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Standardization and Sensory evaluation of sweet orange (*Citrus sinensis* L.) squash blended with herbal extracts

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Abstract

The present investigation, entitled “Standardization and Sensory Evaluation of Sweet Orange (*Citrus sinensis* L.) Squash Blended with Herbal Extracts” was carried out in the Processing Laboratory, Department of Post-Harvest Management, College of Horticulture and Research Station, Sankarapatan, Durg (C.G.) during the academic year 2024-25. The experiment was laid out in a Completely Randomized Design (CRD) with three replications, comprising seven different treatment combinations of sweet orange juice blended with herbal extracts. The investigated material comprised of seven treatments with six blending ratio *i.e.* To control (sweet orange 100%), T₁ (sweet orange juice 98% + ginger 1% + mint 1%), T₂ (sweet orange juice 97% + ginger 2% + mint 1%), T₃ (sweet orange juice 96% + ginger 3% + mint 1%), T₄ (sweet orange juice 98% + lemongrass 1% + mint 1%), T₅ (sweet orange juice 97% + lemongrass 2% + mint 1%), T₆ (sweet orange juice 96% + lemongrass 3% + mint 1%), and replicated three times under Completely Randomized Design. Sweet orange fruits along with herbs such as ginger, lemongrass and mint were evaluated for their Sensory characteristics. Squash was prepared by blending sweet orange juice fortified with different proportions of these herbs and observations were recorded at 15-day intervals to assess the variation in sensory attributes during storage. The blended squash was subjected to sensory evaluation using the Hedonic rating scale and data pertaining to the changes in the product were systematically recorded throughout the entire storage period of 45 days.

Among the various treatments, the squash prepared with the recipe T₆ (96% sweet orange juice + 3% lemongrass + 1% mint) sensory parameters, was rated the best in terms of taste (7.65), color (8.17), Appearance (7.44) flavor (6.25) and overall acceptability (7.71) on the Hedonic scale.

Keywords: Sweet orange, herbal squash, sensory evaluation, standardization, hedonic scale

1. Introduction

Sweet orange (*Citrus sinensis* L.) is one of the most widely cultivated and economically important fruit crops belonging to the family Rutaceae. It is renowned for its sweet flavor, refreshing juice and high nutritional value, particularly its vitamin C content. Among citrus fruits, sweet orange constitutes the largest share of global citrus production and is extensively cultivated in tropical and subtropical regions around the world (Li *et al.*, 2021) [10]. The chemical composition of sweet orange shows that it contains water 86-92% sugar 5-8%, pectin 1-2%, glycosides 0.1-1.5%, pentosans 0.8-1.2%, citric acid 0.4 to 1.5%, fibre 0.6-0.9%, proteins 0.6-0.8%, fat 0.2- 0.5%, minerals 0.5-0.9% and essential oils 0.2-0.5% (Yadla *et al.*, 2018) [15].

The word “herb” was derived from the French word “herbe” and Latin word, “herba”. Herb may be a non tracheophyte or a part of the plant like seed, stem, fruit, flower, leaf or root. The term “herb” was solely applied to non woody plants in earlier which comes from trees and shrubs (Nair and Sreelakshmi, 2021) [11]. Herbal and natural products of folk medicine have been used for centuries in every culture throughout the world (Acharya and Srivastava, 2008) [1]. “Let food be your medicine and let medicine be your food” is world famous advice of father of medicine “Hippocrates” (Katarzyna). Nowadays, herbal extracts are added to many recipe so as to enhance the sensory and therapeutic value of the product (Jain *et al.*, 2016) [8].

Ginger (*Zingiber officinale*) is a perennial herb. It is a very popular and important ingredient used in cooking in India as well as throughout the world. Ginger is a very potent antioxidant and has diverse medicinal use.

The medicinal property of ginger has the ability to treat rheumatoid arthritis, ulcer, preventing heart attack and stroke. Ginger is also used as antiviral, anti-cancer and anti-ulcerogenic drug (Ayustaningwarno *et al.*, 2024) [4]. As per data from Anon. (2024 a) [3] ginger is grown on about 186 thousand hectares in India yielding around 2,208 thousand metric tonnes of fruit. In Chhattisgarh ginger is being grown in an area of around 9.067 hectares with an annual production of 94.081 metric tonnes (Anon. 2024 b) [3].

Lemon grass (*Cymbopogon citratus*) is a popular herb in tropical nations, particularly Southeast Asia. This plant is fortified with nutrients including folate, potassium and magnesium, as well as vitamins A and C, which aid in immune function and infection resistance (Sahu 2021) [13].

Mint (*Mentha spp.*), particularly peppermint (*Mentha piperita*), is a widely used herb known for its strong aroma and refreshing taste. It has been used in culinary applications for centuries as well as in medicinal preparations for its digestive, analgesic and anti-inflammatory properties (Grigore *et al.*, 2018) [7].

Squash is a non-alcoholic, fruit-based concentrated beverage that is prepared by blending fruit juice or pulp with sugar, water and permitted preservatives. It is diluted with water or carbonated beverages before consumption. Squash serves as an essential source of nutrients, particularly vitamins, minerals and antioxidants, making it a popular choice in tropical and subtropical regions where fruit availability is abundant (Bhardwaj and Mukherjee, 2011) [5]. According to the Food Safety and Standards Authority of India (FSSAI, 2020) and Codex Alimentarius, fruit squash must contain a minimum of 25% fruit juice content in citrus-based squashes and at least 40°Bx Total Soluble Solids (TSS) for proper taste, texture and shelf stability.

2. Materials and Methods

2.1 Experimental site and design

The investigation was carried out at the Processing Laboratory, Department of Post-Harvest Management, College of Horticulture and Research Station, Sankara-Patan, Durg (C.G.) during the academic year 2024-25. The experiment followed a Completely Randomized Design (CRD) with seven treatments replicated thrice.

2.2 Materials: Sweet orange and ginger were purchased fresh from the local market. Lemongrass and mint leaves were collected from the home kitchen garden located at Amleshwar, Durg. In addition to the primary ingredients and other essential materials used in the preparation included sugar, citric acid and sodium benzoate as a preservative. Clean and sterilized juice bottles required for bottling and storage were also purchased from the local market. All materials were handled and stored under hygienic conditions to maintain their quality throughout the study.

2.3 Extraction of juice from sweet orange

After removing the peel from the sweet orange, the segments were transferred to a juice extractor for juice

extraction. The extracted juice was then filtered using a muslin cloth to remove any solid residues. The clarified juice was stored in pre-sterilized glass bottles sealed with airtight screw caps.

2.4 Calculation of sugar and water requirement

The quantity of sugar to be incorporated was determined on the basis of the total soluble solids (TSS) content of Sweet orange juice and the herbal extracts infused into it. The calculation ensured attainment of the desired TSS percentage in the prepared squash. The amount of water required was computed using the formula suggested by Shrivastava and Kumar (2002).

Quantity of water required (litres)=Quantity of finished product (litres)–Quantity of ingredients used [Juice (litres) + Sugar (kg)]

2.5 Mixing of Ingredients: Following juice extraction, herbal extracts were incorporated into sweet orange juice in different proportions, namely 98:01:01, 97:02:01 and 96:03:01 (ginger:lemongrass), with a constant 1% mint in all formulations. Sugar syrup was prepared by dissolving the required amount of sugar in water to adjust the total soluble solids (TSS) as per the treatment requirements. The herbal-sweet orange juice blend was then mixed with the prepared sugar syrup to obtain the final product. A preservative, potassium metabisulphite (KMS), was added uniformly at a concentration of 0.1% in all treatments.

2.6 Treatments

- **T0:** Control (100% sweet orange juice)
- **T1:** Sweet orange 98% + ginger 1% + mint 1%
- **T2:** Sweet orange 97% + ginger 2% + mint 1%
- **T3:** Sweet orange 96% + ginger 3% + mint 1%
- **T4:** Sweet orange 98% + lemongrass 1% + mint 1%
- **T5:** Sweet orange 97% + lemongrass 2% + mint 1%
- **T6:** Sweet orange 96% + lemongrass 3% + mint 1%

2.7 Preparation of squash: Freshly extracted sweet orange juice was blended with herbal extracts as per treatment combinations. Squash was prepared with standard sugar syrup and citric acid, bottled, pasteurized and stored under ambient conditions.

2.8 Sensory evaluation: Sensory quality of the squash was evaluated at 15-day intervals during 45 days of storage. A semi-trained panel of five judges assessed the samples for taste, color, appearance, flavor and overall acceptability using a 9-point Hedonic scale, where 9 = like extremely and 1 = dislike extremely, as described by Ranganna (1986) [12].

2.9 Statistical analysis: The data recorded on various parameters in the laboratory were subjected to statistical analysis using the analysis of variance (ANOVA) technique, as outlined by Gomez and Gomez (1985).

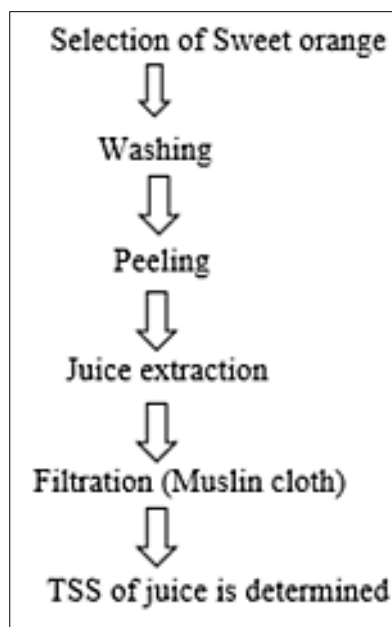


Fig 1: Flow chart for juice extraction

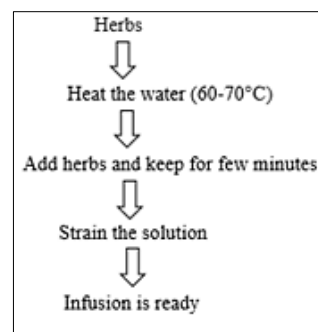


Fig 2: Flow chart for herbal infusion

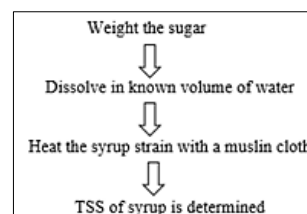


Fig 3: Flow chart for syrup preparation

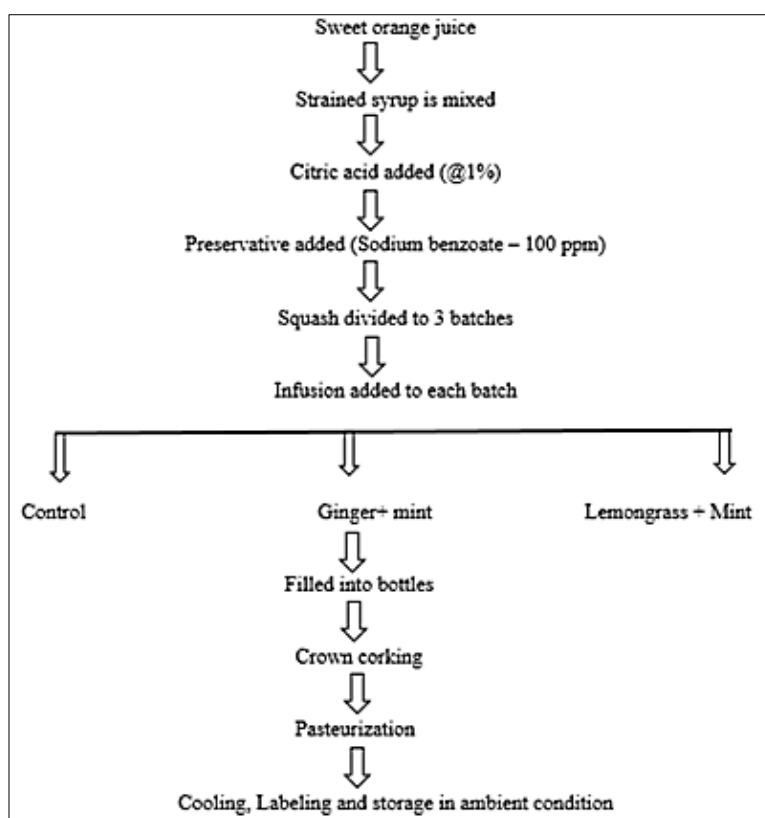


Fig 4: Flow chart for preparation of sweet orange juice with herbal infusions

Results and Discussion

1 Taste: The effect of different herbal blends on the taste of sweet orange squash during storage is presented in table 1. A gradual decline in taste scores was observed in all treatments as the storage period advanced from 0 to 45 days. This reduction may be attributed to changes in flavor compounds and slight oxidative changes during storage, which is in agreement with earlier findings reported by Bhardwaj and Mukherjee (2011) [5] and Singh *et al.* (2013). Among the treatments, T₆ (sweet orange 96% + lemongrass 3% + mint 1%) recorded the highest mean score

(7.65), indicating superior consumer acceptability due to the refreshing flavor imparted by lemongrass and mint. It was followed by T₂ (sweet orange 97% + ginger 2% + mint 1%) with a mean score of 7.30, which also maintained higher taste preference throughout the storage period. On the other hand, the lowest taste score (5.61) was recorded in control (T₀), which lacked herbal extracts and thus failed to provide the same flavor enrichment as blended treatments. Overall, the results confirm that blending sweet orange juice with herbal extracts significantly improved the taste profile of the squash, with T₆ emerging as the most acceptable treatment.

3.2 Color

The data related to the effect of herbal fortification on the color of sweet orange squash during storage is presented in table 2. A slight declining trend in color scores was observed in all treatments as the storage period progressed from 0 to 45 days. Among the treatments, T₆ (sweet orange 96% + lemongrass 3% + mint 1%) registered the highest mean score (8.17), indicating that this blend retained the most attractive appearance throughout the storage period. It was followed by T₂ (7.28) which was, lowest color score (6.35) was recorded in control (T₀), which lacked herbal extracts and therefore failed to maintain visual attractiveness during storage.

3.3 Appearance: The effect of herbal fortification on the appearance of sweet orange squash during storage is presented in table 3. A general declining trend in appearance scores was observed across all treatments with the increase in storage period from 0 to 45 days. Among the treatments, T₆ (sweet orange 96% + lemongrass 3% + mint 1%) recorded the highest mean score (7.44), followed closely by T₂ (7.37) and T₃ (7.20), indicating that these blends were

superior in maintaining appealing appearance throughout the storage period. On the other hand, the lowest appearance score (5.55) was recorded in the control (T₀).

3.4 Flavour

The data on the effect of herbal fortification on the flavour of sweet orange squash during storage is presented in table 4. Among the treatments, T₆ (sweet orange 96% + lemongrass 3% + mint 1%) recorded the highest mean score (7.58), followed by T₂ (7.34) and T₃ (7.13), indicating that higher levels of lemongrass or ginger improved flavour stability during storage. The lowest flavour acceptability was observed in T₀ (6.25).

3.5 Overall Acceptability

The data pertaining to the overall acceptability of sweet orange squash blended with herbal extracts during storage is presented in table 5. Among the treatments, T₆ (sweet orange 96% + lemongrass 3% + mint 1%) recorded the highest mean score (7.71), followed by T₂ (7.32) and T₃ (7.05) the lowest overall acceptability was noted in T₀ (control 5.94).

Table 1: Taste of stored herbal sweet orange squash prepared from infusing herbs in sweet orange juice at different ratio.

Treatment	0 days	15 days	30 days	45 days	Mean
T ₀	5.93	5.72	5.52	5.28	5.61
T ₁	6.23	5.98	5.70	5.43	5.84
T ₂	7.77	7.42	7.13	6.87	7.30
T ₃	7.33	7.03	6.78	6.53	6.92
T ₄	6.63	6.33	6.17	6.00	6.28
T ₅	6.90	6.63	6.38	6.13	6.51
T ₆	8.10	7.75	7.50	7.25	7.65
SE(m) (±)	0.09	0.08	0.06	0.05	-
CD (@ 5%)	0.27	0.24	0.18	0.15	-
CV (%)	2.21	2.05	1.62	1.35	-

Table 2: Color of stored herbal sweet orange squash prepared from infusing herbs in sweet juice at different ratio.

Treatment Notation	0 days	15 days	30 days	45 days	Mean
T ₀	6.40	6.40	6.33	6.27	6.35
T ₁	6.40	6.53	6.40	6.33	6.42
T ₂	7.33	7.27	7.27	7.23	7.28
T ₃	7.13	7.00	6.93	6.67	6.93
T ₄	7.13	6.67	6.47	6.40	6.67
T ₅	7.13	6.80	6.53	6.47	6.73
T ₆	8.47	8.27	8.07	7.87	8.17
SE(m) (±)	0.10	0.17	0.16	0.15	-
CD (@ 5%)	0.32	0.50	0.48	0.46	-
CV (%)	2.52	4.09	3.97	3.92	-

Table 3: Appearance of stored herbal sweet orange squash prepared from infusing herbs in sweet orange juice at different ratio.

Treatment Notation	Storage interval (days)				Mean
	0	15	30	45	
T ₀	6.20	5.80	5.30	4.90	5.55
T ₁	7.17	6.83	6.40	6.00	6.60
T ₂	7.87	7.60	7.20	6.80	7.37
T ₃	7.73	7.40	7.03	6.63	7.20
T ₄	7.03	6.70	6.30	5.90	6.48
T ₅	7.57	7.23	6.83	6.40	7.01
T ₆	7.90	7.60	7.30	6.97	7.44
SE(m) (±)	0.04	0.05	0.05	0.06	
C.D. (@ 5%)	0.11	0.16	0.16	0.17	
C.V. (%)	0.84	1.28	1.36	1.57	

Table 4: Flavor of stored herbal sweet orange squash prepared from infusing herbs in sweet orange juice at different ratio.

Treatment Notation	0 days	15 days	30 days	45 days	Mean
T ₀	6.60	6.47	6.07	5.85	6.25
T ₁	6.73	7.68	6.18	5.97	6.64
T ₂	7.73	7.43	7.20	6.98	7.34
T ₃	7.53	7.23	7.00	6.75	7.13
T ₄	6.93	6.73	6.50	6.28	6.61
T ₅	7.20	6.92	6.65	6.42	6.80
T ₆	8.00	7.68	7.43	7.22	7.58
SE(m) (±)	0.09	0.08	0.07	0.07	-
CD (@ 5%)	0.26	0.24	0.21	0.20	-
CV (%)	2.04	1.93	1.76	1.79	-

Table 5: Overall acceptability of stored herbal sweet orange squash prepared from infusing herbs in sweet orange juice at different ratio.

Treatment Notation	Storage interval (days)				Mean
	0	15	30	45	
T ₀	6.28	6.10	5.80	5.58	5.94
T ₁	6.63	6.76	6.17	5.93	6.37
T ₂	7.68	7.43	7.20	6.97	7.32
T ₃	7.43	7.17	6.94	6.65	7.05
T ₄	6.93	6.61	6.36	6.15	6.51
T ₅	7.20	6.90	6.60	6.35	6.76
T ₆	8.12	7.83	7.58	7.33	7.71
SE(m) (±)	0.05	0.05	0.05	0.04	-
C.D. (@ 5%)	0.14	0.16	0.16	0.13	-
C.V. (%)	1.11	1.28	1.34	1.16	-

4. Conclusion

The study concluded that blending sweet orange juice with herbal extracts significantly improved sensory attributes of squash. Among the treatments, T₆ (sweet orange 96% + lemongrass 3% + mint 1%) recorded the highest scores for taste, color, appearance, flavor and overall acceptability, making it the most suitable recipe for commercialization.

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