# "A Study on Infused Tea: A Power Pack of Ingredients with Anti-Inflammatory and Immune Enhancement Effects"

**Akshatha[1], Manasa S[2], Muhsin. V. M [3], Janani Pritha. D. R [4]**

[1]Assistant professor, Department of Clinical Nutrition and Dietetics, Padmashree Institute of Management and Sciences, Bangalore, Akshatha.pims@gmail.com.

[2,4] Bachelor of Science, Department of Clinical Nutrition and Dietetics, Padmashree Institute of Management and Sciences, Bangalore.

[3] Bachelor of Science, Department of Nutrition and Dietetics, Padmashree Institute of Management and Sciences, Bangalore.

## ABSTRACT

The growing consumer interest in functional beverages has driven innovation in herbal tea development that prioritizes both health benefits and sensory appeal. This study focused on formulating, standardizing, and evaluating a novel caffeine-free infused tea made from a unique blend of dragon fruit, rose petals, hibiscus, cinnamon, cardamom, cloves, and black pepper. These ingredients were selected for their rich phytochemical composition, proven health-promoting properties, and complementary flavor profiles. The preparation process involved sourcing, drying, and pulverizing raw materials, followed by the development of three distinct formulations. Sensory evaluation by 15 semi-trained panelists assessed key attributes including color, aroma, taste, mouthfeel, and aftertaste. In each formulation, moisture content was TS1(0.80%± 0.68), TS2 (0.32 % ± 0.002) and TS3 (0.15% ± 0.22) and ash content TS1(5.22%± 0.18), TS2 (5.27 % ± 0.14) and TS3 (5.33% ± 0.07). Among the variation TS3 tannins (33.5mg/100g) and phenols (56.4 GAE mg/100g) ranked highest. Additionally, thin thin-layer chromatography (TLC) and UV-Visible spectrophotometry were employed to confirm the presence of major functional compounds. The detection of phenolics, flavonoids, and anthocyanins underscores the tea's therapeutic potential, particularly in promoting immune health and reducing inflammation. Overall, the study demonstrates the feasibility of developing a scientifically validated herbal tea that aligns with the rising demand for natural, health-oriented beverages.

**Keywords** – Infused tea, Dragon fruit, Herbal formulation, Phytochemical.

## I. Introduction

Herbal tea is a widely consumed beverage traditionally prepared from the leaves, flowers, seeds, fruits, stems, or roots of various plant species help in health maintenance and disease prevention, herbal teas have gained increasing attention due to their potential health-promoting effects, largely attributed to their rich content of bioactive compounds (Kamiloglu *et al.*, 2012). Numerous epidemiological studies have demonstrated the role of herbal supplements in reducing the risk of chronic diseases like cardiovascular disorders, diabetes (Vinson *et al*., 2001), and arthritis (Haqqi *et al*., 1999). The use of various fruit extracts in herbal tea formulations enhances antioxidant properties with improved sensory attributes (Dhalla *et al*., 2000). Among tropical fruits, dragon fruit has grown in popularity due to its vibrant appearance, refreshing flavor, and nutritional richness. It is a significant source of essential nutrients and bioactive compounds, including glucose, dietary fiber, polyphenols, betacyanins, carotenoids, vitamin C, calcium, and phosphorus, which contribute to both nutrition and disease prevention (Venkatesh *et al*., 2025). Research has shown that hot infusions prepared with hibiscus and rose petals exhibit enhanced levels of bioactive compounds, with hibiscus–rose tea demonstrating 47% higher total anthocyanin content. Rose teas have also been reported to contain 50.7–119.5 mg/100 ml of gallic acid equivalents (GAE), comparable to or exceeding those in green tea (Vinokur *et al*., 2006). Blended herbal infusions, especially those incorporating clove, cinnamon, cardamom, and black pepper, have been found to possess elevated levels of phenolic and flavonoid compounds. Clove tea, in particular, has demonstrated the highest total phenolic content, flavonoid content, and antioxidant activity as measured by ABTS and DPPH radical scavenging assays, as well as increased β-carotene and anthocyanin levels (Islam *et al*., 2019). Based on these findings, the present study aims to develop and evaluate an infused herbal tea formulated from selected ground medicinal herbs namely cardamom, cinnamon, clove, and black pepper focusing on their antioxidant potential and synergistic health benefits.

## II. Materials and Methods

The study aims to develop an infused herbal tea incorporating dragon fruit, rose, hibiscus flower and spices (cinnamon, cardamom, cloves, black pepper). The product formulation and analysis were performed and conducted in the Department of Clinical Nutrition and Dietetics at Padmashree Institute of Management and Sciences Bangalore in 2025.

**Procurement of raw materials**

Raw materials used for the preparation of infused herbal tea such as dragon fruit, hibiscus, rose, cinnamon, clove, cardamom, black pepper, were procured from local suppliers in Bangalore dragon fruit was used as the main ingredient, rose and hibiscus is added for colour and nutritional benefits spices (cinnamon, cardamom, clove, pepper) adds on flavor with anti-inflammatory properties. The tea bag used for infusing the herbal tea was procured from an e-commerce platform.

## Methods of Preparation

**Step 1: Peeling**

Firstly, peel the dragon fruit and separate the petals from the rose and hibiscus flowers.

**Step 2: Washing**

Wash the dragon fruit, rose and hibiscus flowers.

**Step 3: Slicing**

After washing cut the dragon fruit into small slices

**Step 4: Drying**

De-moisturizing of the sample was performed through the hot air oven method for the sample (dragon fruit, rose and hibiscus flower) at 50 °C for 5-6 hours.

**Step 5: Pulverizing and Formulating**

Pulverizing of the sample (dragon fruit, rose, hibiscus flower, and the spices cinnamon, cardamom, clove, pepper) was done to formulate as shown Table 1 and filled into the tea bags

**Step 6: Boiling and steeping**

Boil 100ml of water at 100ºC for steeping of the tea bag

Procurement of the raw materials

↓

Cleaning & Separating (rose, hibiscus)

↓

Peeling & Slicing (dragon fruit)

↓

Drying (Dragon fruit, rose, hibiscus)

↓

Pulverizing (Dragon fruit, rose, hibiscus)

↓

Weigh & mix all the ingredients (Formulation)

↓

Filling ingredients into filter bags

↓

Boiling and steeping

**Flow Chart No. 1 Formulation of infused herbal tea**

Pawar *et al.*, (2024) International research journal of modernization in engineering technology and science

**Table No. 1: Standardization and formulation of product**

| Ingredients (g) | TS1 (mg) | TS2 (mg) | TS3 (mg) |
|---|---|---|---|
| Hibiscus | 800 | 700 | 600 |
| Dragon fruit | 700 | 800 | 600 |
| Rose petals | 600 | 800 | 700 |
| Cinnamon | 300 | 200 | 200 |
| Cardamom | 200 | 200 | 300 |
| Clove | 200 | 200 | 300 |
| Black pepper | 200 | 200 | 300 |
| Total | 3000 | 3000 | 3000 |

## Sensory evaluation

A sensory evaluation using the descriptive method was conducted with 15 semi-trained panelists. Each panelist was given three different samples and told to identify and describe the differences in appearance (colour, clarity, sediment), aroma (floral, fruity, tart, spicy,) flavor (Tartness-acidity, floral, fruity, spice,) mouthfeel (body- light to medium, astrigency-moderate from) aftertaste (floral/spice linger, long lasting floral and warm spice notes) clean finish (non lingering bitterness) and balance among them. De-Heer *et al.*, (2011)

## Nutrition evaluation

Moisture evaluation

Moisture content was determined by weighing approximately 5g of each sample in duplicate using de-moisturized Petri plates. Moisture analysis was conducted at 105°C for 4 hours and the samples were cooled in a desiccator and weighed. AOAC (1990)

$$\text{Moisture (\%)} = \frac{100 \times (W1 - W2)}{W}$$

W1= Weight of the petri dish and sample before drying in (g)

W2 = Weight of the petri dish and sample after drying in (g)

W= Weight of the empty petri dish in (g)

## Ash evaluation

The ash content of the sample was determined by dry ashing. The samples are placed into a muffle furnace at put into an ash incinerator at 550°C for 4 hours. AOAC (1990).

$$\text{Total ash (\%)} = \frac{(W2 - W1) \times 100}{W}$$

## Anti-nutritional test

### Qualitative test for tannins

A 1 ml sample is mixed with 10 ml of distilled water and boiled. After boiling, a few drops of 0.1% ferric chloride are added and mixed well. The formation of a blue-black color confirms the presence of tannins. Mughal *et al*., (2018).

### Quantitative test for tannins

Sample volumes of 0, 0.2, 0.4, 0.6, 0.8, and 1.0 ml are taken. Distilled water is added to each to a final volume of 1 ml, followed by 1 ml of 35% Sodium bi carbonate After a 20-minute incubation at room temperature, 0.5 ml of Folin's reagent is added, and the mixture is incubated again at room temperature before measuring the O.D. at 660 nm using a colorimeter. Mughal *et al*., (2018).

## Phytochemical test

### Qualitative test for phenols

1 ml sample is mixed with 10 ml of distilled water and boiled. After boiling, a few drops of 0.1% ferric chloride are added and mixed well. The formation of greenish blue colour indicates the presence of phenols. Sonam *et al*., (2017).

### Quantitative test for phenols

Sample volumes of 0, 0.2, 0.4, 0.6, 0.8, and 1.0 ml are taken. Distilled water is added to each to a final volume of 1ml, followed by 5 ml of 7% Sodium bi carbonate After a 20-minute incubation at room temperature, 0.5 ml of Folin's reagent is added, and the mixture is incubated again at room temperature before measuring the O.D. at 660 nm using a colorimeter.

### Thin-layer paper chromatography

Chromatography was performed using TLC silica gel 60 $F_{254}$ aluminium sheets (Merck, Germany) of size 7.5 cm × 10 cm. Aqueous extracts and solvent mixtures comprising methanol, acetic acid, butanol, acetone, chloroform, and toluene in various proportions were prepared at a concentration of 100 mg/mL and used for TLC analysis. A 10 µL volume of each extract was manually applied as a spot using a 50 µL Hamilton syringe, positioned 1 cm from the bottom and 1.5 cm from the side of the plate. Each TLC plate was used to analyze anthocyanins, polyphenols, alkaloids, terpenes, flavonoids, and phenolics, with five spots applied per plate and 1.5 cm spacing between each spot. The spotted TLC plates were developed in a glass chamber pre-saturated with different solvent systems as the mobile phase. After development, the plates were removed and dried on a hot plate to evaporate residual solvents. The separated spots were visualized under an ultraviolet (UV) chamber, and the Rf values were calculated accordingly. Sureshkumar *et al*., (2021).

**UV-Visible spectrophotometry**

The sample was extracted and filtered through Whatman No. 1 filter paper. The filtrate was diluted and analyzed using a UV-visible spectrophotometer with a wavelength range of 200 to 800 nm, with characteristic absorption peaks recorded. *(*Jirvankar *et al., 2022).*

**Statistical analysis**

The experimental data were analyzed in duplicate (n = 2) and the results were processed using Microsoft Excel. Outcomes were reported as their means and standard deviations (±).

## III. Result and Discussion

The herbal tea mix was developed at room temperature through three trials (T1, T2, T3), as presented in Table 1. All raw materials were pre-processed (cleaning, drying, pulverizing). This method, adapted from Zhao *et al*., (2023), successfully extended the shelf life of the ingredients by approximately 5 to 8%. More importantly, it contributed to the preservation of key phytonutrients and bioactive compounds, including catechins, flavanols, saponins, and compounds responsible for antioxidant activity. Mechanical grinding, hand crushing allowed for the gentle release of essential oils, thereby enhancing the tea's aroma and flavor. This traditional method also ensured minimal loss of nutritional value and preserved the volatile oils, as supported by findings from Zhao *et al*., (2016).

**Sensory evaluation**

A detailed descriptive sensory analysis was conducted to evaluate the infused herbal tea focusing on specific attributes including appearance, aroma, flavor, mouthfeel, and aftertaste among various trials (T1, T2, T3).

**Appearance**

The intensity of colour in the floral-infused tea samples is attributed to the presence of anthocyanins, flavonoids, and betacyanins (Pichayajittipong & Thaiudom, 2014; Yuniati *et al*., 2021) derived from rose, dragon fruit, and hibiscus, respectively. These pigments contribute to a varied colour spectrum, as detailed in Tables 2, 3, and 4. Panelists recorded the highest intensity shades of dark pink (9) and deep magenta (2).

**Aroma**

The intensity of aroma in the floral-spice infused tea samples can be attributed to the presence of volatile compounds such as linalool, geraniol, and eugenol, which are primarily derived from hibiscus and rose (Yilmaz & Gokmen, 2020; Pires *et al*., 2018). These compounds, along with elevated levels of aromatic esters and aldehydes (Marchioni *et al*., 2024), contribute to the refreshing, pleasant, and long-lasting floral (9) and spicy (4) notes perceived by the panelists**.**

**Flavour**

The distinct spice and floral flavours observed in the infused tea are attributed to the presence of bioactive compounds cinnamaldehyde, eugenol, and linalool observed in cinnamon, clove, and rose respectively (Guleria, 2016; Zua *et al*., 2013). A slight tartness noted by the panelists is likely due to the presence of tannins (Clifford, 2000). Sensory evaluation revealed a high intensity of spice flavour (7) and floral flavour (5).

### Mouthfeel and Aftertaste

The mouthfeel of the infused tea was described as having a medium body or thickness, attributed to the combination of hibiscus, rose, dragon fruit, and selected spices (Hofmann, 2018). Among the variations, T2 recorded the highest intensity in mouthfeel according to panelists. The aftertaste was noted as long-lasting, characterized by warm, spicy, and floral notes. The warming sensation was linked to essential oils and phenylpropanoids present in spices such as clove and cinnamon, while the floral after-notes were attributed to volatiles from rose and hibiscus (Rebello *et al*., 2022). As noted by (Lee *et al*.,2018), essential oils from edible flowers not only contribute to aroma but also create a soothing, warm aftertaste due to their volatility and retention in the oral cavity (Karori *et al*., 2007).

a. b. c.

d. e. f. g.

**Figure 1**: Procurement of the raw materials
a. Rose b. Dragon fruit c. Hibiscus d. cinnamon e. Cardamon f. Clove g. Pepper

a. b. c.

**Figure 2**: Drying of raw materials
a.Rose b. Dragon fruit c. Hibiscus.

a. b. c. d.

**Figure 3**: Pulverization using mortar-pestle
a. Cinnamon b. Cardamon c. Clove d. Pepper

**Figure 4**: Ingredients packed in LDPE.

**Table 2**: Descriptive method of sensory evaluation TS1

| Appearance | Aroma | Flavor | Mouthfeel | Aftertaste |
|---|---|---|---|---|
| Dark pink (9) | Spicy (7) | Spice (11) | Light (5) | Long-lasting & balanced (7) |
| Light pink (2) | Floral (6) | Floral (2) | Medium (5) | Long-lasting & warm spices (5) |
| Magenta Pink (2) | Tart (1) | Tartness (1) | Moderate (4) | Long-lasting & floral (2) |
| Ruby red (1) | Fruity (1) | Fruity (1) | Spicy (1) | Slightly long-lasting (1) |
| Medium pink (1) | | | | |

**Table 3**: Descriptive method of sensory evaluation TS2

| Appearance | Aroma | Flavor | Mouthfeel | Aftertaste |
|---|---|---|---|---|
| Light pink (5) | Floral (9) | Spice (7) | Medium (6) | Long-lasting & balanced (5) |
| Dark pink (4) | Spice (3) | Floral (5) | Light (5) | Long-lasting & Floral (4) |
| Ruby pink (2) | Fruity (2) | Fruity (3) | Moderate (4) | Bitterness (3) |
| Deep magenta (2) | Tart (1) | | | Long-lasting & warm (2) |
| Deep pink (2) | | | | Floral Bitterness (1) |

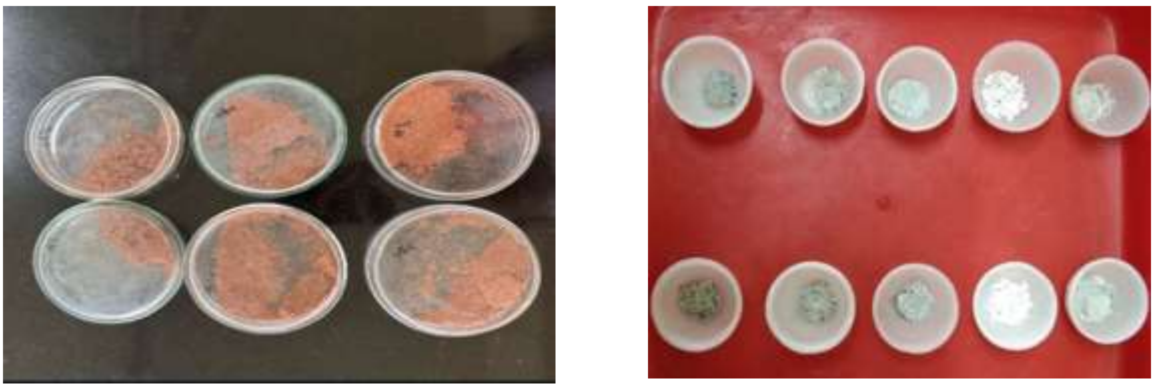
**Table 4**: Descriptive method of sensory evaluation TS3

| Appearance | Aroma | Flavor | Mouthfeel | Aftertaste |
|---|---|---|---|---|
| Light pink (7) | Floral (8) | Spicy (7) | Moderate (5) | Balanced (5) |
| Dark pink (4) | Spicy (4) | Floral (4) | Light (5) | Long-lasting & balanced (4) |
| Ruby red (2) | Fruity (2) | Tart (2) | Medium (4) | Floral (3) |
| Deep Magenta (2) | Bitter (1) | Fruity (2) | Fruity (1) | Bitterness (3) |


**Figure 5**: Infused tea bag for sensory evaluation

**Nutritional Analysis**

The ash content of Hibiscus (HS), Dragon Fruit (DS), and Rose (RS) was recorded at 5.3%, 6.04%, and 4.12%, respectively. The spice mixtures comprising clove, cinnamon, cardamom, and pepper showed ash contents of 4.66% (SS1), 6.16% (SS2), and 6.19% (SS3), as illustrated in Graph 1. These findings align with earlier reports by Mahadevan & Pradeep (2009), Yasmin *et al.*, (2024), and Silva *et al*., (2014), who documented ash contents of 6.9% for hibiscus flowers, 1.27% for red dragon fruit, and 5.22% for rose petals, respectively. The moisture content (%) of the infused herbal tea trials was found to be low across all formulations: TS1 (0.80%), TS2 (0.32%), and TS3 (0.15%), which is favorable for extending the shelf life. Among the formulations, TS3 recorded the highest ash content (5.33%), indicating a richer mineral presence compared to the other trials. Rohmah *et al.*, (2025) developed an herbal tea by drying the samples at temperatures of 45°C, 50°C, and 55°C. The drying process resulted in moisture contents ranging from 3.09% to 6.76%, with the highest ash content of 14.30% observed at the maximum drying temperature of 55°C.



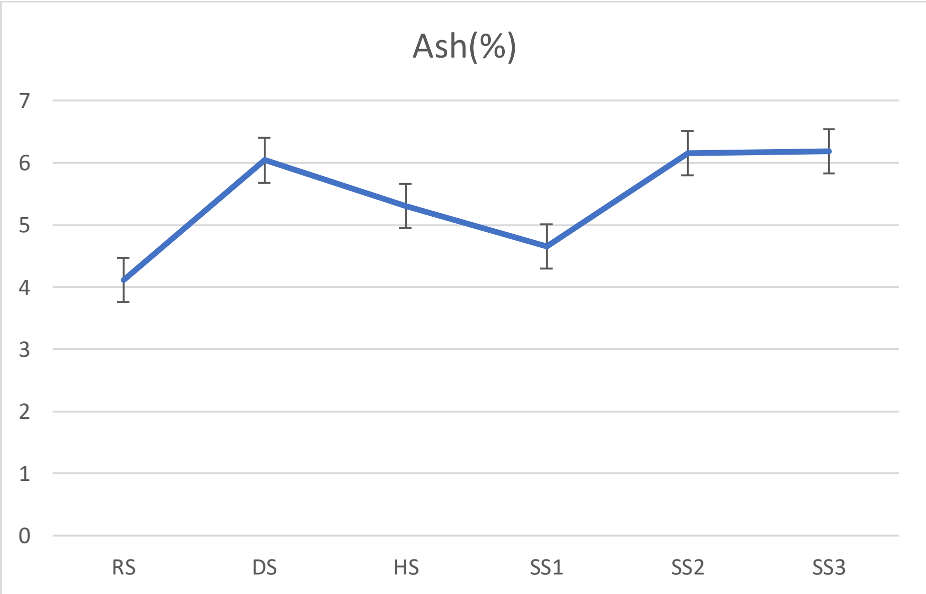
**a.** **b.**

**Figure 6:** a) Petri plate of moisture estimation, b) Crucibles of ash estimation.

**Table 5**: Nutritional analysis of developed infused herbal tea

| Nutrient | TS1* | TS2* | TS3* |
|---|---|---|---|
| **Ash (%)** | 5.22 ± 0.18 | 5.27 ± 0.14 | 5.33 ± 0.07 |
| **Moisture (%)** | 0.80 ± 0.68 | 0.32 ± 0.002 | 0.15 ± 0.22 |

(n=2), *TS1- Tea sample 1, TS2- Tea sample 2, TS3- Tea sample 3.




* RS- Rose sample, DS- Dragon fruit sample, HS- Hibiscus sample, SS1- Spices mix 1, SS2- Spices mix 2, SS3 - Spices mix 3

**Graph 1:** Ash (%) of the raw materials

## Phytochemicals Analysis

### Tannins

Tannins are a prominent group of polyphenolic compounds, commonly found in rose petals, cloves, cinnamon, and hibiscus. A qualitative phytochemical analysis, as shown in Table 6, confirmed the presence of tannins in the herbal tea samples. These compounds are known for their potent antioxidant activity, effectively neutralizing free radicals and protecting cells from oxidative stress, as noted by Chung *et al*., (1998). Among the tested variations, the TS1 sample contained 24 mg/100g of tannins, while TS3 exhibited a higher concentration of 33.5 mg/100g. These findings are in line with the results reported by Sunday *et al*., (2024), where tannin content in herbal tea blends ranged between 2.34 mg/100g and 3.86 mg/100g, depending on the composition of floral and spice ingredients.

### Total Phenols

Total phenolic compounds play a significant role in improving endothelial function and reducing the oxidation of low-density lipoprotein (LDL). Phenols derived from fruits such as dragon fruit and floral infusions have also been shown to lower postprandial blood glucose levels and inhibit key digestive enzymes like α-amylase and α-glucosidase, as reported by Sari *et al*., (2017). Moreover, studies indicate that the combination of various spices, fruits, and flowers in herbal tea blends enhances the bioavailability and overall efficacy of total phenols due to synergistic interactions among the phytochemicals. A qualitative test confirmed the presence of phenolic compounds by the development of a greenish-blue coloration, indicating positive results. As detailed in Table 7, the total phenol content was found to be 54.6 mg GAE/100g in TS1, 52.6 mg GAE/100g in TS2, and 56.4 mg GAE/100g in TS3. These values are consistent with the findings of Rohman *et al*., (2025), who observed that higher drying temperatures lead to the inactivation of polyphenol oxidase enzymes. Their study reported phenolic values in herbal teas ranging from 18.01 mg GAE/g to 29.90 mg GAE/g, depending on processing conditions**.**

**Table 6:** Qualitative test for phytochemical parameters of infused tea.

| Sl.no | Name of the compound | Observation | Result |
|---|---|---|---|
| 1. | Tannins | Blue-black color was observed | + |
| 2. | Total phenols | A greenish blue color was observed | + |

**Table 7:** Quantitative test for phytochemical parameters of infused tea.

| Sample | Tannins(mg/100g) | Total phenols (GAE mg/100g) |
|---|---|---|
| TS1 | 24 | 54.6 |
| TS2 | 32 | 52.6 |
| TS3 | 33.5 | 56.4 |

**Thin layer paper chromatography**

Thin Layer Chromatography (TLC) analysis confirmed the presence of various bioactive compounds such as polyphenols, flavonoids, phenolics, anthocyanins, terpenes, and alkaloids, abundantly present in spices, edible flowers, and fruits, as illustrated in Figure 7. These phytochemicals are associated with a wide range of health-promoting effects, including anti-inflammatory, anti-diabetic, neuroprotective, cardioprotective, cholesterol-lowering, digestive support, and anti-cancer properties, as reported by Díaz *et al*., (2020). In the current study, the Rf value of 0.89 in all three formulations (TS1, TS2, TS3) indicated the presence of anthocyanins, as determined using a solvent system of butanol, acetic acid, and water. Similarly, an Rf value of 0.91, observed with the solvent mixture of chloroform, methanol, and acetic acid, confirmed the presence of flavonoid and phenolic compounds. These findings are consistent with the study by Yahyaoui *et al*,. (2017), who used TLC to profile phytochemicals in *Adansonia digitata* and *Acacia raddiana* extracts.

**Table 8:** Thin Layer Chromatography solvent mixture and retention factor

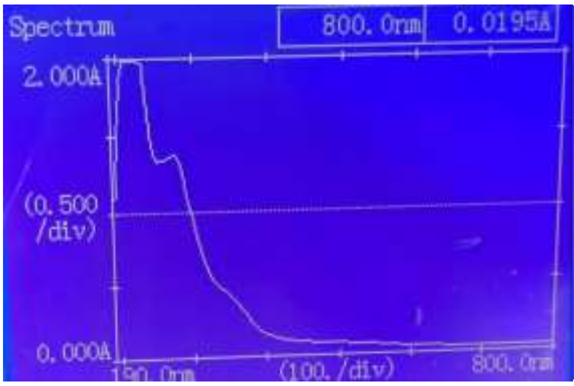
| Sl.no | Compounds | Solvent system* | Rf value | Result |
|---|---|---|---|---|
| 1. | Anthocyanins | n-butanol: Acetic acid: Water (4:1:5) | 0.89 | Present |
| 2. | Polyphenols | Acetone: Water (8:2) | 0.48 | Present |
| 3. | Alkaloids | Chloroform: Methanol (9:1) | 0.86 | Present |
| 4. | Terpenes | Toulene :Acetone (9:1) | 0.68 | Present |
| 5. | Flavonoids + Phenolics | Chloroform: Methanol: Acetic acid (10:5:1) | 0.91 | Present |
| 6. | Betalins | Methanol: Water (5:5) | 0 | Absence |

*Danciu *et al*., (2018).

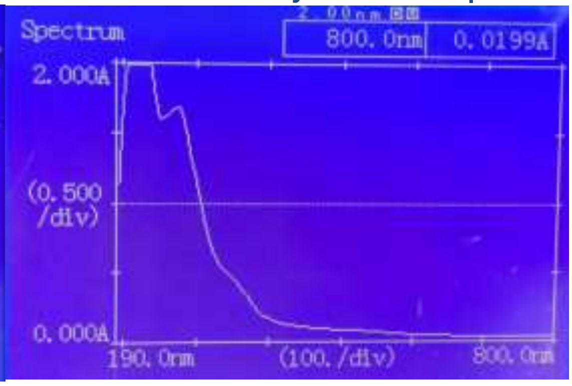
**Figure 7**: Thin layer chromatography of phytochemical screening

**UV-Visible spectrophotometer**

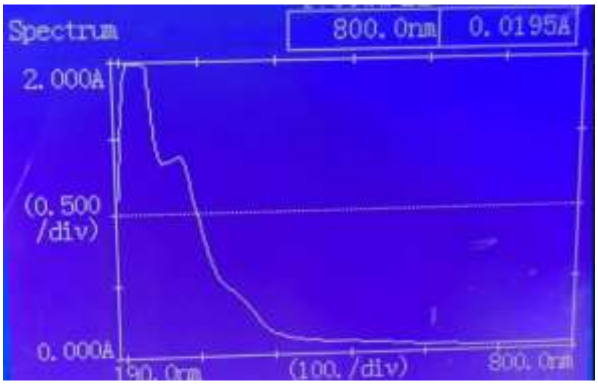
The UV-Visible absorbance spectrum of the sample is illustrated in Figure 8, where a distinct peak in the range of 270–275 nm with absorbance values between 1.3 and 1.6 indicates the presence of phenolic compounds, flavonoids, and tannins. Additionally, a strong absorbance observed between 215–220 nm (ranging from 2.3 to 2.5) confirms the presence of alkaloids, peptides, terpenoids, and saponins, which are commonly associated with absorption in the deep UV region.




**a.**




**b.**




**c.**

**Figure 8**: a.T1, b. T2, c. T3 UV-Visible Absorption Spectrum of Infused Tea

## IV. Conclusion

The development of this novel infused tea blend brings together tradition, wellness, and innovation in a single cup. By thoughtfully combining nutrient-rich dragon fruit, fragrant edible flowers like rose and hibiscus, and the time-tested warmth of spices such as cardamom, cinnamon, clove, and pepper, this tea offers not just a flavorful beverage but a holistic sensory experience. Each ingredient contributes more than taste or aroma; they bring potential health benefits, from antioxidant protection and digestive support to anti-inflammatory effects. The balanced profile of fruity brightness, floral elegance, and spicy warmth makes the blend both comforting and refreshing, appealing to a wide range of consumers looking for functional yet enjoyable drinks. The exploration of novel ingredients in this herbal tea blend highlights the potential of combining functional botanicals with appealing sensory characteristics. The synergy of dragon fruit's nutritional richness, floral elegance from hibiscus and rose, and the spicy warmth from traditional herbs creates a unique infusion that's both palatable and health-promoting. Through careful formulation and ingredient selection, this blend not only enhances the drinking experience but also aligns with the increasing consumer demand for clean-label, antioxidant-rich, and immune-supportive beverages. This study opens the door to further research into bioactive compound stability, consumer acceptability, and market scalability, while reinforcing the importance of culturally rooted yet innovative functional drinks

## V. Acknowledgment

The author gratefully acknowledges Padmashree Institute of Management and Science, along with the Head of Department and Principal, for providing the laboratory facilities and essential support that enabled the successful completion of this research work.

## VI. Reference

1. AOAC, Official Methods of Analysis of the Association of Official Analytical Chemists (15th edition), Washington D.C, 992 – 995, 1990.
2. Chung. K.T, "Tannins and human health: A review". *Critical Reviews in Food Science and Nutrition*, 38(6), 421–464,1998.
3. Clifford. M. N, "Tannins – the polyphenols responsible for astringency in tea and wine", *Critical Reviews in Food Science and Nutrition*, 40(6), 421–464, 2000
4. Da Silva. S. F, Cardoso. J. R, Mendes. J. V, & Pinto. M. V, "Pharmacognostic study of Rosa alba L". *Revista Eletrônica FMB, 7*, 136-150, 2014.
5. Danciu. V, Hosu, A, & Cimpoiu. C, "Thin-layer chromatography in spices analysis", *Journal of Liquid Chromatography & Related Technologies*, *41*(6), 282-300, 2018.
6. De-Heer. N. E. A, "Formulation and sensory evaluation of herb tea from Moringa oleifera, Hibiscus sabdariffa and Cymbopogon citratus (Master's thesis, Kwame Nkrumah University of Science and Technology)". *Kwame Nkrumah University of Science and Technology*, 23-38, 2014.
7. Dhalla. N. S, Temsah. R. M, & Netticadan. T, "Role of oxidative stress in cardiovascular diseases", *Journal of hypertension*, 18(6), 655-673, 2000
8. Díaz. L, Cárdenas Toro. F. P, & Vallejo-Castillo. V, "Total phenolic content and antioxidant activity of herbal infusions used in traditional medicine in Colombia", *Revista Brasileira de Farmacognosia*, 30(5), 600–607, 2020
9. Guleria. S, & Kumar. A, "Influence of spice-derived essential oils on sensory quality of herbal teas". *Journal of Food Science and Technology*, 53(9), 3619–3626, 2016.
10. Haqqi. T. M, Anthony. D. D, Gupta. S, Ahmad. N, Lee. M. S, Kumar. G. K, & Mukhtar. H, "Prevention of collagen-induced arthritis in mice by a polyphenolic fraction from green tea". *Proceedings of the National Academy of Sciences*, *96*(8), 4524-4529, 1999.
11. Hofmann. T, "Characterisation of tea mouthfeel using descriptive and instrumental sensory techniques". PhD Thesis, University of Nottingham, 2018.
12. Ilaria Marchioni, Morena Gabriele, Giulia Carmassi, Barbara Ruffoni, Luisa Pistelli, Laura Pistelli, Basma Najar. "Phytochemical, nutritional and mineral content of four edible flowers", *Foods*, 13 (6), 939, 2024.
13. Islam. M. Z, Cho. D-K, & Lee. Y.T, "Bioactive compounds and antioxidant capacity of tea infusion prepared from whole and ground medicinal herb parts", *Journal of Food*, 18(1), 116–121, 2020.

14. Jirvankar. P. S, Khobragade. D, Chandewar. S, Pimpale. A, Gawali R, Lokade. A, Maske. A, & Agrawal. R, “Phytochemical, UV-Visible and FTIR assessment along with in vitro antioxidant activity of methanolic extract of Tephrosia purpurea Linn root”, *Journal of Pharmaceutical Research International*, 34(3B), 26–33, 2022.
15. Kamiloglu. S, Toydemir. G, Boyacıoglu, D, & Capanoglu, E, “Health perspectives on herbal tea infusions”. *In J. N. Govil & M. Pathak (Eds.), Recent progress in Medicinal Plants: Phytotherapeutics* II, Vol. 43, pp. 353–368, 2012.
16. Karori. S. M, Wachira. F. N, Wanyoko. J. K, & Ngure. R. M, “Antioxidant activity of polyphenol-rich tea infusions prepared from Kenyan tea cultivars”, *Food Chemistry*, 100(3), 745–751, (2007).
17. Lee. M, & Kim. K, “Sensory attributes influencing consumer preference in functional herbal tea blends”. *Journal of Sensory Studies*, 34(2), 2017.
18. Mughal. T. A, Abid. U, Saddique. Z, Nosheen. S, & Pervaiz. S, “Qualitative and quantitative evaluation of tannins in bark extracts of some indigenous plants of Pakistan”. *International Journal of Biosciences*, 12(6), 78–84, 2018.
19. N.Mahadevan. S, & Pradeep. K, “Hibiscus sabdariffa Linn- An overview”. *Natural Product Radiance*, 8(1), 77-83, 2009.
20. Ouafae El. Yahyaoui. N. A. O, Guinda. I, Sammama. A, Kerrouri. S, Bouabid. B, El Bakkall. M, Quyou. A, Lrhorfi. L. A, & Bengueddour. R,” Phytochemical screening and thin layer chromatography of two medicinal plants: Adansonia digitata (Bombacaceae) and Acacia raddiana (Fabaceae)”. *Journal of Pharmacognosy and Phytochemistry*, 6(1), 10–15, 2017.
21. Pawar. P. S, & Wanve. H. R, “Formulation and evaluation of hibiscus herbal tea”, *International Research Journal of Modernization in Engineering, Technology and Science*, 6(6), 2024
22. Pichayajittipong. P, & Thaiudom, S, “Optimum condition of beta-cyanin colorant production from red dragon fruit (Hylocercus polyrhizus) peels using response surface methodology”. *Chiang Mai University Journal of Natural Sciences*, *13*(1), 483-496, 2014.
23. Rebello. L. P. G, Teixeira. M. C, Lima. Á. J. B, Santos. J. M, Dragano. N. R. V, & Pastore. G. M, “Edible flowers as a source of bioactive compounds: A review of their phytochemical composition and functional properties”. *Plants*, 11(3), 396, 2022.
24. Rohmah. M, Saada. N, Apriadi. R, Rahmadi. A, Utoro. P.A.R, and Saragih. B, “The effect of drying temperature on the physico-chemical characteristics of herbal tea preparation of red dragon fruit skin (Hylocereus polyrhizus) in whole form and powder form”, *Letters in Food Research*, 1(1), 2025
25. Sari. N, Lestari. D. A, & Meiyanto. E, “The effect of red dragon fruit (*Hylocereus polyrhizus)* tea on blood glucose and body weight in Wistar rats”. *Traditional Medicine Journal*, 22(2), 78–83, 2017.
26. Sonam. M, Singh. R. P, & Pooja. S, “Phytochemical screening and TLC profiling of various extracts of *Reinwardtia Indica”. International Journal of Pharmacognosy and Phytochemical Research*, 9(4), 523–527, 2011.
27. Sunday. A. J, Effiong. B. N, & Edima-Nyah. A. P, “Production and Evaluation of Herbal Tea Blends from Zobo (*Hibiscus sabdariffa*) and Jacobinia (*Justicia carnea*) Fortified with Ginger (*Zingiber officinale*)”, *World Journal of Innovation and Modern Technology*, 8(5), 2024.

28. Sureshkumar. V, “Phytochemical screening and thin layer chromatography profiling of various extracts of Achyranthes aspera and Cissus quadrangularis”, *The Journal of Phytopharmacology*, 10(4), 225–229, 2021.
29. Tania C.S.P Pires, Lillian Barros, Celestino Santos-Buelga, Isabel C.F.R Ferreira, “Edible flowers: Emerging components in the diet”, *Trends in Food Science & Technology*, 93, 244-258, 2019.
30. Venkatesh. A, Anandakumar. S, & Banerjee. S, “Functional food products of dragon fruit: An insight”, In Functional compounds and foods of plant origin (p. 365), 2025.
31. Vinokur, Y., Rodov, V., Reznick, N., Goldman, G., Horev, B., Umiel, N., & Friedman, H. (2006). Rose petal tea as an antioxidant-rich beverage: Cultivar effects. Journal of Food Science, 71(1), S42–S47.
32. Vinson. J. A, Su. X, Zubik. L, & Bose. P, “Phenol antioxidant quantity and quality in foods: fruits”, *Journal of agricultural and food chemistry*, *49*(11), 5315-5321, 2021.
33. Yasmin. A, Sumi. M. J, Akter. K, Rabbi. R. H. M, Almoallim. H. S, Ansari. M. J, & Imran. S, “Comparative analysis of nutrient composition and antioxidant activity in three dragon fruit cultivars”, *PeerJ*, *12*, 2024.
34. Yılmaz. C, & Gokmen, V, “Neuroactive compounds in foods: Occurrence, mechanism and potential health effects”. *Food Research International*, *128*, 2020.
35. Yin. H, Ma. F, Wang. D, He. X, Yin. Y, Song. C, & Zhao. L, “Establishing a prediction model for tea leaf moisture content using the free-space method’s measured scattering coefficient”. *Sensors*, 23(3), 1250, 2023.
36. Yuniati Y, Elim P. E, Alfanaar. R, & Kusuma. H. S, “Extraction of anthocyanin pigment from hibiscus sabdariffa L. by ultrasonic-assisted extraction”. In *IOP Conference Series: Materials Science and Engineering*,1010(1), p. 012032. *IOP Publishing*, 2021.
37. Zhao. C.Y, Xue. L, Cai. X. D, Guo. J, Li. B, & Wu. S, “Assessment of the key aroma compounds in rose-based products”, *Food Chemistry*, 210, 308–318, 2016.