



## Standardization and qualitative evaluation of tea spice balls as a convenient health-enhancing beverage

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### Abstract

The development, standardization and assessment of Tea Spice Balls-a new convenience food designed to enhance the taste, aroma and potential health benefits of tea. Cardamom, cinnamon, cloves, dried ginger and black pepper are some of the spices used in the product formulation. Tea has been used for its health-promoting qualities for a long time. To achieve a perfect equilibrium of flavor, aroma and nutritional value, the development process involves adjusting the moisture content, binding agents and spice ratios. In order to standardize the product and evaluate consumer acceptability, shelf life and health benefits, the current study conducted sensory, proximate, vitamin and mineral analyses in addition to microbiological evaluations. The results showed that Tea Spice Balls provide essential antioxidant properties and essential nutrients in addition to being a quick and easy way to add flavor to tea.

**Keywords:** Tea spice balls, convenience food, functional beverages, sensory evaluation, antioxidant activity, nutritional analysis

### Introduction

Convenience foods have become extremely common in today's fast-paced world, especially with those who have busy lifestyles or minimal culinary skills. With the convenience of use and nutritional value, these products provide an efficient means to cut down on the time and effort required to prepare meals (Heath & Meek, 2006) <sup>[1]</sup>. One of the most popular drinks in the world, tea (*Camellia sinensis*) is well-known for its flavor as well as a host of other health benefits, such as antioxidant qualities brought on by its polyphenolic compounds (Singh *et al.*, 2021) <sup>[2]</sup>. Spices are now added to tea formulations in an effort to improve their flavor and functional qualities.

Spices have been used for centuries in traditional medicine due to their potent bioactive compounds, which have been shown to possess anti-inflammatory, antimicrobial and antioxidant effects (Saha & Chatterjee, 2024) <sup>[3]</sup>. The addition of spices such as cardamom, cinnamon, cloves, dried ginger and black pepper can elevate the nutritional value of tea while also supporting various physiological

functions, including improved digestion, immune support and cognitive health (Gidwani *et al.*, 2022) <sup>[4]</sup>. Despite the recognized benefits of spiced tea, there remains a need for convenient products that deliver these advantages in an easy-to-use format. The objective of this research was to develop and standardize a novel convenience product-Tea Spice Balls-that combines the traditional flavors and health benefits of spices with the ease of use expected by modern consumers. The product is designed to be added directly to tea, providing an instant infusion of both flavor and health benefits.

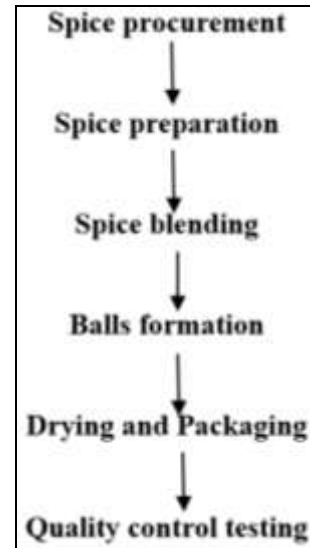
### Materials and Methods

#### Ingredient Purchase

The raw materials for this study were sourced from a local supermarket in Toopran, Hyderabad. The ingredients used were: Cardamom (*Elettaria cardamomum*), Cinnamon (*Cinnamomum verum*), Cloves (*Syzygium aromaticum*), Dried ginger (*Zingiber officinale*), Black pepper (*Piper nigrum* L.)

**Preparation of Product**

The preparation of Tea Spice Balls involved a systematic process beginning with the procurement of high-quality spices selected for their freshness to ensure optimal flavor and health benefits. The spices-cardamom, cinnamon, cloves, dried ginger and black pepper-were thoroughly cleaned to remove impurities and then ground into a fine powder using a mixer grinder. These powdered spices were blended in specific proportions to create three formulations (T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>) as per the standardization matrix (Table 1). Water was gradually incorporated into the spice blend, and the mixture was kneaded to form a homogeneous, pliable dough. This was manually shaped into uniform balls. The formed spice balls were then dried in a hot air oven at 50 °C for 24 hours to reduce moisture content and enhance shelf stability. Finally, the dried Tea Spice Balls were packaged in airtight containers to preserve quality, flavor and microbial safety for extended storage.



**Fig 3:** Procedure of Preparation of Tea Spice cube the sample

**Table 1:** The standardization of variation T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>

Ingredients	Variation-1(T <sub>1</sub> )	Variation-2(T <sub>2</sub> )	Variation-3(T <sub>3</sub> )
Cardamom	30 grams	25 grams	20 grams
Cinnamon	25 grams	30 grams	25 grams
Cloves	20 grams	15 grams	25 grams
Dry ginger	20 grams	20 grams	25 grams
Black pepper	25 grams	10 grams	5 grams



**Fig 1:** Ingredients of tea spice cube

**Sensory Evaluation**

Sensory evaluation of the Tea Spice Balls was carried out using a 7-point hedonic scale, where panelists assessed the color, texture, aroma, taste and overall acceptability of the product. The evaluation was conducted under controlled conditions at Shapur Nagar, Jeedimetla and the results were analyzed using descriptive statistics. The prepared spice ball was mixed into 250 ml of milk tea (includes milk, tea powder and sugar) while boiling and served to the panelists for evaluation using 7 scale hedonic scale.



**Fig 2:** Powdered form of the ingredients



**Fig 4:** Tea spice balls samples along with Tea T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>

**Nutritional Analysis**

The nutritional composition of the selected sample (T<sub>3</sub>) was determined by analyzing the following parameters are Energy (Kcal/100g), Protein (g/100g), Carbohydrates (g/100g), Total Fat (g/100g), Dietary Fiber (g/100g),

Moisture Content (%) and Ash Content (%). These analyses were performed using standard laboratory techniques following AOAC guidelines (AOAC, 2005) [5].

### Mineral and Vitamin Analysis

The vitamin and mineral content of the best sample (T<sub>3</sub>) was analyzed for the following: Vitamin E (mg/100g), Vitamin C (mg/100g), Vitamin K (mg/100g), Vitamin B1 (mg/100g), Vitamin B2 (mg/100g) Minerals including Iron, Calcium, and Potassium were also analyzed using atomic absorption spectroscopy (AAS) (Huang *et al.*, 2018) [6].

### Antioxidant Activity

The antioxidant activity of the Tea Spice Balls was measured using the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay, which is commonly used to determine the free radical scavenging ability of food products (Jayaprakasha *et al.*, 2002) [7].

### Microbial Analysis and Shelf-Life Studies

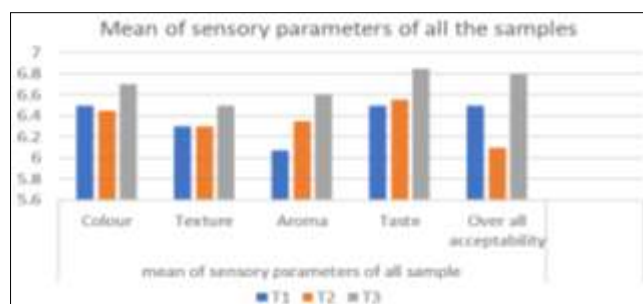
Microbial testing was conducted to evaluate the presence of harmful microorganisms. The microbial parameters tested include aerobic plate count, yeast and mold count, Enterobacteriaceae, and *Staphylococcus aureus*. The shelf life of the product was determined using the AOAC method 925.10, which assesses the stability of the product over a 3-month period (AOAC, 2005) [5].

### Results and Discussion

**The Sensory Evaluation of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> Samples of the tea spice balls:** The sensory evaluation of the data in the Table 2 shows the average and standard deviation of the sensory scores. Colour T<sub>1</sub> sample has a mean value of 6.7 and standard deviation of 0.4, T<sub>2</sub> sample has mean value of 6.2 and standard deviation of 0.7, T<sub>3</sub> sample has mean value of 6.7 and standard deviation of 0.4, in terms of Texture T<sub>1</sub> sample has a mean value of 6.8 and standard deviation of 0.4, T<sub>2</sub> sample has mean value of 6.6 and standard deviation of 0.4, T<sub>3</sub> sample has mean value of 6.7 and standard deviation of 0.5, in terms of Aroma T<sub>1</sub> sample has a mean value of 6.0 and standard deviation of 0.6, T<sub>2</sub> sample has mean value of 6.7 and standard deviation of 0.4, T<sub>3</sub> sample has mean value of 6.6 and standard deviation of 0.6, in terms of Taste T<sub>1</sub> sample has a mean value of 6.8 and standard deviation of 0.4, T<sub>2</sub> sample has mean value of 6.8 and standard deviation of 0.4, T<sub>3</sub> sample has mean value of 6.7 and standard deviation of 0.5 and followed by Overall acceptability the T<sub>1</sub> has a mean value of 6.2 and standard deviation is 0.7, T<sub>2</sub> sample had a mean value 6.5 and standard deviation value is 0.6 and T<sub>3</sub> sample has mean value 6.8 and standard deviation is 0.4. hence as per best sensory attributes T<sub>3</sub> sample selected for further analysis.

**Table 2:** Sensory parameters of treated samples (T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>)

Sample	Colour	Texture	Aroma	Taste	Over all Acceptability
T <sub>1</sub>	6.5± 0.510	6.3± 0.571	6.075± 0.612	6.5± 0.688	6.5± 0.767
T <sub>2</sub>	6.45± 0.510	6.3± 0.732	6.35± 0.670	6.55± 0.604	6.1± 0.640
T <sub>3</sub>	6.7± 0.470	6.5± 0.606	6.6± 0.502	6.85± 0.366	6.8± 0.410



**Fig 5:** Mean values of the T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> samples

Statistical analysis of the sensory data using one-way ANOVA indicated a significant difference (F = 6.96, p = 0.0095) in the sensory scores among the three formulations. This suggests that slight variations in spice ratios can influence the acceptability of the product.

### Nutritional analysis of Tea spice balls

The nutritional analysis of the Tea Spice Balls (sample T-3) revealed a well-balanced composition, highlighting its potential as a functional food product. The energy content of the spice balls was found to be 320.7 kcal per 100 grams, indicating a moderate caloric density suitable for a healthy snack or additive to beverages. The protein content was 8.3 g per 100 grams, which is beneficial for supporting muscle repair and growth, aligning with the known nutritional profiles of the spices used (Gidwani *et al.*, 2022) [4]. The carbohydrate content, at 55 g per 100 grams, is primarily derived from the spices' natural sugars and fiber, which contribute to the product's energy release and digestive benefits (Haro-González *et al.*, 2021) [8]. Additionally, the total fat content of 7.5 g per 100 grams reflects a healthy fat profile, predominantly from the spices' natural oils, which are recognized for their antioxidant and anti-inflammatory properties (Gopalakrishnan, 1994) [9]. The high dietary fiber content, measured at 31.7 g per 100 grams, is particularly noteworthy, as it promotes digestive health, aids in satiety, and supports metabolic functions (Saha & Chatterjee, 2024) [3]. The moisture content was 28.96%, which is relatively low, supporting a longer shelf life, while the water activity of 0.26% further suggests that the product is less susceptible to microbial growth, enhancing its safety and stability during storage (Jolad *et al.*, 2005) [10]. The minimal ash content (0.3%) indicates that the spice balls are primarily composed of organic materials, with negligible inorganic residues. This nutritional profile suggests that Tea Spice Balls can serve as both a flavorful and health-enhancing addition to tea, providing essential nutrients while complementing the beverage's natural antioxidant properties (Sunarharum *et al.*, 2022) [11].

**Table 3:** The Nutritional analysis of Tea spice balls (sample T-3)

Test parameters	Units	Results
Energy	Kcal	320.7
Protein	g/100gm	8.3
Carbohydrates	g/100gm	55
Total fat	g/100gm	7.5
Dietary fiber	g/100gm	31.7
Moisture	%	28.958
Water activity	%	0.26
Ash	%	0.3

**Mineral and Vitamin analysis of Tea spice balls**

The combined mineral and vitamin analysis of Tea Spice Balls reveals a notable profile of essential micronutrients that contribute to the product’s health-promoting properties. The sample exhibited significant mineral content, with calcium (754 mg/100g) and potassium (1048 mg/100g) being the most prominent. Calcium is critical for bone health and muscle function, while potassium supports heart health by maintaining proper electrolyte balance and blood pressure regulation (Saha & Chatterjee, 2024) [3]. The iron content of 23 mg/100g indicates a moderate contribution to daily iron requirements, supporting its role in preventing iron deficiency anemia, especially when consumed regularly as part of a balanced diet (Gopalakrishnan, 1994) [9].

Regarding vitamins, the Tea Spice Balls are a rich source of Vitamin K (143 mg/100g), an essential nutrient for blood clotting and bone health (Gidwani *et al.*, 2022) [4]. The presence of Vitamin C (20.7 mg/100g) enhances immune function, while Vitamin E (3.06 mg/100g) offers antioxidant benefits, protecting the body from oxidative stress and supporting skin health (Haro-González *et al.*, 2021) [8]. The small but notable presence of Vitamins B1 (0.2 mg/100g) and B2 (0.15 mg/100g) further indicates a modest contribution to energy metabolism and overall vitality. Together, these micronutrients make Tea Spice Balls not only a flavorful addition to beverages but also a valuable source of essential vitamins and minerals, aligning with the growing consumer interest in functional foods that support wellness (Sunarharum *et al.*, 2022) [11].

**Table 4:** Mineral and Vitamin analysis of Tea spice balls

Test parameters	Units	Results
Iron	mg/100gm	23
Calcium	mg/100gm	754
Potassium	mg/100gm	1048
Vitamin E	mg/100mg	3.06
Vitamin C	mg/100mg	20.7
Vitamin K	mg/100mg	143
Vitamin B1	mg/100mg	0.2
Vitamin B2	mg/100mg	0.15

**Antioxidant activity of Tea spice balls**

The antioxidant activity of the Tea Spice Balls was evaluated, revealing a total antioxidant content of 3.2 mg/100 mg (Table 5). This value highlights the potential health benefits of the product, particularly in terms of its ability to combat oxidative stress, which is linked to various chronic diseases and aging (Gidwani *et al.*, 2022) [4]. The presence of antioxidants, primarily derived from the spices such as cinnamon, clove, and black pepper, supports the product's role as a functional food. These spices are rich in polyphenols, flavonoids, and other bioactive compounds known for their antioxidant properties (Haro-González *et al.*, 2021) [8]. Antioxidants play a key role in neutralizing free radicals, which can otherwise lead to cellular damage. The 3.2 mg/100 mg of total antioxidant content indicates that Tea Spice Balls may serve as an effective supplementary source of antioxidants when consumed as part of a balanced diet, further enhancing their potential as a wellness product (Sunarharum *et al.*, 2022) [11].

**Table 5:** Antioxidant activity of Tea spice balls

Test parameters	Units	Results
Total antioxidant	mg/100mg	3.2

**Microbial analysis of the Tea spice balls**

The microbial analysis of the Tea Spice Balls revealed that the product meets safety standards for microbial contamination (Table 6). The aerobic plate count and yeast & molds were both found to be less than 10 CFU/g, indicating minimal microbial growth and ensuring the product's hygienic quality. Furthermore, the absence of *Enterobacteriaceae* and *Staphylococcus aureus* (*S. aureus*) in the sample confirms that the Tea Spice Balls are free from common pathogens that could pose health risks (Gidwani *et al.*, 2022; Sunarharum *et al.*, 2022) [4, 11]. These results are crucial for validating the product's safety, particularly given the use of spices with natural antimicrobial properties, such as cinnamon and clove (Haro-González *et al.*, 2021) [8]. The low microbial count coupled with the absence of harmful bacteria suggests that the drying and packaging processes, including the use of airtight containers, were effective in preserving product quality and extending shelf life. This level of microbial control is essential for the commercial viability and consumer acceptance of functional foods like Tea Spice Balls, which must not only offer health benefits but also meet stringent food safety regulations.

**Table 6:** Microbial analysis of the tea spice balls

Test parameters	Units	Results
Aerobic plate count	CFU/g	<10
Yeast & Molds	CFU/g	<10
Enterobacteriaceae	CFU/g	Absent
<i>S. aureus</i>	CFU/25 g	Absent

**Conclusion**

The Development and Evaluation of Tea Spice Balls demonstrate their potential as a convenient, functional food product that combines traditional spices with modern consumer preferences for convenience and health benefits. The product exhibited promising nutritional profiles, including a significant amount of dietary fiber, essential minerals, vitamins and along with antioxidant properties all of which contribute to its health-promoting potential. Microbial analysis confirmed the product's safety, with minimal microbial contamination and the absence of harmful pathogens, indicating effective preservation through drying and airtight packaging. Given the combination of flavor enhancement, health benefits, and ease of use, Tea Spice Balls present a valuable addition to the growing market of functional foods, offering a practical and nutritious option for health-conscious consumers. Further studies on long-term shelf stability and consumer acceptance could help optimize production and solidify the product's place in the functional beverage industry.

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