The drying temperature of 60 °C with 6 hours treatment gave the highest total phenolic content, 1.45 mg GAE/100g w.b., with antioxidant activities 1.47 mg Trolox/100g w.b. by DPPH and 7.90 mg Trolox/100g w.b. by ABTS. Moreover, that treatment showed rendemen 15.93% and a total plate count of 120 CFU/g. Hence, we suggest for analyzing the specific bioactive compound by GCMS and the antimicrobial activities in that powder.

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