Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
Impact Factor (RJIF): 6.35
www.phytojournal.com
JPP 2025; 14(5): 28-30
Received: 17-06-2025
Accepted: 22-07-2025

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Formulation and preliminary evaluation of multi-herbal tea blends for functional health benefits

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DOI: https://www.doi.org/10.22271/phyto.2025.v14.i5a.15548

Abstract
Herbal teas have gained growing popularity as natural alternatives to caffeinated beverages, owing to their therapeutic potential and safety. The present study aimed to formulate and evaluate multi-herbal tea blends using selected medicinal plants with reported health benefits. Guava leaves (*Psidium guajava*), forskolin roots (*Coleus forskohlii*), ginger rhizome (*Zingiber officinale*), ash gourd peel (*Benincasa hispida*), and moringa leaves (*Moringa oleifera*) were selected based on their antioxidant, immunomodulatory, digestive, and metabolic activities. Three herbal tea formulations were developed and packed into tea bags for convenient use.

The formulations were evaluated for physicochemical and sensory characteristics, including weight variation, organoleptic parameters, pH, infusion time, moisture content, swelling index, and foaming index. Phytochemical screening confirmed the presence of bioactive compounds such as flavonoids, alkaloids, terpenoids, phenolics, and vitamin C in different formulations. Results revealed that all formulations showed acceptable stability and sensory attributes, with unique features: HF1 (Guava + Forskolin) exhibited balanced taste and antioxidant potential; HF2 (Ginger) provided strong aroma and rapid infusion; and HF3 (Moringa + Ash gourd) displayed mild flavor and nutritional value.

Overall, the study demonstrated that multi-herbal tea blends prepared with locally available medicinal plants are safe, palatable, and possess promising functional health benefits. These formulations may serve as convenient daily beverages with potential applications in preventive healthcare and wellness. Further clinical studies are recommended to validate their efficacy.

Keywords: Herbal tea, *Psidium guajava*, *Coleus forskohlii*, *Zingiber officinale*, *Benincasa hispida*, *Moringa oleifera*; functional health benefits

Introduction

Herbal teas are widely consumed worldwide as functional beverages due to their therapeutic potential and natural origin. Unlike conventional black or green teas derived from *Camellia sinensis*, herbal teas are generally caffeine-free and are prepared from dried leaves, roots, flowers, fruits, and other plant parts [1]. Their consumption has been associated with multiple health benefits, including improved digestion, immune enhancement, antioxidant activity, and protection against metabolic disorders [2, 3].

The rising interest in natural remedies and preventive healthcare has contributed to the growing popularity of herbal teas as daily wellness drinks [4]. Several medicinal plants traditionally used in Ayurveda, Unani, and folk medicine are now being investigated scientifically for their phytochemical composition and pharmacological effects [5]. Among them, guava leaves (*Psidium guajava*) possess strong antioxidant, antidiabetic, and antimicrobial activities due to the presence of flavonoids such as quercetin and catechins [6]. Forskolin roots (*Coleus forskohlii*) are valued for their role in metabolic regulation and cardiovascular health, mediated through cyclic AMP activation [7]. Ginger rhizome (*Zingiber officinale*) is well known for its anti-inflammatory, digestive, and immunomodulatory effects, attributed to bioactive compounds like gingerols and shogaols [8]. Ash gourd (*Benincasa hispida*) peel contains flavonoids and polysaccharides with antioxidant, cooling, and detoxifying properties [9], while moringa leaves (*Moringa oleifera*) are rich in vitamins, minerals, and polyphenols, supporting nutrition, immunity, and glycemic control [10].

Combining these herbs in tea formulations offers the possibility of synergistic health benefits. Multi-herbal teas not only provide a palatable alternative to synthetic supplements but also ensure consumer convenience when packed in tea bags [11]. Despite the wide traditional use of these plants, limited studies are available on their combined formulation and evaluation in tea blends.

Therefore, the present study was undertaken to formulate and perform preliminary evaluation of multi-herbal tea blends using guava, forskolin, ginger, ash gourd, and moringa, with the aim of assessing their physicochemical, organoleptic, and phytochemical properties. This research contributes to the development of safe, acceptable, and health-promoting herbal beverages with potential applications in preventive healthcare.

Materials and Methods

1. Collection and Preparation of Plant Materials

Fresh plant parts were collected from local sources in Hyderabad, India. Guava leaves (*Psidium guajava*), forskolin roots (*Coleus forskohlii*), ginger rhizome (*Zingiber officinale*), ash gourd peel (*Benincasa hispida*), and moringa leaves (*Moringa oleifera*) were procured from gardens, local markets, and nurseries. The materials were cleaned, shade-dried (except ginger and forskolin, which were sun-dried), and powdered using a mechanical grinder. The powders were passed through 200-400 µm sieves to obtain a uniform particle size [1, 2].

2. Authentication of Plant Materials

The collected samples were identified based on their macroscopic characteristics, and preliminary phytochemical tests were carried out for confirmation. Common pharmacognostic parameters such as foreign matter, total ash, acid-insoluble ash, and moisture content were determined according to WHO guidelines for quality control of herbal drugs [3].

3. Formulation of Herbal Tea Blends

Three formulations (HF1, HF2, and HF3) were prepared by combining different plant powders in specified proportions (Table 1). Each blend (2.0 g) was packed into disposable filter paper tea bags and stored in airtight containers until further evaluation [4].

Table 1: Composition of Multi-Herbal Tea Blends

Ingredient	HF1 (g)	HF2 (g)	HF3 (g)
Guava leaf	1.50	-	-
Forskolin root	0.10	-	-
Ginger rhizome	-	1.20	-
Ash gourd peel	-	-	0.70
Moringa leaf	-	-	0.80
Mint	0.10	-	-
Cinnamon	0.30	0.70	-
Ginger (powdered)	0.50	-	-
Fennel seeds	-	-	0.30
Liquorice	-	-	0.20

Evaluation of Tea Blends

Organoleptic Evaluation

Infusions were prepared by steeping one tea bag in 100 mL of boiled water for 5-10 minutes. The color, aroma, taste, mouthfeel, and appearance of each formulation were assessed by a panel of volunteers [5].

Physicochemical Parameters

a) **Weight variation test:** Twenty tea bags from each batch were weighed individually, and the mean weight and deviations were recorded.
b) **pH:** Infusion solutions were analyzed using a digital pH meter.
c) **Infusion time:** The time required for uniform color and aroma development was noted.
d) **Moisture content:** Determined by oven drying at 105 °C until constant weight.
e) **Swelling index:** The increase in volume of plant material after hydration was measured in a graduated cylinder.
f) **Foaming index:** Estimated by preparing decoctions and observing froth stability, which indicates the presence of saponins [6, 7].

Phytochemical Screening

Standard qualitative tests were performed to identify the major phytoconstituents, including flavonoids (Shinoda test), terpenoids (Salkowski test), alkaloids (Wagner's and Dragendorff's tests), phenolics (lead acetate test), saponins (foam test), and vitamin C (DCPIP test) [8].

Results and Discussion

Authentication and Preliminary Tests

All plant materials were identified based on macroscopic features and confirmed using simple phytochemical tests. The results showed that guava leaves contained tannins, ginger rhizome indicated flavonoids, forskolin roots confirmed diterpenoids, ash gourd peel indicated starch, and moringa leaves tested positive for polyphenols and vitamin C. The values of foreign matter, total ash, and moisture content were within the acceptable pharmacopoeial limits for crude herbal materials, confirming their quality for formulation [1, 2].

Phytochemical Screening

The qualitative phytochemical tests demonstrated the presence of bioactive constituents across the formulations. HF1 (Guava + Forskolin) showed terpenoids, flavonoids, phenolics, and alkaloids. HF2 (Ginger) indicated essential oils, terpenoids, and saponins. HF3 (Moringa + Ash gourd) tested positive for flavonoids, vitamin C, and alkaloids. These findings correlate with earlier reports on the phytochemical richness of these plants [3-5].

Organoleptic Evaluation

The sensory properties of the herbal teas are summarized in Table 2. HF1 produced a golden-amber infusion with fruity and herbal notes, HF2 was characterized by a strong spicy aroma and amber-brown color, while HF3 offered a mild grassy flavor with a pale yellow infusion. All formulations were well-accepted by the evaluation panel. Such attributes are important for consumer compliance and market acceptability [6].

Table 2: Organoleptic Characteristics of Herbal Tea Formulations

Parameter	HF1 (Guava + Forskolin)	HF2 (Ginger)	HF3 (Moringa + Ash gourd)
Color	Golden amber	Amber brown	Golden yellow
Aroma	Fruity, herbal	Strong, spicy	Mild, vegetal
Taste	Sweet-tart, herbal	Bold, pungent	Light, refreshing
Appearance	Clear, coral-green tint	Clear amber	Pale yellow-green
Mouthfeel	Smooth, slightly dry	Warming, tingling	Soft, light-bodied

Physicochemical Parameters

The formulations were further assessed for quality parameters (Table 3). Weight variation remained within ±10%, confirming dosage uniformity. The pH of infusions ranged from 4.5-6.8, suitable for palatability and stability. Infusion time varied across blends, with ginger tea (HF2) showing the fastest infusion (2.5-7 min). Moisture content was within 4-7%, indicating stability under proper storage. The swelling index was highest in HF1, attributed to mucilaginous components, while all blends exhibited low foaming index (<100), suggesting negligible saponin-related surfactant activity.

Table 3: Physicochemical Evaluation of Herbal Tea Formulations

Test	HF1	HF2	HF3
pH (range)	4.5-6.0	5.0-6.0	6.0-6.8
Infusion time (min)	6-8	2.5-7	3.6-8
Moisture content %	4.2-5.1	6.5-7.2	5.3-6.0
Swelling index (mL/g)	4.2	2.0	3.6
Foaming index	<100	<100	<100

Discussion

The combination of guava, forskolin, ginger, ash gourd, and moringa provided complementary functional benefits. Guava and forskolin contributed antidiabetic and metabolic regulation potential [7], while ginger enhanced immunity and circulation [8]. Ash gourd and moringa enriched the blend with antioxidants, vitamins, and cooling effects [9, 10]. The acceptable physicochemical and organoleptic results suggest that these formulations are not only stable but also consumer-friendly.

The findings align with previous studies that reported the beneficial effects of multi-herbal teas in preventive health management [11, 12]. Importantly, each formulation displayed unique sensory and functional characteristics, providing scope for consumer-specific targeting-HF1 for metabolic health, HF2 for digestive and immune support, and HF3 for nutritional supplementation

Conclusion

The present study successfully formulated and evaluated three multi-herbal tea blends using guava leaves (*Psidium guajava*), forskolin roots (*Coleus forskohlii*), ginger rhizome (*Zingiber officinale*), ash gourd peel (*Benincasa hispida*), and moringa leaves (*Moringa oleifera*). The formulations demonstrated acceptable physicochemical quality, stability, and favorable sensory attributes. Phytochemical screening confirmed the presence of bioactive compounds such as flavonoids, alkaloids, terpenoids, phenolics, and vitamin C, which are associated with antioxidant, digestive, metabolic, and immunomodulatory effects [1-3].

Among the blends, HF1 (Guava + Forskolin) exhibited balanced taste and metabolic health potential, HF2 (Ginger) showed rapid infusion and strong aroma suited for digestive and immune support, and HF3 (Moringa + Ash gourd) provided mild flavor with nutritional benefits.

Overall, these findings suggest that multi-herbal tea bags can serve as safe, convenient, and health-promoting functional beverages, supporting preventive healthcare and wellness. However, further pharmacological and clinical studies are required to validate their therapeutic efficacy [4-6].

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