DEVELOPMENT AND EVALUATION OF MULBERRY HERBAL TEA WITH DIFFERENT FLAVOURS

ABSTRACT

This study aimed to develop and evaluate mulberry herbal tea with various flavours to enhance its sensory appeal and health benefits. Fresh mulberry leaves were processed into tea and combined with seven flavours: *pudina*, *jeera*, ginger, cardamom, lemongrass, vanilla and cocoa. The sensory evaluation of mulberry herbal tea with different flavors revealed that Mint(Pudina) was the most preferred treatment, scoring the highest (15.28±1.24), followed by Cumin(*Jeera)* with a score of 14.61±0.91, and Ginger with 14.08±1.77, all showing significant acceptability. Cardamom ranked fourth with a score of 12.86±2.84, indicating moderate preference. Among the non-significant treatments, Lemongrass scored 11.40±2.21, followed by Vanilla at 11.91±2.96 and Cocoa at 11.99±2.05, showing lesser acceptability. Overall, Pudina, Jeera, and Ginger showed as the most preferred flavors, with Pudina standing out as the top choice for mulberry herbal tea, significantly improved overall acceptability by masking the natural bitterness and astringency of mulberry leaves. Blending the top flavours created a highly acceptable. 765434This research offers scope for future innovation in herbal tea formulations and market expansion.

Key words: Mulberry herbal tea, Flavours enhancement, Sensory evaluation, Herbal tea formulation

INTRODUCTION

Tisane is a generic term for tea made from herbs instead of leaves of tea plant. In today's western world tea serves as beverage for enjoyment as well as for herbal therapies. Tisane or herbal tea is any beverage made from the infusion or decoction of herbs, spices or any other plant material in hot water and usually does not contain caffeine1 and used as a beverage or for medicinal effects. Common herbs infused to prepare tisanes are aniseeds, ginger, mint, ginseng, jasmine, chamomile, Echinacea, cocoa leaves, cinnamon sticks, cocoa bean, citrus peel (lemon & orange), lemon grass, neem leaves, roasted barley, rosemary, thyme *etc*. In recent times, however tisane, is gaining increasing popularity among consumers. Types of tisanes Tisanes are usually categorized by what part of the plant they come from. Leaf tisanes such as lemon balm, mint, lemon grass and French verbena (Bennet *et al*., 2016)

For centuries, herbal remedies have been used to treat infections, ailments and diseases. They are often consumed in the form of tea, *i.e*. an infusion of dried plant parts (leaves, flowers, seeds, roots and barks) steeped in boiling water. Herbal teas have been gaining popularity in recent years and a great variety is sold in health food stores. They are popular because of their fragrance, antioxidant properties and therapeutic applications.

Many consumers believe that herbal teas are natural and safe as herbs can promote health and assuage illness. Considered an important alternative source of antioxidants, herbal teas are often classified based on their therapeutic actions. However, the use of herbal remedies was not widely advocated by modern medicine as their mechanisms of action and effectiveness of active ingredients are not evidence-based or scientifically proven. (Chan *et al*., 2012)

Herbal drinks in India are based on the Ayurveda system, which dates back over 3000 years. The Ayurveda system has three basic principles which are called *doshas* (*vata, pitta*, and *kapha*) (Kumar *et al*., 2017). Herbal drinks are essentially made by different combinations of ayurvedic herbs such as turmeric, ginger, tulsi, mint, coriander, Terminalia arjuna, *Decalepis hamiltonii* root, Piper longum, Tinospora cordifolia and others according to their specific purposes (Sarkar *et al*., 2015; Kumar *et al*., 2017a). Herbal drinks that are well known in the ayurvedic system are herbal rice drink, halu kashaya, jaljira powder juice, nannari sharbat and tambuli.

Mulberry leaf (ML) is a very popular food material with high safety (Li *et al*. 2018), and it is often processed with addition of traditional honey to make a variety of teas or other flavoured foods

(Jan *et al*. 2021; Park *et al*. 2021). DNJ in mulberry leaves has a strong inhibitory effect on α-glucosidase; thus, DNJ can inhibit the post-prandial increase in blood glucose in patients with diabetes and reduce the risk of insulin resistance (Liu *et al*. 2020; Thaipitakwong *et al*. 2020). Mulberry leaf (ML) is a very popular food material with high safety (Li *et al*. 2018), and it is often processed with addition of traditional honey to make a variety of teas or other flavoured foods (Jan *et al*. 2021; Park *et al*. 2021).

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For a long time, there has been a controversy about the safety and efficacy of taking honey for diabetic patients (Meo *et al*. ; Sharma *et al*.2020). One view is that honey cannot be used for diabetic patients due to its high carbohydrate content. However, there is now a lot of evidence to support that honey is beneficial for the treatment of diabetes and related complications, due to the complex compound system and rich nutrients in honey (Sahlan *et al*. 2020; Salla *et al*. 2020). In traditional applications, it is generally believed that ML processed with honey could increase the effect on diabetes prevention. Although this type of mulberry tea with honey has been accepted and used, there is no research on the changes in the composition of ML after processing with honey

MATERIAL AND METHODS

The study, Development of Mulberry Herbal Tea with Different Flavours, was conducted during 2023-2024 at the Department of Sericulture, UAS, GKVK, Bengaluru, in collaboration with the Department of Food Science and Nutrition, CoA, UAS, GKVK, Bengaluru. The aim was to prepare and evaluate mulberry herbal tea enhanced with various flavors. Fresh, tender mulberry leaves of the Victory-1 (V1) variety were sourced from the Mulberry Garden at the Department of Sericulture, University of Agricultural Sciences, GKVK, Bengaluru. The location is situated in the northern part of Bangalore at a latitude of 13º05’ N and a longitude of 77º34’ E, with an altitude of 924 meters above mean sea level. The garden spans an area of 1380 acres and experiences an average maximum temperature of 29.6ºC

and a minimum temperature of 18.5ºC, providing ideal climatic conditions for cultivating high-quality mulberry leaves.

Tender mulberry leaves were harvested from the top of the branches early in the morning and immediately transferred into zip-pouches to retain moisture. The collected leaves were manually sorted, washed under tap water to remove extraneous matter, and spread on a clean cloth for drying. The leaves were dried in the shade until they became crisp, after which they were ground into small pieces and stored for further processing.

The ginger (*Zingiber officinale)* was thoroughly washed, peeled, and grated to prepare for processing. It was dried using a tray dryer set at 60 °C and subsequently ground into a fine powder. The lemongrass (*Cymbopogon citratus*) was also washed, cut into uniform pieces, and dried under identical tray dryer conditions. Cumin seeds (*Cuminum cyminum*) were dry-roasted over a low flame to enhance their aroma and flavor before being ground into a fine powder. Fresh mint leaves (*Mentha spicata*) were sorted after washing and shade-dried to preserve their natural color and volatile oils, then ground into a powder. Green cardamom pods (*Elettaria cardamomum*) were processed by separating the seeds, which were ground into a fine powder. Additionally, vanilla essence was procured from a commercial source, and Weikfield cocoa powder, available in the supermarket, was used as a standard ingredient.

Preparation of mulberry herbal tea with different flavours

Mulberry herbal tea with different flavours was prepared according to procedure. The products developed were mulberry herbal tea with seven different flavours: Ginger, Lemongrass, Cumin(*Jeera*), Mint(*Pudina*), Cardamom, Vanilla essence and Cocoa powder. Initial trials were done to find out the optimum proportion of the flavouring agents at different concentration and assessed the developed flavoured mulberry herbal tea.

Water was measured and taken in a clean vessel, then heated until it reached a rolling boil. At this point, mulberry leaf tea powder was added to the boiling water and allowed to steep, ensuring complete dissolution of its active components. Subsequently, individual flavoring agents ginger powder (*Zingiber officinale*), lemongrass powder (*Cymbopogon citratus*), cumin powder (*Cuminum cyminum*), mint powder (*Mentha spicata*), cardamom powder (*Elettaria cardamomum*), vanilla essence and cocoa powder, were introduced into separate batches to prepare seven distinct flavored teas. The tea was then

carefully filtered through a double-layered filter to remove any particulate matter, resulting in a clear and smooth beverage. The prepared mulberry herbal teas, each enhanced with a unique flavor, were served for evaluation.

Sensory evaluation of mulberry herbal tea with different flavours

Sensory analysis was done by twenty-point hedonic scale. The prepared products were organoleptically evaluated by a semi-trained panel of 21 judges. The judges were served each preparation with one control and three test samples. Control samples were prepared by using dried mulberry leaves only and test samples using different flavours (ginger, lemongrass, Cumin(*jeera*), Mint(*pudina*), cardamom, vanilla and cocoa powder) were prepared by using dried mulberry leaves at constant and flavours at three different levels of 0.5g, 1g and 1.5g, respectively. Different samples were given at different levels used in food products so that the levels were not revealed to the panellists to get their exact judgment of the samples. Sensory evaluation of the developed products was carried out to determine the most suitable level of mulberry leaves incorporated with flavours for each product. The panel was provided 20-point hedonic scale for attributes like appearance, colour, aroma, bouquet, acidity, sweetness, body, astringency, flavour, quality and overall acceptability. The mean scores for the varieties for each product were then calculated. The sensory evaluation was performed in controlled environmental conditions with minimum distractions to reduce the effect of physical conditions on panellist's judgment. The scores assigned were as follows.

Grading Scores: Dislike - 0, moderately like - 1, like very much – 2

Table 1. Mean sensory scores of overall acceptability of mulberry herbal tea for different flavours

Treatments	PUDINA	JERRA	GINGER	CARDAMOM	COCOA	VANILLA	LEMONGRASS
C	11.45±1.38	10.72±2.03	11.26±1.25	10.29±2.40	10.23±1.50	10.70±3.12	10.49±2.61
T_1	12.37±2.03	12.27±1.51	12.14±2.35	11.23±2.54	11.01±1.57	10.78±2.60	10.10±2.28
T_2	15.28±1.24	14.61±0.91	14.08±1.77	12.86±2.84	11.99±2.05	11.91±2.96	10.42±2.42
T_3	12.16±1.51	11.66±3.26	11.59±1.80	12.14±2.82	8.92±1.13	11.24±1.94	11.40±2.21

F value	*	*	*	*	NS	NS	NS
Sem±	0.34	0.46	0.44	0.58	2.33	0.58	0.52
CD at 5%	0.97	1.30	1.12	1.63	-	-	-

*Significance, NS- Non significant at 5 per cent level, Control – Mulberry leaf tea powder (4g), T_1- Mulberry leaf tea powder 4g + 0.5g of ginger, lemongrass, *jeera*, *pudina*, cardamom, vanilla and cocoa powder each, T_2- Mulberry leaf tea powder 4g +1g of ginger, lemongrass, *jeera*, *pudina*, cardamom, vanilla and cocoa powder each, T_3 - Mulberry leaf tea powder 4g +1.5g of ginger, lemongrass, *jeera*, *pudina*, cardamom, vanilla and cocoa powder each

RESULT AND DISCUSSION

Mean sensory scores of overall acceptability of mulberry herbal tea for different flavours, where all treatment includes constant 4g of mulberry tea powder and varied flavours with T_1 with 0.5g, T_2 with 1g and T_3 with 1.5g for all 7 different flavours, among them *pudina* ranked first with 1g of *pudina* powder, second *jeera* with 1g of *jeera* powder, third by ginger with 1g of ginger powder, fourth cardamom with 1g of cardamom powder, fifth cocoa with 1g of cocoa powder, sixth vanilla with 1ml vanilla essence and last lemongrass with 1.5g of lemongrass powder (Table 1. and Fig. 1)

There was significant difference observed for ginger, *jeera*, *pudina*, cardamom whereas, lemongrass, vanilla and cocoa showed non-significant results for overall acceptability attribute.

Jeera (cumin), ginger, and *pudina* (mint) show higher acceptability in mulberry tea compared to vanilla, cocoa, and lemongrass because of their complementary and balancing flavour profiles. The bold, earthy, and slightly spicy taste of *jeera*, combined with the warm and zesty notes of ginger, effectively counteract the natural astringency and bitterness of mulberry leaves. *Pudina*, with its refreshing and cooling menthol flavour, further masks the bitterness and enhances the overall flavour, making the tea taste more refreshing and vibrant.

In contrast, vanilla and cocoa have milder, sweeter and creamier profiles that may not balance bitterness as effectively. These flavours may not offer the same level of contrast or ability to mask astringency, leading to a less balanced flavour profile. Lemongrass, though it adds a citrusy freshness, may not be strong enough to counteract the bitterness of mulberry leaves and may not appeal to all palates. As a result, the more robust and complementary flavours of *jeera*, ginger and *pudina* lead to higher overall acceptability in sensory evaluations. Hence, flavours such as *pudina*, *jeera* and ginger were blended to make flavour blended mulberry herbal tea. Further sensory evaluation was carried out.

PUDINA:

There is significant difference between the variations of mulberry herbal *pudina* tea for sensory attributes like appearance, colour, aroma, bouquet, acidity, sweetness, body, astringency, flavour, quality and overall acceptability.

The results revealed that 1g of *pudina* powder (T_2) incorporation to mulberry tea scored higher overall acceptability than other treatments. *Pudina* had a strong, refreshing flavour and natural menthol that

successfully conceals the astringency of mulberry tea. Mulberry leaves are bitter, but the cooling, fragrant tones balance it out, and the menthol calms the palate and reduces the sensation of astringency.

Control without *pudina* flavour incorporation showed highest score for appearance and colour. This might be due to dark green colour after addition of *pudina* to normal mulberry tea which is light green tea.

Similar findings were reported by Manikant *et al*. (2023) studied blended Tulsi-drumstick herbal tea, The optimal treatment, of 50 per cent tulsi leaf powder, 30 per cent moringa leaf powder, and 20 per cent green tea, exhibited the best overall organoleptic quality.

JEERA:

There was significant difference between the variations of mulberry herbal tea flavoured with *jeera* tea for sensory attributes like appearance, colour, bouquet, sweetness, astringency, flavour, quality and overall acceptability, whereas, aroma, acidity and body showed non-significant. T_2 with 1g of *jeera* incorporation to mulberry tea showed highest sensory score than other variations.

This might be due to *Jeera* has strong, distinctive aroma can dominate the tea's overall scent, leading to minimal variation in perceived aroma among different formulations. Additionally, *jeera* does not significantly affect the tea's acidity, as cumin itself lacks a pronounced acidic profile. *jeera* does not influence the physical richness or texture of the tea, so changes in body are minimal

Similarly, Rong *et al*. (2021) developed Angelica keiskei medicinal tea, made from its leaves, stems and roots, exhibits distinct sensory characteristics. Leaf and stem teas are more aromatic, with a pronounced umami and sweet aftertaste, and less bitterness and astringency compared to root tea.

The obtained data are nearly agreement with De-Heer *et al*. (2011) reported sensory evaluation of herb tea from *Moringa oleifera*, *Hibiscus sabdariffa* and C*ymbopogon citrates* who found that herb tea composed of (50 %) Moringa, (30 %) roselle and (20 %) lemongrass scored higher scores for colour (3.90), flavour (3.88), aroma (3.94), astringency (3.64) and overall acceptance (4.08). Conversely control made up of 100 per cent Moringa scored the lowest scores for colour (2.68), aroma (2.66) and flavour (2.38)

GINGER:

The statistically significant results were observed for aroma, astringency, flavour and Overall acceptability, whereas, appearance, colour, bouquet, acidity, sweetness, body and quality showed non-significant results.

The 1g of ginger powder addition to mulberry leaf tea provided an optimal flavor balance, offering enough ginger to impart a noticeable, but not overpowering taste. In contrast, 0.5g may have been too mild, while 1.5g have resulted in excessive spiciness, reducing overall acceptability.

Similarly, results were reported by Angki *et al*. (2018) who developed tudans organic mulberry tea and reported sensory scores for aroma, colour, taste, mouthfeel and their overall acceptance. Overall acceptance scores were more than 30 per cent.

Yau and Huang (2000) found that Oolong tea drinks made with unprocessed and membrane-processed water differed significantly in 13 of 19 sensory attributes. The commercial tea sample had a richer red-brown colour and more alkaline flavour but scored lower in oolong-tea aroma, astringency and bitterness.

The findings of the present study are similar to the observation reported by Singh *et al*. (2021). This study explored the formulation of flavoured herbal teas using dried corn silk powder from the VL Baby corn-1 variety, combined with various herbs: Thyme, Clove, Cinnamon, Timur, Tulsi, Gandraini, Lemongrass, a blend of Clove, Timur, and Gandraini, and plain corn silk. Sensory evaluations revealed that all combinations were moderately liked, with the lemongrass flavour being the most favoured, followed by the cinnamon and clove blend.

These first three flavours jeera, pudina and ginger showed highest overall acceptability. These flavours were further blended and flavour blended mulberry herbal tea powder

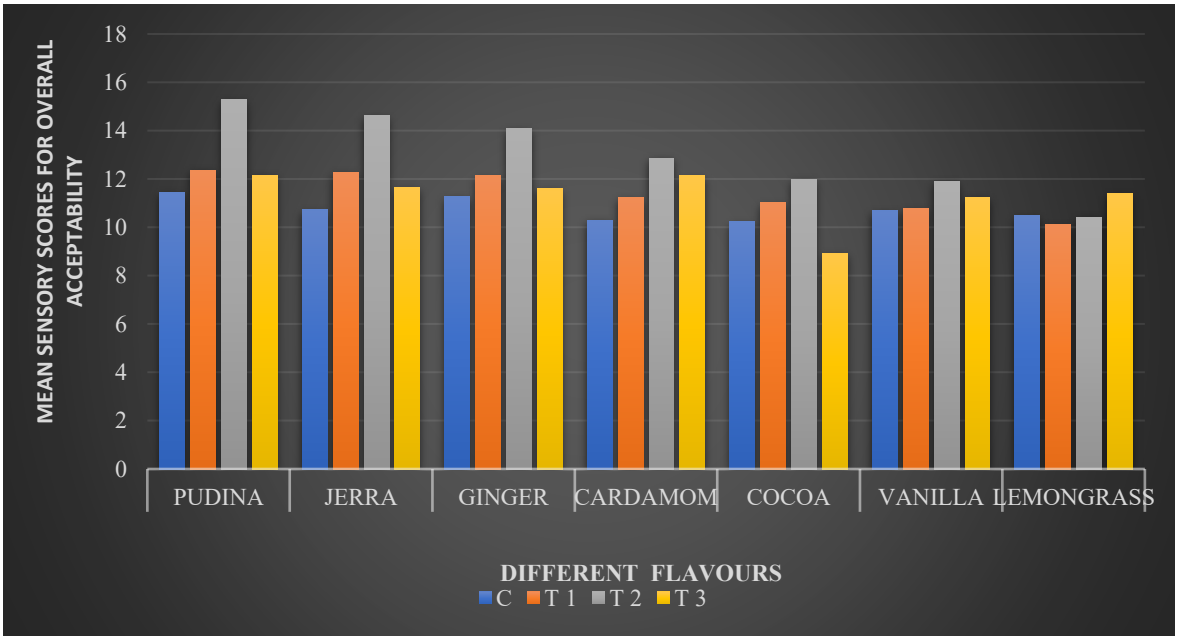

Fig. 01: Mean sensory scores of overall acceptability of mulberry herbal tea with different flavours

Control – Mulberry leaf tea powder (4g), **T_1**- Mulberry leaf tea powder 4g + 0.5g of ginger, lemongrass, *jeera*, *pudina*, cardamom, vanilla and cocoa powder each, **T_2** - Mulberry leaf tea powder 4g +1g of ginger, lemongrass, *jeera*, *pudina*, cardamom, vanilla and cocoa powder each, **T_3** - Mulberry leaf tea powder 4g +1.5g of ginger, lemongrass, *jeera*, *pudina*, cardamom, vanilla and cocoa powder each.

Conclusion: The study on mulberry herbal tea demonstrated that incorporating flavours like (mint)*pudina*, (cumin)*jeera*, and ginger significantly enhanced its sensory appeal, with 1g of each flavour achieving the highest acceptability. These flavours effectively masked the natural bitterness of mulberry leaves, offering a balanced and refreshing taste. The findings open avenues for future research into innovative flavour combinations and broader consumer testing, underscoring the potential of flavoured herbal teas to cater to the growing demand for nutritious, health-focused beverages. Blending the top flavours resulted in a unique and commercially viable product. This research highlights opportunities for innovation in herbal tea formulations and broader consumer acceptance.

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