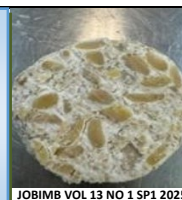




JOURNAL OF BIOCHEMISTRY, MICROBIOLOGY AND BIOTECHNOLOGY

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JOBIMB VOL 13 NO 1 SP1 2025
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Effects of Different Drying on Chemical Composition, Antioxidant Activity, and Sensory Evaluation of Cassia Senna Tea Leaves (*Cassia angustifolia* Vahl.)

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HISTORY

Received: 17th April 2025
Received in revised form: 15th July 2025
Accepted: 29th July 2025

KEYWORDS

Cassia angustifolia
Cabinet drying
Freeze drying
Antioxidant activity
Sensory evaluation

ABSTRACT

This study aims to investigate the chemical composition, antioxidant activity, and sensory evaluation of *Cassia angustifolia* Vahl. tea leaves processed using two drying methods: cabinet (at 80°C) and freeze-drying. The research focuses on evaluating the impact of different drying methods on proximate composition, including carbohydrates, protein, and fat, as well as the presence of bioactive compounds such as phenolics and flavonoids, which are closely linked to antioxidant properties. It's also highlighting vitamin C content and free radical inhibition capacity, assessed through DPPH and ABTS assays. The findings reveal that freeze-drying preserved higher bioactive content, as observed in the vitamin C analysis and the total phenolic and flavonoid content (1.10%, 311.76 mg GAE/g, and 372.70 mg QE/g, respectively) compared to cabinet drying, which resulted in a loss of these compounds due to high temperatures. These compounds are strongly correlated with antioxidant activity, as demonstrated in both free radical inhibition tests (DPPH and ABTS assays). Freeze-dried tea exhibited higher antioxidant activity in both assays (67.76% for DPPH and 57.71% for ABTS) compared to cabinet-dried tea (50.74% for DPPH and 44.71% for ABTS) at a concentration of 250 mg/L. The antioxidant tests confirmed significant free radical inhibition activity in *Cassia angustifolia* tea, highlighting its potential as a natural antioxidant source. However, sensory evaluation revealed that panellists preferred tea made from cabinet-dried leaves in terms of colour, taste, and overall quality, emphasizing the importance of processing methods in determining sensory attributes.

INTRODUCTION

Tea consumption has increased worldwide, not only as a daily beverage but also for its health benefits. Herbal teas, in particular, have gained popularity due to their natural bioactive compounds, especially polyphenols, which help prevent diseases caused by free radicals [1]. As a result, research on herbal teas has expanded, focusing on their functional properties and potential health benefits. *Cassia angustifolia* Vahl., commonly known as Senna, is a well-known medicinal herb widely used in traditional medicine. Its leaves contain sennoside, the primary bioactive

compound responsible for its laxative effects. Senna tea is commonly consumed for relieving constipation by stimulating bowel movements and improving digestion [2]. Beyond its laxative effects, previous studies have shown that sennoside exhibits pharmacological properties such as anti-obesity effects, blood sugar regulation in type 2 diabetes (T2DM), anti-inflammatory effects in pancreatitis, and antitumor activity on human osteosarcoma cells [3]. Additionally, senna leaves can be ground into a paste for treating skin conditions and have been found to be effective against various pathogens [2].

Senna leaves, like other tea leaves, undergo a drying process to enhance their shelf life and retain their bioactive properties. Typically, senna leaves are harvested when the plant reaches about two years old, followed by drying before storage [4]. However, different drying methods can significantly affect the tea's chemical composition, antioxidant activity, and sensory properties. Studies suggest that drying techniques influence the levels of flavonoids, phenolics, and vitamin C in herbal teas, which contribute to their health benefits. Therefore, identifying the most suitable drying method is crucial to preserving the beneficial compounds in senna tea.

Despite its health benefits, excessive consumption of senna tea can cause side effects such as stomach cramps, diarrhoea, and electrolyte imbalances, especially when consumed for weight loss purposes [4]. Furthermore, many commercially available senna tea products lack detailed nutritional information, including energy content, serving size, and potential risks, making it difficult for consumers to make informed choices. The unregulated sale of senna tea, especially through online platforms like Lazada and Shopee, further increases the risk of misuse, as these products do not always adhere to regulations set by health authorities. The lack of standardized nutritional labelling also raises concerns, as important information regarding macronutrients like carbohydrates, proteins, fats, and fiber content is often missing.

The objectives of this study include determining the effects of different drying methods on the physicochemical composition of *Cassia angustifolia* tea leaves, particularly their proximate composition and vitamin C content. Additionally, this research aims to analyse the total phenolic and flavonoid content in tea leaves and senna tea beverages dried using different methods. It will also investigate the antioxidant capacity of senna tea leaves and beverages and evaluate the relationship between antioxidant activity and various drying techniques, including cabinet drying and freeze-drying. Ultimately, the study aims to evaluate consumer preferences for senna tea prepared using various drying methods through sensory analysis.

This research will provide valuable insights into the optimal drying method for preserving the bioactive properties of senna tea, benefiting academics, researchers, herbal tea manufacturers, and local entrepreneurs. Understanding the relationship between drying techniques and chemical composition will help improve tea quality, ensuring it retains its beneficial properties. Additionally, this study will support local tea producers and traditional medicine practitioners in developing better products while also creating economic opportunities in the herbal tea industry. By ensuring proper drying techniques and improved labelling, consumers can make more informed choices about senna tea consumption.

MATERIALS AND METHODS

Cassia angustifolia tea leaves are obtained from the supplier located in Kampung Sundang, Sandakan, Sabah, Malaysia. Matured tea leaves of *Cassia angustifolia* (distinguished by their dark green colour) are used in this study. The weight of Senna leaves for overall analysis used in this study is one kilogram.

Preparation of Senna tea leaves powder

Firstly, one kilogram of Senna leaves is washed and cut to remove dirt and ease the drying process. A total of 500 g of raw senna leaf samples is dried using a cabinet dryer at 80°C for 6 hours with an airflow rate of 2 m/s, and the samples are evenly spread in a single layer and manually rotated every 2 hours to

ensure uniform drying. The remaining 500 g are dried using the freeze-drying method at -50°C under a vacuum pressure of 0.05 mbar for 72 hours. The leaves are dried until they reach a final moisture level of approximately 7% to 10%. The dried leaves are then ground into a fine powder in preparation for proximate analysis, chemical composition determination, antioxidant capacity analysis, and sensory evaluation.

Extraction of *Cassia angustifolia* tea leaves

The extraction of tea leaves was based on the hot water extraction method conducted by Neves *et al.* [5]. A total of 1 g of sample from each drying method was dissolved in 50 ml of hot water at 85°C. The hot water was poured into a beaker containing the tea leaves. The tea solution was stirred for 2 minutes until the tea leaves were fully immersed. The mixture was then left to steep for 10 minutes. Next, the tea solution and solid tea leaves were separated using a vortex shaker and further filtered using filter paper. The tea extract was stored in a refrigerator at 5°C until further use.

Proximate Composition

All of the proximate composition methods follow the method shown by the Association of Official Analytical Chemists (AOAC) [6] to determine the ash, moisture, fat, protein, crude fiber, and carbohydrate content. The ash content was determined using the dry-ashing method, the moisture content was determined using the oven drying method, the fat content was analysed using the Soxhlet method, the protein content was determined using the Kjeldahl method, and the crude fiber content was determined using acid-base analysis. The sum of all analyses, minus 100, was used to quantify the carbohydrate content. The output of all analyses is in percentages. All analyses have undergone repetition three times.

Phytochemical Analysis

Vitamin C, phenolic compounds, and flavonoids are the chemicals that are analysed in this research. *Cassia angustifolia* leaves extract was used as the sample in this analysis. The titration method is used to analyse vitamin C content, including titrating the sample extract with an iodine solution and a starch indicator. Meanwhile, the determination of total phenolic content (TPC) and total flavonoid content (TFC) was performed using the Folin-Ciocalteu and aluminium chloride colorimetric methods, respectively. Gallic acid was used as the standard solution for TPC, while quercetin was used as the standard solution for TFC analysis. The phenolic and flavonoid content are quantified as GAE (gallic acid equivalent) and QE (quercetin equivalent) per gram, respectively. All analyses have been repeated thrice.

Antioxidant Capacity Analysis

Antioxidant activity of *Cassia angustifolia* leaf extract was evaluated using two antioxidant assays, which are DPPH (2,2-Diphenyl-1-picrylhydrazyl) and ABTS (2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid)) free radical scavenging methods. The outcome after incubation was measured using a UV-VIS spectrophotometer with ascorbic acid solution as the standard. Free radical scavenging activities were calculated as a percentage, and the IC₅₀ value was determined to compare the antioxidant activity between samples.

Sensory Evaluation

The sensory evaluation method was conducted to assess the preference level of consumers for *Cassia angustifolia* tea leaves dried using two drying methods. It involved 50 semi-trained panellists consisting of 4th-year students from the Faculty of Food Science and Nutrition, Universiti Malaysia Sabah. An

ffective test using a 7-point hedonic scale was conducted to determine the preference level for samples from two drying methods and one control sample. Parameters evaluated during this sensory assessment included taste, aroma, colour, and overall perception. Three tea beverage samples, each with a unique code (three numbers), were served: two samples from two different drying methods and one control sample, prepared according to the brewing method described by Ehoche *et al.* [7]. Rinse water was served along with the samples.

Statistical Analysis

The obtained data were analysed using the Statistical Package for Social Sciences (SPSS) version 29. All data were collected in triplicate and reported as mean \pm standard deviation. An independent t-test was conducted for all chemical composition analyses to determine whether there was a significant difference between the two samples based on the two drying methods. Additionally, the total mean score method was used to analyse the hedonic test.

RESULTS AND DISCUSSION

Proximate Composition Between Two Drying Methods of *Cassia angustifolia* tea leaves

The moisture content of *Cassia angustifolia* tea leaves was analysed on a dry basis using the freeze- and cabinet-drying method, revealing a range between 6% and 6.5% for both drying methods. This significant reduction from the original moisture content underscores the effectiveness of drying in preserving tea powder quality, with both samples falling below the recommended 8% moisture threshold [8]. However, a slight difference was observed between the drying methods, with cabinet-dried samples (6.52%) retaining slightly more moisture than freeze-dried ones (6.07%) based on the result tabulated in **Table 1**. This trend aligns with previous findings that noted higher moisture content in cabinet-dried samples compared to freeze-dried ones, attributed to the freezing process bypassing the liquid phase [9].

Table 1. Proximate composition of *Cassia angustifolia* tea leaves.

Sample	Moisture content (%)	Ash content (%)	Crude Protein content (%)	Crude Fat content (%)	Crude Fiber content (%)	Carbohydrate content (%)
CD	6.50 \pm 0.10 ^a	16.40 \pm 0.37 ^a	2.90 \pm 0.13 ^a	5.90 \pm 0.55 ^a	8.90 \pm 0.13 ^a	59.40 \pm 0.05 ^a
FD	6.10 \pm 0.07 ^b	15.20 \pm 0.16 ^b	3.00 \pm 0.04 ^a	6.70 \pm 0.53 ^a	8.70 \pm 0.07 ^a	60.40 \pm 0.86 ^a

Note: Letters **CD** and **FD** indicate cabinet dried samples and freeze-dried samples, respectively. The values are expressed as the mean percentage \pm standard deviation, where n = 2. The different superscript (a-b) indicates that the values across each column differ significantly (p < 0.05).

Regarding ash content, determined via dry-ashing, both drying methods significantly influenced the mineral residue in the tea leaves. According to **Table 1**, cabinet-dried samples exhibited higher ash content (16.38%) compared to freeze-dried samples (15.24%). This aligns with previous studies, where similar drying methods have shown varying ash content, emphasizing the mineral-rich nature of the cabinet-dried samples [10]. The ash content indicates the presence of minerals and soil-based components in the tea leaves, crucial for their nutritional profile [11].

Crude protein and fat contents, analysed using the Kjeldahl and Soxhlet methods, respectively, showed stable levels across both drying techniques as tabulated in **Table 1**. Protein content remained consistent within the optimal range for high-quality tea [1], while fat content was slightly higher in freeze-dried samples compared to cabinet-dried ones, aligning with expectations from

previous studies [12]. The crude fiber content, determined using the acid-base treatment method, demonstrated no significant variation between drying methods, emphasizing that fiber content is primarily influenced by leaf maturity rather than drying technique. The crude fiber content in tea leaves is reported to be lower in young tea leaves compared to mature ones [13]. Both methods yielded similar results, contrasting with the higher fiber content reported in a previous study, which suggests consistent fiber levels in mature *Cassia angustifolia* leaves regardless of the drying method [10]. Carbohydrate content calculations, based on the difference between 100% and total proximate composition, showed stable levels across both drying methods. Freeze-dried samples exhibited marginally higher carbohydrate content (60.37%) compared to cabinet-dried samples (59.36%), consistent with the natural high carbohydrate content in tea leaves due to cellulose and plant fibers [14]. These findings highlight the influence of drying techniques on moisture and ash content, while other proximate components such as protein, fat, fiber, and carbohydrates remain relatively stable. Differences observed between this study and past studies further emphasize the role of drying conditions and sample characteristics in determining proximate composition.

Chemical Composition of *Cassia angustifolia* tea leaves

The vitamin C content of *Cassia angustifolia* tea leaves, as shown in **Table 2** has a significant difference between the two drying methods, with freeze-dried samples retaining higher vitamin C levels than cabinet-dried ones.

Table 2. Vitamin C content of *Cassia angustifolia* tea leaves extract.

Type of Drying Methods	Percentage of vitamin C (%)
Cabinet Drying	0.74 \pm 0.09 ^b
Freeze Drying	1.10 \pm 0.12 ^a

Note: The values are expressed in mean percentage \pm standard deviation, where n=2. The different superscript (a-b) indicates that the values across each column differ significantly (p < 0.05).

This can be attributed to the low-temperature conditions of freeze-drying, which help prevent the degradation of water-soluble vitamins like vitamin C [15]. Vitamin C is highly sensitive to heat and oxidation, leading to substantial losses during high-temperature processing. Depending on temperature, duration, and oxygen exposure, vitamin C loss can range from 20% to 90% [15]. However, studies specifically investigating the vitamin C content of *Cassia angustifolia* tea leaves are limited, making it challenging to compare the current results with past research directly.

Table 3. Total phenolic content of *Cassia angustifolia* tea leaves extract with cabinet and freeze drying.

Type of Drying Methods	Total Phenolic Content (mg GAE/g)
Cabinet Drying	285.85 \pm 0.84 ^b
Freeze Drying	311.76 \pm 0.73 ^a

Note: The values are expressed in mean \pm standard deviation, where n=2. The different superscript (a-b) indicates that the values across each column differ significantly (p < 0.05).

The total phenolic content (TPC) of the tea samples was determined spectrophotometrically using gallic acid as a standard, with a calibration curve equation of $y = 0.0048x + 0.4939$. The analysis was conducted on ethanolic extracts of the dried tea powder. Results indicated in **Table 3** show that freeze-dried samples retained a higher TPC (311 mg GAE/g extract) compared to cabinet-dried ones (285 mg GAE/g extract), suggesting that drying methods significantly affect phenolic retention. The lower TPC in cabinet-dried samples is likely due to prolonged exposure to high temperatures, which promote enzymatic oxidation and phenolic degradation [9]. Previous studies also observed a similar trend, reporting that ice crystal

formation in frozen samples disrupts cell structures, enhancing solvent penetration and improving phenolic extraction [16]. These findings emphasize the role of processing conditions in preserving bioactive compounds such as phenolics in plant-based materials.

Table 4. Total flavonoid content of tea leaves extract dried with cabinet and freeze drying.

Type of Drying Methods	Total Flavonoid Content (mg QE/g)
Cabinet Drying	121.22±1.11 ^b
Freeze Drying	372.70±3.20 ^a

Note: The values are expressed in mean ± standard deviation where n=2. Different superscript (a-b) shows the value across each column differs significantly (p<0.05).

The total flavonoid content (TFC) of the tea samples was analysed spectrophotometrically using quercetin as a standard, with a calibration curve equation of $y = 0.0009x + 0.1169$. TFC analysis was also conducted on ethanolic extracts. Results in **Table 4** revealed that freeze-dried samples had significantly higher TFC (372 mg QE/g extract) than cabinet-dried ones (121 mg QE/g extract), further demonstrating the influence of drying methods on flavonoid stability. The substantial reduction in TFC in cabinet-dried samples may be attributed to the degradation of heat-labile flavonoid subclasses such as anthocyanins and flavonols, which are known to be highly sensitive to elevated temperatures.

Kittibunchakul *et al.* [17] reported that hot air drying led to greater flavonoid degradation in mulberry compared to freeze-drying, reinforcing that flavonoids are highly sensitive to heat. In particular, subclasses like anthocyanins rapidly degrade through structural breakdown and oxidation when exposed to thermal processing, which may explain the pronounced difference observed. Furthermore, previous studies [18–19] suggest that flavonoids degrade more rapidly under thermal conditions than other phenolic compounds such as tannins, phenolic acids, stilbenes, and lignans. This highlights the importance of freeze-drying as a preferred method for preserving flavonoid content in tea leaves.

Antioxidant Capacity of *Cassia angustifolia* tea leaves

The antioxidant capacity of *Cassia angustifolia* tea leaves was evaluated using DPPH and ABTS assays, both of which showed significant differences between the two drying methods. Freeze-dried samples demonstrated superior free radical scavenging activity compared to cabinet-dried samples, indicating that the drying method significantly influences the retention of antioxidants.

Table 5. Inhibitory concentration at 50% (IC₅₀) of *Cassia angustifolia* tea leaf extracts (cabinet-dried and freeze-dried) and ascorbic acid for DPPH and ABTS assays.

Sample	Antioxidant Activity Test	Equation ($y = mx + c$)	Linearity (r^2)	Radical Scavenging Activity (IC ₅₀ , mg/L)
Ascorbic Acid	DPPH	$y = 0.2613x + 39.211$	0.4802	104.98
	ABTS	$y = 0.2125x + 27.691$	0.5497	41.29
Cabinet Drying	DPPH	$y = 0.1414x + 14.684$	0.7590	249.76
	ABTS	$y = 0.1589x + 19.309$	0.5850	193.15
Freeze Drying	DPPH	$y = 0.1809x + 13.965$	0.6563	199.20
	ABTS	$y = 0.2042x + 17.482$	0.7119	159.25

Note: Ascorbic acids are used as the standard solution. The R-squared (r^2) value that is almost 1, reflecting the linear graph. Lower IC₅₀ value shows the good inhibition concentration.

For the DPPH assay, the IC₅₀ value for ascorbic acid, a well-known antioxidant, was determined to be 104.98 mg/L, as shown in **Table 5**. Comparatively, although the IC₅₀ values of *Cassia angustifolia* tea leaves were significantly higher than ascorbic acid (104.98 mg/L for DPPH and 41.29 mg/L for ABTS), the freeze-dried samples showed relatively stronger antioxidant activity than cabinet-dried samples. However, the antioxidant capacity of these samples was still considerably lower than the reference standard, ascorbic acid, indicating moderate efficacy. A lower IC₅₀ value indicates a stronger antioxidant capacity, suggesting that freeze-dried samples retained more DPPH radical scavenging activity than cabinet-dried samples. These findings align with previous research indicating that lower temperatures help preserve antioxidant properties in plant-based materials [15].

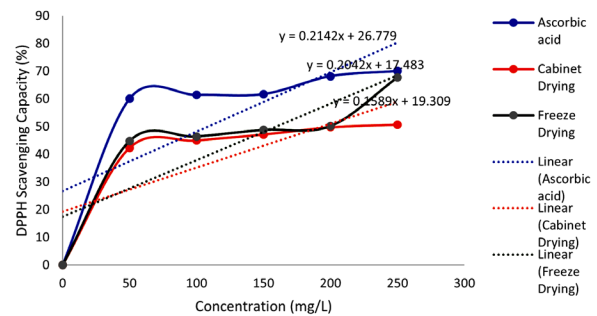


Fig. 1. Inhibition at 50% (IC₅₀) and the linear equation, $y = mx + c$, along with r^2 , of *Cassia angustifolia* tea leaves extract, as measured by the DPPH scavenging capacity. Ascorbic acid is used as a reference.

The results further emphasize that freeze-drying is an effective technique for retaining antioxidant activity, making it a suitable method for preserving tea leaves in the tea industry.

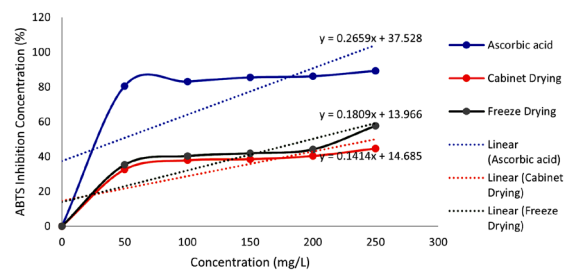


Fig. 2. Inhibition at 50% (IC₅₀) and the linear equation, $y = mx + c$, along with r^2 , of *Cassia angustifolia* tea leaves extract, as measured by the DPPH scavenging capacity. Ascorbic acid is used as reference.

Similarly, the ABTS assay demonstrated a comparable trend. The IC₅₀ value for ascorbic acid against ABTS radicals was found to be 104.98 mg/L. Freeze-dried *Cassia angustifolia* tea leaves exhibited stronger ABTS radical scavenging activity with an IC₅₀ value of 199.20 mg/L, while cabinet-dried leaves had a higher IC₅₀ value of 249.76 mg/L. This further supports the conclusion that freeze-drying preserves antioxidant compounds more effectively than cabinet drying, as high temperatures can degrade polyphenols and flavonoids that contribute significantly to free radical scavenging activity [16]. Overall, both DPPH and ABTS assays confirm that freeze-dried *Cassia angustifolia* tea leaves possess superior antioxidant capacity compared to cabinet-dried samples, highlighting the importance of selecting

appropriate drying methods to maximize the health benefits of herbal teas.

Sensory Evaluation of *Cassia angustifolia* tea beverages

The sensory evaluation of *Cassia angustifolia* tea leaves analysed colour, taste, aroma, and overall acceptance, revealing significant differences between drying methods. The results indicate that panellists preferred cabinet-dried tea over freeze-dried and control samples, with variations in sensory attributes influenced by differences in bioactive compound retention.

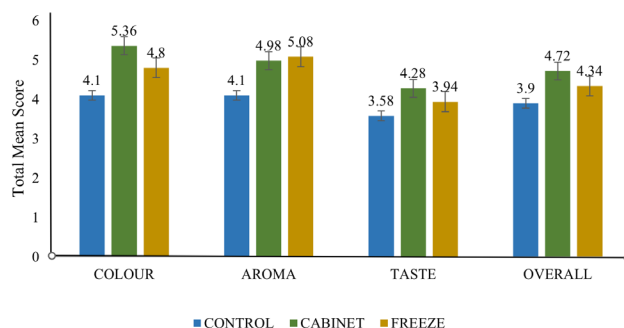


Fig. 3. The graph shows the sensory evaluation of three types of *Cassia angustifolia* tea beverages (control, cabinet drying, and freeze drying) based on the total mean score for each attribute.

Fig. 3 above presents the colour evaluation of the three analysed tea samples. The tea beverage from cabinet drying had the highest preference, followed by freeze-dried tea and the control sample. Based on the results, the order of colour preference from most to least favoured by the panellists was as follows: cabinet drying > freeze-drying > control. From a general assessment, the control sample was less preferred due to its pale-yellow hue, which gave an impression of low concentration or weak infusion. Meanwhile, the freeze-dried sample had an overly pigmented appearance, resulting in a dark brown colour that was perceived as overly strong and less appealing.



Fig. 4. General assessment of the three tea beverage samples. The samples, from left to right, are freeze-dried, control, and cabinet-dried samples, respectively.

This is because freeze-drying preserves a higher concentration of bioactive compounds such as polyphenols [9]. When tea leaves are infused with boiling water, these retained compounds break down and dissolve into the liquid [16]. The cabinet-dried sample was most preferred for colour as it resembled the typical golden-brown hue expected in herbal teas, offering a visually familiar and appealing beverage. Taste evaluation results showed that the cabinet-dried sample received the highest mean score, followed by the freeze-dried sample and the control. Since the samples were brewed without added flavouring, the natural taste of *Cassia angustifolia* tea was assessed. Tannins, key compounds in tea, contribute to both colour and taste. The darker colour of the freeze-dried sample suggests higher polyphenol retention, which likely contributed to a stronger and more bitter taste. This aligns with a previous study

that noted polyphenols influence the sensory perception of tea, particularly bitterness and astringency [20]. Although the freeze-dried tea preserved more beneficial compounds, the enhanced bitterness appears to have negatively affected its taste profile, outweighing its advantage in aroma. This suggests that taste, particularly the balance of astringency and bitterness, may have a stronger influence on overall liking than aroma alone. In terms of aroma, freeze-dried tea received the highest score, followed by cabinet-dried and control samples. The strong and distinct aroma of freeze-dried tea was attributed to the preservation of essential oils, which contribute to flavour and scent. Essential oils are volatile compounds that degrade under high temperatures, making freeze-drying the most effective method for retaining these organoleptic properties [21]. Unlike cabinet drying, which involves heat exposure, freeze-drying prevents thermal degradation of aroma compounds, allowing for enhanced fragrance retention. This explains why the freeze-dried sample was perceived as having the most intense and complex aroma among the tested teas.

However, despite its superior aroma, freeze-dried tea was not the most preferred overall. The overall acceptance evaluation indicated that cabinet-dried tea was the most preferred, followed by freeze-dried and control samples. This contrast highlights the complex interaction between sensory factors—while aroma is important, it does not fully compensate for less favourable taste characteristics such as excessive bitterness. A combination of visual appeal, taste balance, and familiarity strongly influenced consumer preference. Tea with a balanced colour and milder flavour was perceived as more enjoyable, while excessively dark tea was associated with over-extraction and bitterness. Additionally, tea enthusiasts often favour a harmonious flavour profile—mild astringency, smoothness, and a pleasant aftertaste—over intense but imbalanced profiles [22,23].

These findings underscore the importance of flavour balancing in the formulation of functional teas. While high retention of bioactive compounds is nutritionally advantageous, sensory acceptability—particularly in terms of taste and visual appeal—ultimately governs consumer choice. Thus, selecting an appropriate drying method requires balancing nutritional quality with consumer sensory expectations.

CONCLUSION

This study provides a comprehensive assessment of the chemical composition, antioxidant activity, and sensory perception of *Cassia angustifolia* tea leaves and tea beverages with different drying methods. The proximate composition analysis revealed the nutritional content and chemical makeup of the tea leaves. At the same time, significant amounts of key bioactive compounds, such as phenolics and flavonoids, were identified. These compounds play an essential role in combating oxidative stress and may contribute to various health benefits, including improved digestion and potential therapeutic effects. The study also highlights the impact of different drying methods—cabinet drying and freeze-drying—on the retention of nutrients and phytochemicals in the tea leaves. The results show that freeze-drying is more effective in preserving bioactive compounds and antioxidants compared to cabinet drying, which led to some loss due to higher processing temperatures. This highlights the importance of selecting the appropriate processing method to optimize the health benefits of the final product. Additionally, the antioxidant capacity of *Cassia angustifolia* tea, evaluated using DPPH and ABTS tests, demonstrated significant free radical scavenging activity, supporting its potential as a natural dietary antioxidant source. These findings align with the growing interest

in herbal teas as an alternative to conventional beverages, especially those offering medicinal and functional benefits. From a sensory perspective, teas produced using different drying methods showed varying levels of consumer preference. The cabinet-dried sample was generally rated higher in terms of colour and taste, while the freeze-dried sample was more notable for its strong aroma. This highlights the importance of selecting the right drying method for tea production. Evaluating both nutritional and sensory attributes is crucial in product development to ensure consumer satisfaction and market acceptance. Overall, this study contributes to a deeper understanding of the potential of *Cassia angustifolia* tea as a nutraceutical product, combining nutritional benefits with therapeutic properties. These findings pave the way for further research and industrial applications, aiming to optimize production processes and explore broader health implications.

CONFLICT OF INTEREST

The authors have declared that no conflict of interest exists.

ACKNOWLEDGEMENT

First and foremost, I would like to express my greatest gratitude to God for His blessing throughout the process of making this manuscript. Special thanks to Ts. Dr. Mohd Nazri Abdul Rahman for his invaluable guidance and support throughout this research endeavour. I would like to extend my appreciation to those who contribute to my study, my family, friends, and colleagues for their continuous support. Lastly, I also appreciate Universiti Malaysia Sabah and the lab assistant of the Faculty of Food Science and Nutrition for providing me with the facilities, equipment, and machinery necessary for the completion of my research.

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