Amerta Nutrition
e-ISSN: 2580-1163 (Online)
p-ISSN: 2580-9776 (Print)
Bahar et al. | Amerta Nutrition Vol. 9 Issue 1 (March 2025). 119-127

RESEARCH STUDY
English Version
OPEN ACCESS

Phytochemical Analysis of Herbal Teabags Based on Drying Temperature

Analisis Fitokimia Teh Celup Herbal Ditinjau dari Suhu Pengeringan

Asrul Bahar[1], Ita Fatkhur Romadhoni[2], Dwi Iriyani[3]*

[1]Undergraduate Program of Education, Faculty of Engineering, Universitas Negeri Surabaya, Surabaya, Indonesia
[2]D4 Tata Boga Study Program, Faculty of Vocational Studies, Universitas Negeri Surabaya, Surabaya, Indonesia
[3]Department of Biology, Faculty of Science and Technology, Universitas Terbuka, Surabaya, Indonesia

ARTICLE INFO

Received: *15-03-2024*
Accepted: *24-02-2025*
Published online: *14-03-2025*

Correspondent:
Dwi Iriyani
dwiiriyani@ecampus.ut.ac.id

DOI:
10.20473/amnt.v9i1.2025.119-127

Available online at:
https://e-journal.unair.ac.id/AMNT

Keywords:
Phytochemical Analysis, Herbal Tea Bag, Drying Temperature

ABSTRACT

Background: The potential for diversifying herbal beverages by combining mangosteen peel, red ginger, lemongrass, cherry leaves, orange leaves, and bay leaves into ready-to-drink herbal tea is substantial. Nonetheless, additional examination of the phytochemical composition post-drying is required.
Objectives: This study seeks to ascertain the phytochemical composition, including total phenols, flavonoids, and antioxidants, influenced by differences in the drying temperature of herbal tea bags.
Methods: The study employed an experimental design with differing drying temperatures: M1 (45°C), M2 (55°C), M3 (65°C), M4 (75°C), M5 (85°C). Data were gathered through observations by 100 panelists and subsequently analyzed using parametric statistics in SPSS, with a significance level of 5%. The phytochemical test was conducted at the Industrial Research and Standardization Center at Jagir Wonokromo Street No. 360, Tenggilis Mejoyo, Surabaya.
Results: The drying treatment of herbal tea bags M1 at 45°C exhibited the highest antioxidant activity, measuring 216.02 µg/mL, with an IC_{50} value of 46.17 ppm, a moisture content of 7.20%, a yield of 13.15%, a total phenolic content of 134.2 mgGAE/g, and a total flavonoid content of 81.33 mgQE/g. It is characterized by a yellow hue, a distinct herbal aroma, and a blend of ginger and lemongrass spices, ultimately meeting the preferred acceptance criteria.
Conclusions: The drying temperature influences the phytochemical composition and the preferences of panelists for herbal tea bags, including mangosteen peel, red ginger, lemongrass, cherry leaves, lime leaves, and bay leaves.

INTRODUCTION

In the last four years, herbal teabags have emerged as a significant area of investigation in health and nutrition because of their potential characteristics[1]. Herbal teabags have gained popularity due to the transition towards a healthier lifestyle and their contribution to sustaining a robust immune system post-pandemic[2]. Numerous varieties of herbal teabags have been identified[3-5]; however, additional research is necessary to examine the compound constituents, as drying is crucial to producing herbal teabags. Incorporating diverse indigenous materials, including mangosteen peel, red ginger, lemongrass, kersen leaves, orange leaves, and bay leaves, as primary components in herbal tea production is anticipated to enhance antioxidant activity. This aligns with prior studies, indicating that local beverages derived from sea grapes (*Caulerpa racemosa*) are anticipated to possess significant antioxidant capacity and may serve as an alternative therapeutic drink for those with obesity[6].

Mangosteen peels are recognized for their bioactive constituents, including antioxidants, polyphenols, and flavonoids, which may positively influence bodily health[7]. Mangosteen peels comprise numerous bioactive components, including xanthones, flavonoids, and tannins, which may confer health advantages. Kersen leaves are a tropical plant frequently seen in Indonesia. The prevalence of kersen plants is significant, although their utilization remains infrequent[8]. Prior studies indicated that kersen leaves are considered a potential remedy for several ailments, including diabetes, gout, jaundice, cancer prevention, and the maintenance of liver and kidney function[8]. Lemongrass, orange leaves, and salam are agricultural commodities rich in antioxidants and bioactive components, precisely phenolic compounds and flavonoids, which can neutralize and diminish free radicals, inhibiting cellular oxidation and reducing cellular damage[9].

Nonetheless, inadequate drying may diminish the nutritional value, especially antioxidants. Antioxidants combat free radicals in the body and help repair cellular damage and many health issues[10]. The research centres

How to cite: *Bahar, A., Romadhoni, I. F., & Iriyani, D. (2025) Phytochemical Analysis of Herbal Teabags Based on Drying Temperature: Analisis Fitokimia Teh Celup Herbal Ditinjau dari Suhu Pengeringan. Amerta Nutrition, 9(1), 119–127.*

on the antioxidant content in herbal teabags derived from diverse spice combinations due to their potential to enhance endurance and avert different degenerative disorders[11]. Polyphenols are naturally occurring chemical substances present in mangosteen skin[12]. Research findings indicate these chemicals possess anti-inflammatory, anticancer, and antidiabetic effects[13]. Examining polyphenols in herbal teabags may offer a more comprehensive understanding of the potential health benefits of these beverages. Flavonoids, a subclass of polyphenols, are present in mangosteen peel and confer beneficial benefits on human health[14]. Examining flavonoids in herbal teabags may yield insights into the potential of these beverages to enhance cardiovascular function and sustain hormonal equilibrium in the body via the mechanism of active compounds that engage with the endocrine system, which governs production within the body[15]. This study corroborates prior studies about the correlation between awareness of herbal beverage items and lower abdomen pain or tenderness throughout the menstrual cycle[16].

The drying procedure significantly influences herbal tea products' quality and nutritional composition. Numerous studies have examined the impact of drying temperature; nevertheless, the emphasis on nutrient differentiation, notably polyphenols, flavonoids, and antioxidants, remains little explored. A more profound comprehension of the precise nutritional composition could furnish a scientific foundation for producers to enhance the formulation of functional products[8,17,18]. The significance of drying temperature in manufacturing herbal tea bags warrants investigation since it influences the concentration of bioactive chemicals in the tea.

Understanding the levels of antioxidant activity, polyphenols, flavonoids, and water content in herbal tea bags post-drying is anticipated to facilitate the identification of ideal production conditions for these teas. These findings enhance product competitiveness and provide consumers with a healthier beverage alternative. This research has significant implications for developing herbal teabags as functional beverages.

METHODS

The herbal tea bags comprised a blend of components, including mangosteen peel, red ginger, lemongrass, kersen leaves, orange leaves, and bay leaves. The ingredients were sourced from the plantation region of Wonorejo Village, Nglegok District, Blitar Regency. The materials utilized in the bioactivity analysis comprise Na_2CO_3 (sodium carbonate) (Merck), DPPH (Himedia), 100% PA methanol (Merck), gallic acid (Merck), $AlCl_3$ (aluminium chloride), Folin-Ciocalteu reagent (Merck), and quercetin (Sigma). The instrument utilized in this study comprise a food dehydrator, square pan, digital scale, measuring cup, glass funnel, dry blender, and portable burner.

Tools:

(a) (b) (c) (d) (e) (f) (g)
(a) Food Dehydrator (b) Square Baking Pan (c) Scale (d) Measuring Cup (e) Dry Blender (f) Funnel (g) Gas Stove

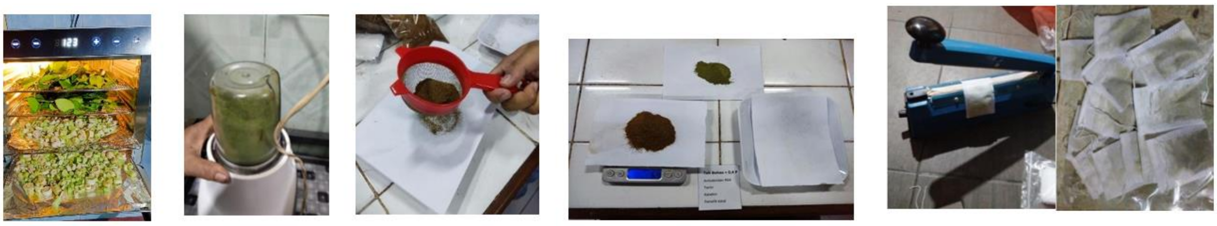
Figure 1. Herbal Tea Making Tools

Material:

(a) (b) (c) (d) (e) (f)
(a) Mangosteen Peel (b) Red Ginger (c) Lemongrass (d) *M.calabura* Leaf (e) Citrus Leaf (f) Bay Leaf

Figure 2. Herbal Tea Making Materials

Manufacturing Process:



(a) (b) (c) (d) (e)

(a) Material Drying (b) Size Decreasing (c) Material Filtering (d) Material Weighing (e) Packaging

Figure 3. Herbal Tea Making Process

This study's observations were confined to variations in drying temperature[19], ash content analysis via the Muffle Furnace method[19], water content assessment according to the specified standard (SNI 01-3836-2000), antioxidant activity measurement using the DPPH method[20], total phenol[20] quantification, total flavonoid evaluation employing the UV-Vis spectrophotometric method with reagents and aluminium chloride, quercetin as a standard[21], and sensory characteristics encompassing aroma, colour, taste, and overall acceptance[22]. The ingredients for the herbal tea comprised mangosteen peel, red ginger, lemongrass, kersen leaves, orange leaves, and bay leaves, all meticulously dried following a careful washing process. Fifty grams of each ingredient were measured prior to reducing the size to approximately 0.2 cm. The drying procedure was conducted utilizing a food dehydrator at the following temperatures: M1 (45°C), M2 (55°C), M3 (65°C), M4 (75°C), M5 (85°C) for 2 hours. Initially, the drying parameters were satisfied at a specific temperature, followed by a blender-crushing procedure. Following pulverization, sifting is conducted with a 30-mesh sieve. The filtered outcome will be placed into tea bags. However, the quantity must not surpass 5 g of herbal tea powder.

The packaging process for herbal tea bags involved weighing each ingredient—mangosteen peel, red ginger, lemongrass, kersen leaves, orange leaves, and bay leaves—each reduced to 0.5 g, resulting in a total weight of 3 g per teabag, measuring 5 x 3 cm. After being enclosed in teabags, they were steeped in 100 ml of 90°C water for roughly 5 minutes, employing a circular motion, before being extracted to yield herbal tea. The research employed a Randomized Group Design (RAK) [23] with a trial treatment with variations in drying temperatures: M1 (45°C), M2 (55°C), M3 (65°C), M4 (75°C), and M5 (85°C). Each treatment was replicated three times, resulting in 15 experimental samples. The observational results were evaluated utilizing the variance test and subsequent assessments on significant variables through Duncan's Multiple Range Test (DMRT) test[24].

RESULTS AND DISCUSSIONS

Table 1 presents the average water content and yield values for herbal teabags. The average findings of the examination of total phenols, total flavonoids, and antioxidant content of herbal teabags, derived from the combination of ingredients including mangosteen peel, red ginger, lemongrass, kersen leaves, orange leaves, and bay leaves, are presented in Table 2. The research findings greatly impacted herbal teabags' water content following drying temperature alterations. The moisture content of the herbs varied from 5.09% to 7.20%. The lowest mean water content was in sample M5 (85°C) at 5.09%, while treatment M1 (45°C) recorded the most excellent mean water content at 7.52%. This problem arises from the evaporation process caused by elevated drying temperatures in herbal tea bags. This observation aligns with the results of research[25], which indicates that the evaporation rate is influenced by the moisture content and temperature conditions of the dried material's environment. Other research indicates that tea bags' ideal moisture content is below 8%[26]. The data demonstrate that the water content in herbal tea bags does not surpass the maximum limit established by SNI for the dry-packaged tea category. The water content influences the freshness and longevity of teabag products in the material; thus, an elevated water level in dry tea can lead to a decline in quality and increased susceptibility to harm[27].

Table 1. Mean values of water content and yield in herbal tea bags based on variations in drying temperature

Temperature Variation (°C)	Water Content (%bb)	Yield (%bb)
M1 (45°C)	7.52±0.24^{a}	13.15±0.58^{a}
M2 (55°C)	7.16±0.13^{a}	11.14±0.49^{b}
M3 (65°C)	6.27±0.32^{b}	10.89±0.88^{c}
M4 (75°C)	5.82±0.19^{c}	10.07±0.68^{d}
M5 (85°C)	5.09±0.13^{d}	9.76±0.35^{d}

$^{a, b, c, d}$ = identical letter notations within the same row suggest that there are no substantial differences among the groups (p-value>0.05)

How to cite: Bahar, A., Romadhoni, I. F., & Iriyani, D. (2025) Phytochemical Analysis of Herbal Teabags Based on Drying Temperature: Analisis Fitokimia Teh Celup Herbal Ditinjau dari Suhu Pengeringan. Amerta Nutrition, 9(1), 119–127.

The data analysis results demonstrate that temperature variations during the drying process substantially influence the yield of herbal tea bags. Table 1 presents the yield of herbal tea bags, ranging from 9.76% to 13.15%. Sample M5 (85°C) exhibits the lowest average yield at 9.76%, whilst sample M1 (45°C) demonstrates the highest average yield of 13.15%. This condition posits that an increased drying temperature will lead to diminished yields. Previous studies indicated that the yield[27] strength of a material decreases as the heating temperature increases. Furthermore, this finding aligns with the assertion[28], which posits that throughout the drying process, a temperature differential between the internal and external environment compels the expulsion of water content to equilibrate the temperature, hence influencing yield shrinkage. The findings of[25] indicate that reduced water content in dry material affects the decrease in the mass of water within the material. The moisture content in dry materials influences the material's weight; thus, decreasing this content will diminish the mass, subsequently affecting the product yield[29].

Table 2. Mean values of total phenols, total flavonoids, and antioxidant activity of herbal teabags based on variation of drying temperature

Temperature Variation (°C)	Total Phenol (MgGAE/g)	Total Flavonoids (MgQE/g)	Antioxidant (µg/mL)
M1 (45°C)	134.2±0.07[a]	81.33±0.08[a]	216.02±0.11[a]
M2 (55°C)	128.1±0.03[b]	75.08±0.09[b]	214.11±0.63[b]
M3 (65°C)	120.5±0.04[c]	68.28±0.07[c]	213.12±2.08[b]
M4 (75°C)	106.2±0.08[d]	64.98±0.04[d]	201.04±0.24[c]
M5 (85°C)	105.1±0.11[d]	60.15±0.05[e]	159.88±1.25[d]

[a, b, c, d] = identical letter notations within the same row suggest that there are no substantial differences among the groups (p-value>0.05)

The fluctuation in temperature differential during drying considerably influences the overall phenol concentration in herbal tea bags. Table 2 indicates that the concentration of phenolic compounds produced ranges from 105.1 mg GAE/g to 134.2 mg GAE/g. The minimum mean phenol value was seen in M5 (85° C) at 105.1 mgGAE/g, whilst the maximum mean phenol value was recorded in treatment M1 (45° C) at 134.2 mgGAE/g. The results indicated that the drying temperature intensity affected the concentration of phenolic compounds. The increased drying temperature is inversely related to the concentration of phenolic compounds generated. A lower drying temperature will also elevate the phenol content. The phenol primarily derives from the herbal tea components of mangosteen peel, kersen, and bay leaves. Prior studies demonstrated that the total phenolic content of mangosteen skin was 6.56 mg GAE per 100 g. Phenols are primary antioxidants containing limonene, menthone, cineole, menthol, and pulegone [30]. Phenols correlate with antioxidant activity; precisely, a rise in phenol levels corresponds to an enhancement in antioxidant activity[31]. This assertion is corroborated by prior research, which indicates that phytochemical constituents exhibiting antioxidant action possess a characteristic susceptibility to elevated temperatures. According to the notion, the phenolic chemicals in herbal teabags will diminish. Researchers have preemptively addressed the issue by creating herbal teabags that incorporate diverse component variants, aiming to reduce phenol concentration.

Temperature fluctuations throughout the drying process affect the overall flavonoid concentration in herbal teabags. Table 2 illustrates that the total flavonoid content in herbal teabags, following various drying temperature treatments, varied from 81.33 mgQE/g to 60.15 mgQE/g. The minimum mean total flavonoids were recorded in sample M5 (85° C) at 60.15 mgQE/g, whilst the maximum mean total flavonoids were found in sample M1 (45° C) at 5.15 mgQE/g. Like phenolic substances, elevated heating temperatures can also degrade flavonoid compounds, diminishing their content, particularly kaempferol and morin. Flavonoid chemicals constitute a category of antioxidants affected by various intrinsic factors. The total flavonoid content increases in direct proportion to the low drying temperature during the production of herbal tea bags. Kersen leaves, a flavonoid-rich component in herbal teabags, contribute 10.025 mgQE/g of flavonoids. The material comprises many chemical compounds, including tannins, saponins, flavonoids, and polyphenols, which are present in significant quantities; nevertheless, their content will diminish when exposed to intense heat[32]. The flavonoid content in mangosteen peel is 7.12 mgQE/g. The compounds methoxide, isorhoifolin, eugenol, and thymol are potent antioxidants[9]. This finding is corroborated by research[26,3] results 26.33, which indicate that drying temperature significantly affects the flavonoid concentration in sungkai leaf-based herbal tea, necessitating additional herbal components to mitigate the reduction in flavonoid content.

The fluctuation in temperature differential during the drying process markedly influences the antioxidant activity in herbal teabags composed of mangosteen peel, red ginger, lemongrass, kersen leaves, orange leaves, and bay leaves. The antioxidant activity observed in herbal teabags, as indicated in Table 2, varied from 159.88 µg/mL to 216.02 µg/mL. The minimum antioxidant activity was recorded in treatment M5 (85°C) at 159.88 µg/mL, whereas the maximum antioxidant activity was seen in treatment M1 (45° C) at 216.02 µg/mL. This study's results demonstrate that varying drying temperatures during herbal tea production significantly influence the antioxidant activity outcomes[18]. Previous study 18 indicated that antioxidant substances are affected by the levels of phenols and flavonoids in several components, including mangosteen peel and kersen

How to cite: Bahar, A., Romadhoni, I. F., & Iriyani, D. (2025) Phytochemical Analysis of Herbal Teabags Based on Drying Temperature: Analisis Fitokimia Teh Celup Herbal Ditinjau dari Suhu Pengeringan. Amerta Nutrition, 9(1), 119–127.

leaves. The elevated levels of phenols and flavonoids are directly linked to increased antioxidant activity. The mangosteen peel comprises phenolic compounds, including limonene, cineole, menthone, menthol, and pulegone, which function as antioxidants and inhibit oxidation by sequestering free radicals[30]. The analysis results indicated that the antioxidant activity from the drying procedure at 45°C yielded the maximum antioxidant content, leading to its selection for IC_{50} determination. The achieved IC_{50} value was 46.17 ppm. A lower IC_{50} value is inversely related to the ability to neutralize free radicals, indicating better antioxidant activity. Herbal teabags subjected to a drying procedure at 45°C are classified as potent antioxidants. According to the findings[34], IC_{50} values below 50 ppm are classified as potent antioxidants, those between 50-100 ppm as potent antioxidants, values from 100-150 ppm as moderate antioxidants, and those from 150-200 ppm as weak antioxidants[6].

The ranking test was employed to evaluate the sensory attributes of herbal tea bags utilizing the hedonic technique. The ranking test encompasses sensory attributes of colour, taste, and scent, but the preference test is restricted to aroma qualities and overall preference[35]. The brewing of herbal tea bags pertains to Indonesian National Standard 3753:2014 about green tea bags. The brewing process commences by immersing a 3 g tea bag in a container, adding 180 ml of water at 90°C, allowing it to steep for approximately 5 minutes, and then agitating it in a circular motion until the extract is thoroughly combined. The subsequent step involves extracting the tea from the hot water solution. The final step is to lower the temperature of the tea solution to 40°C. Table 3 presents the observational results on the average approval of the colour, scent, and taste components. Table 4 presents the average results of preferences regarding the scent component and the overall evaluation of herbal tea items.

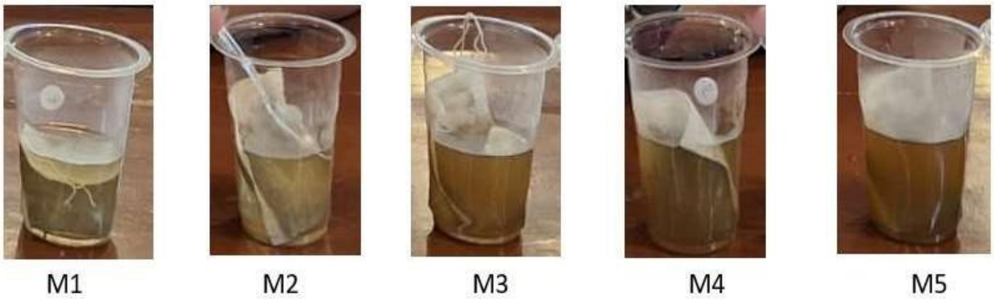


Figure 5. Variations of Herbal Teabag Samples

The results indicated a substantial difference in drying temperature that affected the colour of the infused herbal tea, as seen by the ranking test outcomes. Table 3 depicts the average rating, ranging from 1.23 (yellow) to 4.18 (reddish brown). Treatment M5 (85°C) had the lowest evaluation for tea bag colour, exhibiting a brown hue with a subtle red tint, comparable to treatment M4 at a drying temperature of 75°C. The most excellent mean value was observed in treatment M1 (45°C), characterized by greenish-yellow colour criteria. The steeped herbal tea at 75°C has a greater colour density than that brewed at 55°C. The rationale is that elevated drying temperatures result in the loss of colour in dyed herbal tea, leading to a yellowish-red hue in the brewed beverage. The pigments in the mangosteen skin have deteriorated, resulting in a lighter skin hue. At elevated drying temperatures, chlorophyll converts to pheophytin, producing a darker tea hue. Moreover, the flavonoid pigments in the peel impart a yellow hue, and these molecules also alter the flavour to a sweet profile. Previous studies indicate[25] that drying at elevated temperatures leads to the oxidation of pigments in the material, resulting in colour degradation. Elevated drying temperatures may lead to discolouration and a reduction in material quality.

Table 3. Mean ranking on aroma, color, and taste of herbal teabags based on variation of drying temperature

Temperature Variation (°C)	Color	Aroma	Taste
M1 (45°C)	1.73±0.89^{c}	1.66±0.73^{d}	2.32±1.32^{c}
M2 (55°C)	3.26±1.21^{b}	2.44±0.65^{c}	3.24±1.14^{b}
M3 (65°C)	3.47±0.88^{b}	2.98±0.57^{b}	3.26±0.45^{b}
M4 (75°C)	4.13±0.82^{a}	3.11±0.47^{b}	237±1.42^{c}
M5 (85°C)	4.25±0.71^{a}	3.71±0.63^{a}	3.98±0.9^{a}

$^{a, b, c, d}$ = identical letter notations within the same row suggest that there are no substantial differences among the groups (p-value>0.05)

Table 4. Mean favorability on aroma and overall acceptability of herbal teabags based on variation of drying temperature

Temperature Variation (°C)	Aroma	Overall Acceptance
M1 (45°C)	5.56±0.8^{a}	5.73±0.68^{a}
M2 (55°C)	4.86±0.87^{b}	5.12±0.7^{b}

How to cite: Bahar, A., Romadhoni, I. F., & Iriyani, D. (2025) Phytochemical Analysis of Herbal Teabags Based on Drying Temperature: Analisis Fitokimia Teh Celup Herbal Ditinjau dari Suhu Pengeringan. Amerta Nutrition, 9(1), 119–127.

Temperature Variation (°C)	Aroma	Overall Acceptance
M3 (65°C)	5.00 ± 0.81^b	5.00 ± 0.77^b
M4 (75°C)	4.79 ± 0.90^b	4.76 ± 0.68^b
M5 (85°C)	4.05 ± 1.16^c	4.11 ± 0.81^c

$^{a, b, c, d}$ = identical letter notations within the same row suggest that there are no substantial differences among the groups (p-value>0.05)

The panellists' evaluation of the aroma of herbal teabags revealed that fluctuations in drying temperature significantly influenced the colour, aroma, flavour, and overall acceptability of the teabags. According to the results in Table 3, there is a discernible decline in panellists' preference for all parameters as the drying temperature escalates. This results from an increased evaporation of aromatic and taste components at elevated drying temperatures. Tea bags desiccated at 85°C received the lowest rating on the scent scale. The elevated drying temperature diminished the distinctive aroma of the herbal tea bags during infusion. The predominant component in mangosteen peel is xanthone, a molecule characterized by tricyclic aromatic rings with supplementary phenol, methoxy, and prenyl groups; drying at elevated temperatures diminishes the scent of tea leaves. According to another study[36], volatile aromatic chemicals are responsible for tea's odour, although herbal tea's chemical constituents consist of saccharides that reduce sugars during brewing. Furthermore, the oxidation of polyphenolic substances and their derivatives, including tannins, transpires. The aroma-active volatiles from mangosteen peel possess a potent fragrance and exhibit significant volatility. Furthermore, the findings of an additional study indicated that the aroma of bay leaf can effectively enhance participants' short-term memory performance[37]. The findings indicated that drying temperature significantly influenced the aroma of brewed tea, as determined by the hedonic test (p-value<0.05). The mean favorability score for the aroma of herbal tea bags was lowest at 85°C drying due to its lacklustre scent and greatest at 45°C drying, indicating that panellists preferred the robust aromatic qualities of ginger and orange leaves. As the drying temperature escalated during the treatment, the aroma of mangosteen, derived from oxidized xanthone chemicals in the herbal tea bags, intensified, producing a somewhat unpleasant odour that consumers favoured[2].

The findings suggest that the reduction of herbal aroma in teabags is attributable to a decline in essential oil content throughout the drying phase. Research [27] indicates that an increased drying process leads to a decrease in the essential oil content present. Furthermore, another observation is that excessive mangosteen peel composition can impart a harsh taste after consuming herbal tea.

The impact of temperature-controlled drying on overall preference was substantial. Table 3 illustrates that the disparity between the mean preference test and overall liking varied from 2.75 (somewhat hated) to 4.88 (highly liked). A multitude of elements, including hue, fragrance, and flavour, affect the overall preference for herbal teabags.

This research possesses significant market potential for the future. This study's results offer an overview of easily prepared herbal plant-based beverage diversification items. Moreover, herbal teabags have been demonstrated to contain phytochemicals advantageous to the body. Nonetheless, it is essential to perform a more thorough shelf life assessment to guarantee the safety of herbal teabags, as well as market evaluations to acquire the most current data on suitable packaging for the items of this study.

Respondents' preferences regarding herbal teabags are established; however, further comprehensive research is required to elucidate the correlation between the phytochemical composition of herbal teabags and consumer interest to derive insights and contributions from the developed herbal teabags.

CONCLUSIONS

The alteration of drying temperature during the production of herbal tea bags influences water content, yield, total phenolic compounds, total flavonoids, antioxidant activity, colour, aroma, flavour, and overall acceptability. This technique demonstrates that a temperature of 45°C yields herbal tea bags with enhanced antioxidant capacity and optimal outcomes.

ACKNOWLEDGEMENT

We extend our sincere gratitude to the *Universitas Terbuka* for funding this research. We also express our appreciation to all parties who contributed to the successful completion of this study. Our heartfelt thanks go to the panelists from *UPJ Mojokerto* and *Lamongan* for their valuable participation. We are also grateful to the Undergraduate Culinary Education Study Program, Faculty of Engineering, *Universitas Negeri Surabaya*, for providing access to laboratory facilities for testing purposes. Lastly, we acknowledge the dedication and efforts of the research team, whose commitment and hard work were instrumental in completing this research.

CONFLICT OF INTEREST AND FUNDING DISCLOSURE

All research teams have no conflicts of interest regarding this study. This research received funding from the Institute for Research and Community Service (LPPM) of *Universitas Terbuka* under Agreement Letter Number B/586/UN31.LPPM/PT.01.03/2023, dated February 20, 2023.

AUTHOR CONTRIBUTIONS

IFR: develop the research concept by identifying research problems and objectives, lead the primary investigation, perform formal data analysis, ensure the availability of research resources, compose the initial draft, and revise the results based on reviewer feedback;

DI: assist in research investigations and experiments, conduct formal analysis, compile and revise sections of the research draft, review the writing to ensure the quality of the final product, aid in editing, and finalize the manuscript according to reviewer feedback; AB: enhance the research through revision and editing, critically assess the final draft, provide input on the formal analysis, support the acquisition of necessary resources, and edit the reviewer's revisions to produce a manuscript that adheres to scientific publication standards.

REFERENCES

1. Husnani & Fitri, N. A. Pengaruh Metode Pengeringan pada Mutu Fisik Minuman Herbal Celup dengan Komposisi Jahe, Temulawak, Kunyit dan Sereh. Jurnal Ilmu Sosial **1**, (2022). https://doi.org/10.26877/jiphp.v7vi2i.17288
2. Sheila Maria Belgis Putri Affiza. Analisis Mutu Teh Celup Herbal Sebagai Minuman Fungsional. skripsi (2022).
3. Yesti, Y. et al. Uji Aktivitas Antioksidan Sediaan Teh Herbal Dari Kulit Buah Naga Merah (Hylocereus Polyrhizus) Dan Kulit Kayu Manis (Cinnamomum Burmanii. Ensiklopedia of Journal **5**, (2023). https://doi.org/10.33559/eoj.v5i2.1399
4. Rahardjo, M., Sihombing, M. & Refla, S. Analisis senyawa bioaktif serta karakteristik sensori teh dari edible flower. Journal of Tropical AgriFood **5**, (2023). http://dx.doi.org/10.35941/jtaf.5.1.2023.10853.48-54
5. Dwi Santy Damayati, Hadi Riyadi, Ekowati Handharyani, Evy Damayanthi & I Wayan Teguh Wibawan. The Analysis of Antioxidant Capacities and Sensory in Sea Grapes (Caulerpa racemosa) Powdered Drink as a Therapeutic Obesity. Amerta Nutrition **7**, 175–183 (2023). https://doi.org/10.20473/amnt.v7i2.2023.175-184
6. Jediut, M., Utama, W. G. & Madu, F. J. Pembuatan Teh Herbal Daun Salam Sebagai Minuman Alternatif Pada Peserta Posyandu Dusun Akel Dan Dusun Cipi Kecamatan Cibal Barat. JIPD (Jurnal Inovasi Pendidikan Dasar) 2, (2018).
7. Nawir, I., Anna, C., Afifah, N., Sulandjari, S. & Handajani, S. Pemanfaatan Daun Kersen (Muntingia calabura L) Menjadi Teh Herbal. Jurnal Tata Boga **10**, (2021).
8. Savych, A. et al. HPLC-DAD assay of flavonoids and evaluation of antioxidant activity of some herbal mixtures. Pharmacia **69**, (2022). https://doi.org/10.3897/pharmacia.69.e86486
9. Hasimun, P., Dadang Juanda, Ika Kurnia Sukmawati & Ari Yuniarto. Edukasi Hipertensi dan Pelatihan Pembuatan Teh Herbal Kombinasi Daun Pegagan (Centella asiatica) Dan Rimpang Kunyit (Curcuma longa) Sebagai Minuman Kesehatan Antihipertensi. Amaliah: Jurnal Pengabdian Kepada Masyarakat **4**, (2020).
10. Sandhiutami, N. M. D., Yuslia Noviani, Milla Fitri Amalia & Rafif Fadhlurrahman Ahmad. Anti-Hiperglikemik Teh Celup Herbal Kombinasi Fragaria x ananassa, Camellia sinensis, Stevia rebaudiana Melalui Mekanisme Antioksidan Pada Mencit Gangguan Metabolik Yang Diinduksi Aloxan. Medical Sains: Jurnal Ilmiah Kefarmasian **8**, (2023).
11. Tri, R., Yasni, S., Muhandri, T. & Yuliani, S. Pengaruh Metode Ekstraksi Terhadap Kualitas Ekstrak Kulit Manggis (Garcinia mangostana L.). Jurnal Unitek **15**, (2022).
12. Solikhati, A., Rahmawati, R. P. & Kurnia, S. D. Analisis Mutu Fisik Granul Ekstrak Kulit Manggis Dengan Metode Granulasi Basah. Indonesia Jurnal Farmasi **7**, (2022).
13. Puspitasari, M. L., Wulansari, T. V., Widyaningsih, T. D., Maligan, J. M. & Nugrahini, N. I. P. Aktivitas Antioksidan Suplemen Herbal Daun Sirsak (Annona muricata L.) dan Kulit Manggis (Garcinia mangostana L.): Kajian Pustaka. Jurnal Pangan dan Agroindustri **4**, (2016). https://doi.org/10.24252/teknosains.v12i1.7865
14. Astiti, N. K. A. D. S. Optimalisasi Penggunaan Tepung Kulit Manggis (Garcinia Mangostana L) Dalam Pembuatan Pie Susu. Jurnal Kuliner **2**, (2022).
15. Herviana, C. & Farapti, F. The Relationship

Between Knowledge and Patterns of Herbal Drink Product Consumption with Dysmenorrhea of Female Adolescent: Hubungan Pengetahuan dan Pola Konsumsi Produk Minuman Herbal dengan Kejadian Dismenore Pada Remaja Putri. Amerta Nutrition **7**, 203–209 (2023). https://doi.org/10.20473/amnt.v7i2.2023.203-209

16. Santi, I., Amirah, S. & Andriani, I. Sosialisasi Pembuatan Teh Herbal Dalam Kemasan Teh Celup Pada Kelompok PKK Kalabbirang, Kabupaten Takalar. Dharmakarya **11**, (2022). https://doi.org/10.24198/dharmakarya.v11i1.32667
17. Syam, S. A. R. Optimalisasi suhu dan waktu penyeduhan teh celup herbal Daun kersen (muntingia calabura l.) Dalam mempertahankan Kandungan total senyawa flavonoid. Jurnal Kuliner (2021). http://repository.unhas.ac.id:443/id/eprint/5285
18. Horwitz, W. liam & Latimer, G. W. Official Methods of Analysis of AOAC INTERNATIONAL 18th Edition, 2005. Of fi cial Methods of Anal y sis of AOAC INTERNATIONAL 18th Edition, 2005 (2005).
19. Pamungkas, J. D., Anam, K. & Kusrini, D. Penentuan Total Kadar Fenol dari Daun Kersen Segar, Kering dan Rontok (Muntingia calabura L.) serta Uji Aktivitas Antioksidan dengan Metode DPPH. Jurnal Kimia Sains dan Aplikasi **19**, (2016).
20. Muaja, A. D., Koleangan, H. S. J. & Runtuwene, M. R. J. Uji Toksisitas dengan Metode BSLT dan Analisis Kandungan Fitokimia Ekstrak Daun Soyogik (Saurauia bracteosa DC) dengan Metode Soxhletasi. Jurnal MIPA **2**, (2013). https://doi.org/10.35799/jm.2.2.2013.3000
21. Soewarno T. Soekarto. Penilaian Organoleptik: Untuk Industri Pangan Dan Hasil Pertanian. (Bhratara Karya Aksara, Jakarta, 1985).
22. Dewitayani, D., Sulaiman, M. I. & Widayat, H. P. Studi Pembuatan Teh Celup Daun Ruku-Ruku (Ocimum tenuiflorum L.) dengan Penambahan Bubuk Jahe sebagai Minuman Penyegar. Jurnal Ilmiah Mahasiswa Pertanian **4**, (2019).
23. Permanasari, A. E., Rambli, D. R. A. & Dominic, P. D. D. Forecasting method selection using ANOVA and Duncan multiple range tests on time series dataset. in Proceedings 2010 International Symposium on Information Technology - Engineering Technology, ITSim'10 vol. **2** (2010). https://doi.org/ 10.1109/ITSIM.2010.5561535
24. Sucianti, A., Yusa, N. M. & Sughita, I. M. Pengaruh Suhu Pengeringan Terhadap Aktivitas Antioksidan Dan Karakteristik Teh Celup Herbal Daun Mint (Mentha piperita L.). Jurnal Ilmu dan Teknologi Pangan (ITEPA) **10**, (2021). https://doi.org/10.30591/japhb.v6i3.4953
25. Selvie Mahrita, O. et al. Pengaruh Lama Pegeringan Terhadap Mutu Teh Herbal Daun Sungkai (Pernonema Canescens Jack). JCI Jurnal Cakrawala Ilmiah vol. **2** (2022). https://doi.org/10.53625/jcijurnalcakrawalailmiah.v2i4.4328
26. Komariah, R., Trisna Darmayanti, L. P. & Indri Hapsari Arihantana, N. M. Pengaruh Pengeringan terhadap Karakteristik Teh Herbal Celup Rimpang Temu Putih (Curcuma zedoaria Rosc.). Jurnal Ilmu dan Teknologi Pangan (ITEPA) 10, (2021). https://doi.org/10.24843/itepa.2021.v10.i02.p11
27. Anik Enikmawati, Ana Mar'atus Sholihah & Siti Sarifah. Pengaruh Kulit Manggis Terhadap Penurunan Kadar Gula Darah Pada Penderita Diabetes Mellitus. Jurnal Rumpun Ilmu Kesehatan **2**, (2022).
28. A. Lastriyanto & A. I. Aulia. Analisa Kualitas Madu Singkong (Gula Pereduksi, Kadar Air, dan Total Padatan Terlarut) Pasca Proses Pengolahan dengan Vacuum Cooling. Jurnal Ilmu Produksi dan Teknologi Hasil Peternakan **9**, (2021). https://doi.org/10.29244/jipthp.9.2.110-114
29. Wulandari, R. Skrinning Fitokimia dan Aktivitas Antioksidan Teh Herbal Daun Buas–Buas (Premna

How to cite: Bahar, A., Romadhoni, I. F., & Iriyani, D. (2025) Phytochemical Analysis of Herbal Teabags Based on Drying Temperature: Analisis Fitokimia Teh Celup Herbal Ditinjau dari Suhu Pengeringan. Amerta Nutrition, 9(1), 119–127.

cordifolia ROXB.). Jurnal Dinamika Penelitian Industri **30**, (2019).

30. Tavita, G. E., Linda, R., Ashari, A. M., Apindiati, R. K. & Hartanti, L. Pengujian Kualitas Parameter Fisika Kimia dan Kandungan Total Fenol dari Teh Herbal Cakar Kucing (Uncaria tomentosa Wild. Ex Schult) Sebagai Minuman Fungsional. AGRISAINTIFIKA: Jurnal Ilmu-Ilmu Pertanian **6**, (2022). https://doi.org/10.32585/ags.v6i2.2936
31. Himalian, R. & Singh, M. P. A Comparative account on Antioxidant activities, Total phenolic and Flavonoid contents of Punica granatum, Carica papaya, Foeniculum vulgare, Trigonella foenum-graecum, and Urtica dioica: An in vitro Evaluation. Res J Pharm Technol **15**, (2022). https://doi.org/ 10.52711/0974-360X.2022.00197
32. Beninger, C. W. & Hosfield, G. L. Antioxidant Activity of Extracts, Condensed Tannin Fractions, and Pure Flavonoids from Phaseolus vulgaris L. Seed Coat Color Genotypes. J Agric Food Chem **51**, (2003). https://doi.org/10.1021/jf0304324
33. Widiastini, L. P., Karuniadi, I. G. A. M. & Tangkas, M. Senyawa Antioksidan Ekstrak Etanol Daun Kelor (Moringa Oleifera) Di Denpasar Selatan Bali. Media Kesehatan Politeknik Kesehatan Makassar **16**, (2021). https://doi.org/10.32382/medkes.v16i1.2038
34. Badan Standarisasi Nasional. SNI Petunjuk Pengujian Organoleptik dan atau Sensori. BSN (Badan Standarisasi Nasional) (2006).
35. Yunia Angelia Putri, P., Kartika Pratiwi, I. D. P. & Kadek Diah Puspawati, I. G. A. Pengaruh Lama Pengeringan Daun Cemcem (Spodiaz pinnata LF Kurz) Terhadap Aktivitas Antioksidan Dan Sifat Sensoris Teh Celup Herbal. Jurnal Ilmu dan Teknologi Pangan (ITEPA) **12**, (2023). https://doi.org/10.24843/itepa.2023.v12.i01.p11
36. Sahfitri, A., Moulana, R. & Widayat, H. P. Penerimaan Konsumen terhadap Teh Celup Herbal Ruku-Ruku (Ocimum tenuiflorum L.) dengan Penambahan Bunga Kenanga (Cananga odorata) dan Daun Stevia (Stevia rebaudiana). Jurnal Ilmiah Mahasiswa Pertanian **4**, (2019). https://doi.org/10.17969/jimfp.v4i4.12515