Journal of Applied Horticulture, 26(1): 33-36, 2024
https://doi.org/10.37855/jah.2024.v26i01.06
Journal of Applied Horticulture
ISSN: 0972-1045

Development and standardization of cactus fruit-based tisane

Yashkumar[1], Dutta Samit[2] and P. Srilatha[1]*

[1]Department of Food Processing Technology, College of Food Processing Technology and Bio Energy, Anand Agricultural University, Anand, Gujarat 388110, India. [2]Department of Food Business Management, College of Food Processing Technology and Bio Energy, Anand Agricultural University, Anand, Gujarat 388110, India.
**E-mail: srilatha2708@gmail.com*

Abstract

Cactus (prickly pear) is a nutrient-rich fruit with numerous medicinal and health benefits, including essential minerals, vitamins, antioxidants, and anti-diabetic and anti-cancer properties, while mint enhances flavor and boosts health benefits. Tisanes, popular for their antioxidant properties due to phenols, are gaining popularity in the herbal tea market. In this study, cactus fruits were dried in a hot air dryer, with the drying temperature optimized at 50°C to achieve minimum drying time, maximum betalain content, and maximum antioxidant activity. Mint leaves were dried using shade drying at 30±2°C until a moisture content of 7% was achieved. Various cactus-mint ratios were tested to formulate the cactus fruit-based tisane, with the optimal ratio determined by overall acceptability, antioxidant activity, and color a* value. The tisane infusion was prepared by steeping a tea bag containing 2 grams of dried material in 100 mL of hot water (95±2°C) for 2 minutes. Statistical analysis revealed that the best cactus fruit-mint ratio for the tisane was 85:15. The infusion contained 10.92 mg/100g of total betalain content, 0.89 mg/100g of vitamin C, and 12.19 mM/100g of total antioxidant activity. Microbial analysis showed that the total plate count was within acceptable limits, and yeast and mold counts were zero.

Key words: Cactus fruit, mint, tisane, total betalain content, total antioxidant activity, drying, herbal tea

Introduction

Global efforts are intensifying to improve health and living standards in response to rising poverty and population levels. People are increasingly interested in consuming antioxidant-rich fruits, which play a vital role in human health. Growing health awareness has led to the inclusion of medicinal plants in diets, both as major and minor ingredients. Cactus fruit, in particular, has gained attention for its numerous medicinal benefits, including anti-cancer properties that inhibit cancer cell growth, as well as antiviral, anti-inflammatory, and cholesterol-lowering effects. It is also used to manage conditions such as diabetes, sunburn, cuts, windburn, and insect bites, and is consumed to boost hemoglobin levels in the blood (Chandra *et al.*, 2019; Sabale *et al.*, 2012).

Mint or peppermint (Mentha piperita L.), a medicinal plant native to Europe, offers numerous health benefits and biological activities, making it widely used in the food and pharmaceutical industries. Its nutritional activities include antiviral, antibacterial, antifungal, and allelopathic effects, while its medicinal uses encompass anti-obesity, anti-cancer, anti-diabetic, anti-headache, ulcer healing, and reduction of gastrointestinal complications (Loolaie *et al.*, 2017; Mahboubi, 2014). Drying is a common method to extend the shelf life of food by removing moisture and reducing microbial activity.

Herbal and fruit teas have gained popularity for their pleasant taste and significant health benefits. They are rich sources of natural antioxidants and functional dietary supplements due to their high content of total polyphenols and significant antioxidant and radical scavenging capacities (Sivakumaran and Amarakoon, 2017). Tisanes, or herbal infusions, originated as medicinal drinks and have evolved to include common herbs like mint, chamomile, or lemongrass. Although often referred to as 'herbal tea,' tisanes are distinct from true teas and offer unique flavors and vibrant colors due to natural fruit pigments.

The primary objective of this research was to optimize the cactus fruit-mint ratio to develop a highly acceptable and antioxidant-rich tisane while maintaining key bioactive compounds and ensuring microbial safety for consumption as a dietary supplement

Materials and methods

The study was conducted at the College of Food Processing Technology & Bio-Energy, Anand Agricultural University, Anand, Gujarat.

Cactus fruits for the research work were collected from the plants grown at local farms on the outskirts of Junagadh city. The mint was collected from the local market of Anand, Gujarat. For this research, nylon pyramid tea bags with a 5 g capacity were used as packaging materials for cactus fruit-based tisane. These tea bags were purchased online from Amazon.in (Teacurry nylon pyramid empty tea bags with strings, 60 x 65 mm dimensions). All the chemicals used to analyze the product were of analytical grade and were procured from M/s Loba Chemicals, Mumbai, Maharashtra, and M/s Dutt Enterprise, Anand, Gujarat, India. HDPE and Polypropylene pouches were used to package dried cactus fruit slices.

Chemical and nutritional attributes analysis: Proximate analysis of cactus fruit was done using protocols described by AOAC (2019) and Ranganna (2007). Total sugar (Lane and Eynon method), vitamin C (Dye method (2,6-Dichlorophenol-

Indophenol)), and acidity were estimated as described by Ranganna (2007). The antioxidant assay was performed using a spectrophotometer, mineral analysis was conducted with an ICP-OES model Optima 7000 DV, and total betalain content was measured according to the method suggested by Nilsson (1970).

Microbiological analysis: Total plate count and yeast and mold count were carried out based on the method described by Ranganna (2004).

Drying of cactus fruit slices: Cactus fruits were subjected to steam blanching at 96±2 °C for enzyme inactivation. After blanching, cactus fruits were dried in a hot air dryer at 50°C till they achieved 7% moisture (w.b.) (Yash *et al.*, 2023).

Drying of mint: From the initial trials, it was finalized to dry mint leaves using shade drying at a temperature of 30±2°C up to a moisture content of 7% as per the method of Sangwan *et al.* (2012)

Grinding of dried cactus fruit slices: Preliminary trials were conducted to grind the dried cactus fruit slices. However, due to the high total sugar content, the product stuck to the surface of the pulverizer and formed lumps. As a result, the size reduction of the dried cactus fruit slices was done manually.

Optimization of formulation of cactus fruit-based tisane: Four samples with different proportions of dried cactus fruit slices and mint were finalized based on pre-trials and presented in Table 1. Samples were packed in tea bags to prepare for infusion. The temperature of the water used for the infusion was 95±2°C. Water to sample ratio was kept at 50:1 for the infusion (Yadav *et al.*, 2017). 100 mL water was used for the infusion. So, 2 g of material was filled in each tea bag and dipped in 100 mL hot water for 2 min to prepare infusion of cactus fruit-based tisane. The infusion was prepared as per Fig. 1. Dependent variables for the formulations of cactus fruit-based tisane are the overall acceptability of sensory score (hedonic scale), total antioxidant activity and a* colour value.

Table 1. Different proportions to standardize the formulation of cactus fruit-based tisane

Sample code	Dried cactus fruit proportion (%)	Dried mint leaves proportion (%)
1	95	5
2	90	10
3	85	15
4	80	20

In sample code 1 tea bag, dried cactus fruit proportion was 1.9 g and mint proportion was 0.1 g. In sample code 2 tea bag, dried fruit proportion was 1.8 g and mint proportion was 0.2 g. In sample code 3 tea bag, dried cactus fruit proportion was 1.7 g and mint proportion was 0.3 g. In sample code 4 tea bag, dried fruit proportion was 1.6 g and mint proportion was 0.4 g.

Chemical, nutritional and microbiological quality of cactus fruit-based tisane: Cactus fruit-based tisane was evaluated for chemical, nutritional and microbiological quality, and infusion made from cactus fruit-based tisane was also evaluated for chemical and nutritional quality.

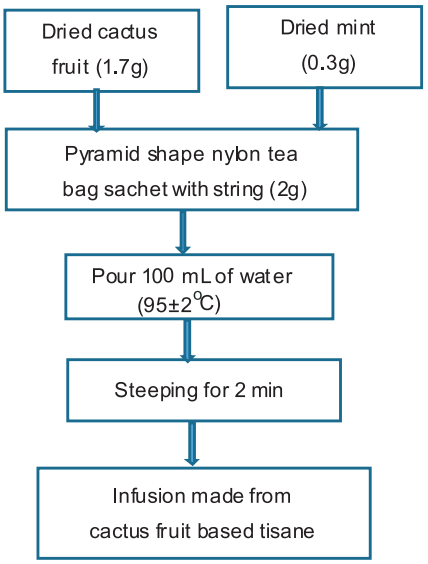

Fig. 1. Flowchart for making infusion from cactus fruit-based tisane

Results and discussion

Standardization of formulation of cactus fruit-based tisane: For the standardization of formulation of cactus fruit-based tisane, single factor CRD was applied in design expert (V12), where overall acceptability, total antioxidant activity and colour a* value were responses.

Effect of cactus-mint ratio on overall acceptability of cactus fruit-based tisane: Fig. 2 illustrates the effect of the cactus-mint ratio on the overall acceptability of cactus fruit-based tisane, measured on a 0 to 9 hedonic scale. The overall acceptability scores for S1, S2, S3, and S4 were 7.4, 7.7, 8.8, and 8.2, respectively. The highest overall acceptability was observed in S3, which had a well-balanced flavor and aroma of mint. S4 had an excessively strong mint flavor and aroma, while S1 had too little mint aroma and flavor.

Effect of cactus-mint ratio on total antioxidant activity of cactus fruit-based tisane: The effect of the cactus-mint ratio on the total antioxidant activity of cactus fruit-based tisane is shown in Fig. 3. The total antioxidant activity values for S1, S2, S3, and S4 were 28.65, 28.19, 27.98 and 27.65, respectively. The highest antioxidant activity was observed in S1, followed by S2, S3, and S4. This decreasing trend may be attributed to the decreasing proportion of cactus fruit from S1 to S4 (Fig. 3).

Effect of cactus-mint ratio on colour a* value of cactus fruit-based tisane: Fig. 4 shows the effect of cactus-mint ratio on colour a* value of cactus fruit-based tisane. The colour a* value of S1, S2, S3 and S4 were 4.09, 3.81, 3.66 and 3.36, respectively. Among them, the highest colour a* value was found in S1, followed by S2, S3 and S4. The trend is decreasing because the cactus fruit is decreasing from S1 to S4, as cactus fruit is contributing to the product's red color.

Standardization of formulation of cactus fruit slices: The numerical optimization technique of the software design expert version 12 was used to standardize the formulation of cactus fruit-based tisane. Single-factor CRD was used, and the cactus-mint ratio was used as a factor, and different cactus-mint ratios were used as a level. So, a total 3 solutions were found by software,

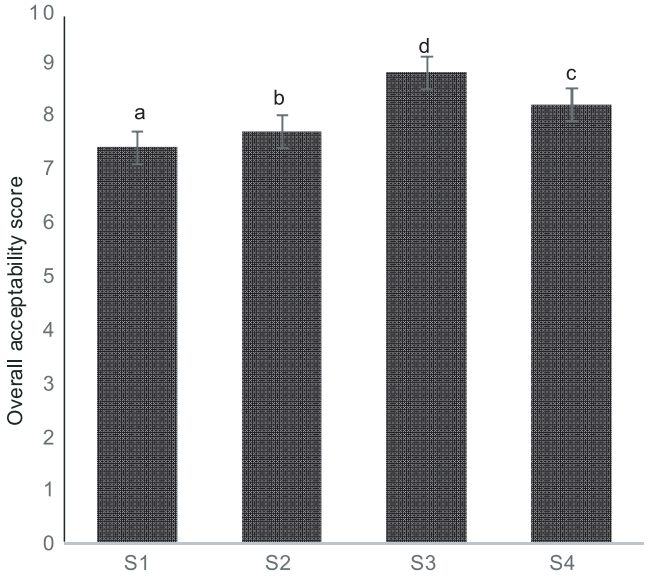

Fig. 2. Effect of cactus-mint ratio on overall acceptability of cactus fruit-based tisane

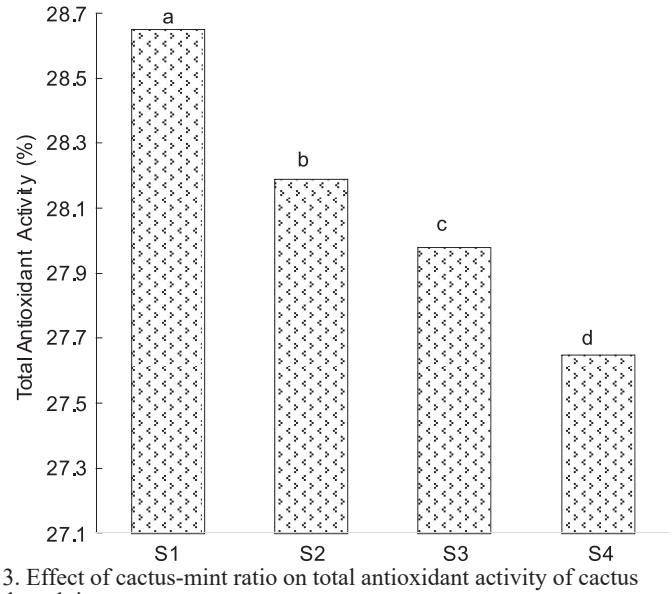

Fig. 3. Effect of cactus-mint ratio on total antioxidant activity of cactus fruit-based tisane

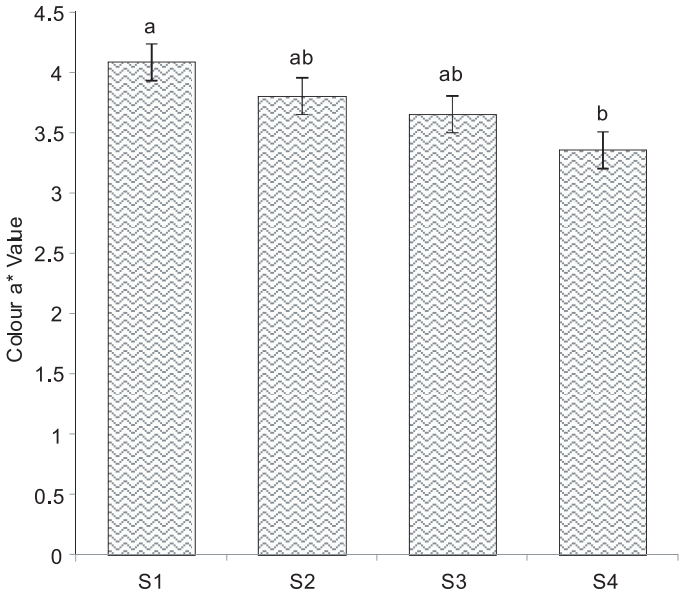

Fig. 4. Effect of cactus-mint ratio on colour a* value of cactus fruit-based tisane

out of which one optimum solution showing the optimum condition of independent variables with the highest desirability was selected. The best solution was S3(85:15), with a desirability value of 0.778. The value of overall acceptability was 8.8, and total antioxidant activity was 27.80, colour a* value was 3.66 for optimization of formulation of cactus fruit-based tisane. For S3 (85:15), Overall acceptability was found higher than all other samples, total antioxidant activity was found to be higher than S4 (80:20) and Colour a* value was found to be higher than S4 (80:20).

Evaluation of proximate, mineral and microbiological quality of cactus fruit-based tisane

Analysis of cactus fruit-based tisane: For cactus fruit-based tisane, the values of moisture content, protein, fat, crude fiber, ash and carbohydrate content were found to be in the range of 6.98±0.07, 8.17±0.05, 3.18±0.04, 3.83±0.05, 6.54±0.14 and 71.32±0.18, respectively (Table 2). The values of the proximate composition are higher than those of raw cactus fruit and mint because the sample was dried.

Table 2. Proximate composition of cactus fruit-based tisane

Sr. No.	Parameter	Mean±SD
1	Moisture (%)	6.98±0.07
2	Protein (%)	8.17±0.05
3	Fat (%)	3.18±0.04
4	Crude fibre (%)	3.83±0.05
5	Ash (%)	6.54±0.14
6	Carbohydrates (%) (by difference)	71.32±0.18

Note: All values are mean±standard deviation

The Inductive Couple Plasma-Optical Emission Spectrometry, (ICP-OES) results showed that cactus fruit-based tisane contains the highest values of potassium (1325.20 mg/100g), calcium (1599.20 mg/100g), iron (10.90 mg/100g) followed by magnesium (1160.80 mg/100g), phosphorous (1047.10 mg/100g) and sodium (25.50 mg/100g) (Table 3).

Table 3. Mineral profile of cactus fruit-based tisane

Sr. No.	Mineral	Mean value (mg/100g)
1	Iron	10.90
2	Calcium	1599.20
3	Magnesium	1160.80
4	Phosphorous	1047.10
5	Potassium	1325.20
6	Sodium	25.50

Microbial analysis (total plate count, yeast and mold count) was determined at 0 days and found that total plate count is <50 and yeast and mold count found absent (Table 4). The results were as per FSSAI standards of microbial analysis for dried fruits.

Table 4. Microbial analysis of cactus fruit-based tisane

Sr. No.	Parameters	Mean value
1	Total plate count (cfu/g)	<50
2	Yeast and Mold count (cfu/g)	Absent

Analysis of infusion made from cactus fruit-based tisane: Analysis of chemical properties such as acidity and nutritional

properties were carried out in triplicate and average values were reported.

For infusion made from cactus fruit-based tisane, the value of acidity, vitamin C, total antioxidant activity, total betalain content and TSS were found to be in the range of 0.12±0.02, 0.89±0.04, 12.19±0.09, 10.92±0.06 and 0.1±0.05, respectively (Table 5). A Study by Coelho *et al.* (2020) showed that green tea infusion exhibited 13.8 mg/100g of total antioxidant activity. This means cactus fruit-based tisane also has good total antioxidant activity.

Table 5. Chemical and nutritional composition of infusion made from cactus fruit-based tisane sachet

Sr. No.	Parameters	Mean±SD
1	Acidity(%)	0.12±0.02
2	Vitamin C (mg/100g)	0.89±0.04
3	Total antioxidant activity (mM/100g)	12.19±0.09
4	Total Betalain content (mg/100g)	10.92±0.06
5	TSS (°Brix)	0.1±0.05

Note: All values are mean±standard deviation

From the chemical and nutritional composition of infusion made from cactus fruit-based tisane, it was found that it has good total antioxidant activity (12.19 mM/100g) and vitamin C (0.89 mg/100g). Therefore, cactus fruit-based tisane can be suggested in place of green tea. Yang and Liu (2013) reported that TPC of green tea infusion as 1.16 mg GAE/mL. Cactus fruit-based tisane can be chosen for health benefits as green tea.

In the present study, the formulation of cactus fruit-based tisane was standardized. The best acceptable cactus-mint ratio for the formulation of cactus fruit-based tisane was 85:15. The shape of the nylon material tea bag was suitable for infusion, as the pyramid shape increased the infusion efficiency. The suitable water temperature for infusion was 95±2°C, resulting in a serving temperature of approximately 70°C after steeping the tea bag for 2 minutes. It was rich in protein, total sugar, vitamin C, total antioxidant activity, iron, calcium, potassium and total betalain content. The product was microbiologically safe as the total plate count was <50 and yeast and mold were absent at 0 day.

References

A.O.A.C, 2019. *Association of Official Agricultural Chemists of Official Methods of Analysis*. Washington, DC: USA.

Chandra, R., P. Bhandari, S.C. Sharma, I. Emmanuel and A. Alam, 2019. Health benefits of cactus. *Annals Phytomedicine*, 8(2): 179-185.

Coelho, Y. K., A.A. Oliverira, M.H.N. Brumano and P.C. Fidelis, 2020. Stability of total phenolic and antioxidant capacity in ready to drink black and green tea formulations. *Research, Society and Development,* 9(10): e219108160-e219108160.

Loolaie, M., N. Moasefi, H. Rasouli and H. Adibi, 2017. Peppermint and its functionality: A review. *Arch. Clin. Microbiol*., 8(4): 54.

Mahboubi, M. and N. Kazempour, 2014. Chemical composition and antimicrobial activity of peppermint (*Mentha piperita* L.) Essential oil. *Songklanakarin J. Sci. Technol*., 36(1): 83-87.

Nilsson, T. 1970. Studies into the pigments in beetroot (*Beta vulgaris* L. ssp. vulgaris var. rubra L.). *Lantbrukshogskolans Annaler.,* 36: 179-219.

Ranganna, S. 2007. *Handbook of Analysis and Quality Control for Fruits and Vegetable Products.* Tata McGraw Hill, New Delhi, India.

Sabale, P., B. Bhimani, C. Prajapati and V. Sabale, 2012. An overview of medicinal plants as wound healers. *J. Appl. Pharmaceutical Sci.*, 2(11): 143-150.

Sangwan, A., A. Kawatra and S. Sehgal, 2012. Nutrient composition of mint powder prepared from various drying methods. *Nutrition Food Sci.,* 42(1): 21-25.

Sivakumaran, K. and S. Amarakoon, 2017. Bioactivity of fruit teas and tisanes – A review. *J. Pharmacognosy Phytochem*., 7(1): 323-327.

Yadav, G. U., B.S. Joshi, A.W. Patwardhan and G. Singh, 2017. Swelling and infusion of tea in tea bags. *J. Food Sci. Tech.,* 54(8): 2474-2484.

Yang, J. and R.H. Liu, 2013. The phenolic profiles and antioxidant activity in different types of tea. *Int. J. Food Sci. Tech*., 48(1): 163-171.

Yashkumar, Dutta Samit and P. Srilatha, 2023. Optimization of drying parameters for cactus fruit in hot air tray drier. *The Pharma Innovation J*., 12(3): 128-134.

Received: September, 2024; Revised: January, 2024; Accepted: January, 2024