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Effect of storability on physico-chemical properties of turmeric-lime blended RTS beverage

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Abstract
The aim of the present experiment was to prepare blended RTS beverages from turmeric pulp and lime juice in various proportions, such as (7:2) for T_1/T_5, (6:3) for T_2/T_6, (5:4) for T_3/T_7, and (4:5) for T_4/T_8, by using sugar (T_1, T_2, T_3 and T_4) and jaggery (T_5, T_6, T_7, and T_8) as a sweetening agent. With 8 treatments and 3 replications, the experiment was set up using a completely randomized design (CRD). The product was stored at ambient condition and evaluated for physico-chemical, sensory and microbial attributes. The research study's findings revealed an increasing trend in TSS, pH, TSS/acid ratio, reducing sugars, and total sugars while a decreasing trend in acidity, ascorbic acid, and non-reducing sugars noticed during the storage period. The turmeric-lime blended RTS prepared with T_5 (7% turmeric: 2% lime and jaggery) was found to be superior among all with respect to minimum changes in TSS, pH, acidity, TSS/acid ratio, ascorbic acid, reducing sugars, non-reducing sugars and total sugars during storage period of 150 days.

Keywords: Turmeric, lime, ginger, blended RTS, sugar and jaggery

Introduction
Turmeric comes under Zingiberaceae family of perennial rhizomatous herbaceous plants and is originally from tropical South Asia. Globally, there are 133 different species of Curcuma. Both Haldi and Indian saffron are terms used to describe it. Turmeric is produced, consumed, and exported in the greatest quantities worldwide in India. It is a well-documented treatment in Ayurvedic medicine for a number of respiratory ailments, including asthma, bronchial hyperactivity, and allergies, as well as for liver diseases, anorexia, rheumatism, diabetic wounds, runny nose, cough, and sinusitis. According to Prasad and Aggarwal (2011) [7], turmeric can be utilized to treat digestive issues and can aid with flatulence, jaundice, menstruation problems, and stomach pain. Due to its nutraceutical component curcumin, turmeric is widely acknowledged for its practical qualities and therapeutic advantages. It has anti-inflammatory, hepatoprotective, antibacterial, antitumor, blood-purifying, stomachic, antiseptic, and antiviral properties (Ghani, 2003) [4].

Undoubtedly one of the most prominent citrus fruits, limes (*Citrus aurantifolia*) are acidic in nature and an outstanding source of vitamin C. It is native of India and a member of the Rutaceae family. Lime is a fruit with an acidic nature. Limes serve as crucial sources of nutritious fiber, vitamin C, phenolic elements, and flavonoids, which are all nutrients that are thought to have substantial health-enhancing properties in citrus fruits. Citric acid, found in lime fruits, acts as a naturally occurring food-preserving agent. Treatment for scurvy, piles, peptic ulcer, respiratory issues, gout, gum illness, urinary ailments, skin wellness, healthy digestion, ease from constipation, and eye care are some of the health advantages of lime.

The herbaceous, aromatic perennial plant identified as ginger (*Zingiber officinale*) has therapeutic properties because of its biologically active compounds, anti-oxidants, and anti-inflammatory abilities.

Jaggery and sugar are utilized as a sweetening agents in improving taste and flavour of the product. Jaggery has enormous health benefits which make it the ideal sweetener. Jaggery offers micronutrients that are non-toxic and anti-carcinogenic owing to their unique properties. It has modest amounts of calcium, phosphorus, and zinc. Jaggery is a high-calorie sweetener that has been proven to be healthier than white sugar since it contains minerals, protein, glucose, and fructose (Shrivastav *et al*., 2016) [9].

Fruit drinks categorized as RTS (Ready-to-serve) require at least fruit juice (10%), total soluble solids (10%), and acidity (0.3%). Due to its nutritional advantages as well as pleasing flavors and tastes, ready-to-serve (RTS) beverage productions are rapidly gaining popularity

across the nation. According to Deka and Sethi, RTS beverages can be produced through blending two or many fruits/vegetable juices in a variety of ratios. Due to their strong acidity, astringency, bitterness, and other characteristics, several extremely nutritious fruits and vegetables are highly challenging to consume. Therefore, it is suggested that blending two or more fruit and vegetable juices with spice extract to produce nutritional ready-to-serve (RTS) beverages is a practical and cost-effective method of utilizing these fruits and vegetables. Blending not only improves the taste and flavour of the product, but also enhances its health benefits and medicinal uses. During COVID-19 pandemic doctors suggested to consume vitamin C rich food for increasing immunity. As turmeric and lime are rich food sources of vitamin C, their consumption in the form of RTS can be prove beneficial for fighting against Covid-19. Therefore, the objective of the current study was to carry out and evaluate the chemical and sensory properties of turmeric and lime blended RTS.

Material and Methods

Materials

The investigation had been conducted in 2021-2022 in Post-Harvest Technology Laboratory and Analytical Laboratory, Department of Fruit Science, Dr. P.D.K.V., Akola to detect the suitable combination of fresh turmeric pulp and lime juice for preparation and better storability of blended ready-to-serve. Raw materials such as the fresh turmeric rhizomes (Var. PDKV-Waigaon) and fully matured lime fruits (Var. PDKV Lime) procured from Department of Vegetable Science and Department of Fruit Science, Dr. PDKV., Akola respectively. Fresh and healthy ginger rhizomes were purchased from local market of Akola. Chemicals utilized in this research were analytically graded and provided by Analytical Laboratory, Department of Fruit Science, Dr. P.D.K.V., Akola.

Methods

Preparation of fresh turmeric pulp and ginger pulp

The fresh rhizomes of ginger and turmeric were thoroughly cleaned and rinsed to get rid of all the debris. Following that, peeling was done to get pulp of high quality. To obtain the pulp, the rhizomes were broken into little pieces and grinded in a mixer or grinder.

Extraction of lime juice

Lime fruits were washed thoroughly for the elimination of undesirable contaminants, such as dust and soil particles. Then they were cut into 2 pieces and juice was extracted using a manual juicer.

Preparation of turmeric-lime blended RTS

The turmeric and lime blended RTS beverage was prepared with varying the proportion of turmeric pulp and lime juice at various level. The combination was made by mixing the turmeric pulp and lime juice in different ratios (T_1 and T_5 =7% turmeric pulp + 2% lime juice + 1% ginger pulp, T_2 and T_6 =6% turmeric pulp + 3% lime juice + 1% ginger pulp, T_3 and T_7 =5% turmeric pulp + 4% lime juice + 1% ginger pulp, T_4 and T_8 =4% turmeric pulp + 5% lime juice + 1% ginger pulp). The addition of sugar (T_1, T_2, T_3 and T_4) and jaggery (T_5, T_6, T_7 and T_8) was standardized to maintain its TSS and acidity in accordance with the guidelines for RTS beverages provided by the FSSAI. For the purpose of storing the freshly blended RTS beverage, 100 ml plastic bottles were chosen. The filled bottles were stored at room temperature.

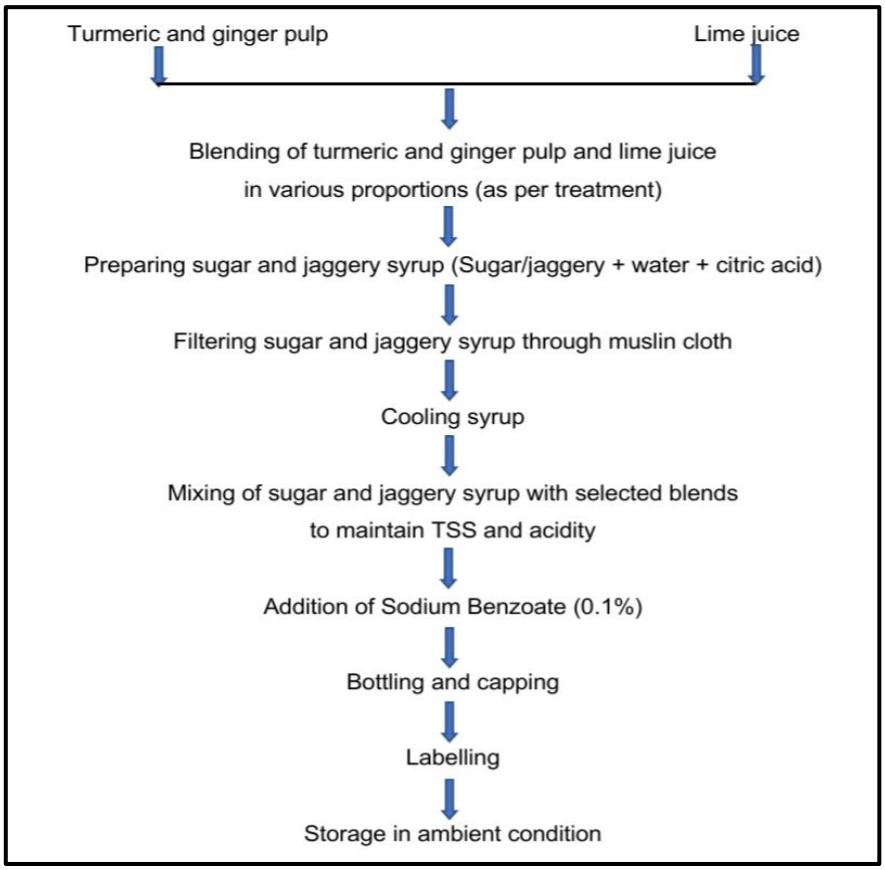

Fig 1: Flow sheet for preparation of turmeric-lime blended ready-to-serve

Standardized recipe for the preparation of turmeric-lime blended RTS beverage based on organoleptic evaluation (1 lit.)

Sr. No.	Ingredients	Quantity (for 1 lit beverage)
1)	Sugar (g)	As per specification
2)	Jaggery (g)	As per specification
3)	Water (ml)	900
4)	Ginger pulp (g)	10
5)	Turmeric pulp (g)	As per treatment
6)	Lime juice (ml)	As per treatment

Physico-chemical analysis of turmeric-lime blended RTS

TSS, pH, titratable acidity, TSS/acid ratio, reducing sugars, total sugars, non-reducing sugars and ascorbic acid were determined by the standard methods of AOAC (Association of Official Agricultural Chemists), at initially and thereafter at 30 days interval for five months.

Results and Discussion

Effect of storage period on physico-chemical properties of turmeric-lime blended RTS

Total soluble solids (°B)

Table 1 contains information about the variations in the TSS of turmeric-lime blended RTS during storage. These variations were significantly different from those at the 30th, 60th, 90th, 120th, and 150th days of observation. Treatment T_5 (7% turmeric: 2% lime + jaggery) had the least amount of total soluble solids increase (from 12.00 to 13.06 °B) during the course of the 150-day storage period.

The progressive increase in total soluble sugars (TSS) of turmeric-lime blended RTS over storage may be produced by the degradation of polysaccharides such as starch, cellulose, and pectin components into monosaccharides and oligosaccharides. The findings of Zeeshan *et al.* (2018) [12] in mandarin and carrot blended RTS coincide with the results shown above.

pH

The data regarding to the variations in the pH of turmeric-lime blended RTS during storage period are presented in Table 1. During storage period, the minimum increase in pH of turmeric-lime blended RTS was reported in treatment T_5 (7% turmeric: 2% lime + jaggery) and the minimum increase (from 3.16 to 3.68) in pH was 0.52 from initial to 150 days of storage followed by treatment T_6 (6% turmeric: 3% lime + jaggery).

Since pH and acidity are inversely proportional to one another, as shown by Bhardwaj and Mukherjee (2011) [1], the increase in pH of turmeric-lime blended RTS during storage is most likely linked to a decrease in acidity. The aforementioned findings match with Singh and Gaikwad's (2012) [10] research on the bitter gourd-lemon RTS beverage.

Titratable acidity (%)

Table 1 presents information on how the titratable acidity of turmeric-lime blended RTS changed over the course of storage. All phases of observation revealed no statistically significant differences in the data. The minimum decrease in acidity (from 0.30 to 0.22) of turmeric-lime blended RTS was recorded in treatment T_5 (7% turmeric: 2% lime + jaggery).

It was discovered that titratable acidity dropped little over the course of storage. The explanation for the decrease in acidity may be related to the enzyme invertase's ability to convert acids into salts and sugars, as was also discovered by Shaheel *et al.* (2015) [8] using RTS made from karonda blended juice.

TSS/acid ratio

Table 1 displays the findings of the variations in the TSS/acid ratio of RTS made from a turmeric-lime blend throughout storage. At all stages of observation, it was discovered that the impact of storage on the TSS/acid ratio of the turmeric-lime blended RTS was statistically non-significant. The minimum increase in TSS/acid ratio (from 40.00 to 60.55) was recorded in treatment T_5 (7% turmeric: 2% lime + jaggery).

With increased storage times, the TSS/acid ratio exhibited an increasing tendency. These outcomes match up with those of Lanjhiyana *et al.* (2010) [5] for lime and ginger beverages.

Reducing sugars (%)

Data related to the changes in the reducing sugars of turmeric-lime blended RTS across the storage period are presented in Table 2 and it showed significant differences at initial, 30th, 60th, 90th, 120th and 150th day of storage. The significantly minimum increase in reducing sugars (from 7.00 to 8.66) of turmeric-lime blended RTS was recorded in treatment T_5 (7% turmeric: 2% lime + jaggery) and it was 1.66 from initial to 150 days period.

The moderate inversion of non-reducing sugars to reducing sugars by the hydrolysis process is likely what caused the enhancement in reducing sugars in turmeric-lime blended RTS throughout storage. The identical findings with a turmeric-orange blended beverage were reported by Mane *et al.* (2019) [6].

Non-reducing sugars (%)

The information regarding the changes in non-reducing sugars of turmeric-lime blended RTS throughout storage period are indicated in Table 2. The minimum decrease in non-reducing sugars (from 3.98 to 3.87) of turmeric-lime blended RTS during storage was recorded in treatment T_5 (7% turmeric: 2% lime + jaggery), followed by treatment T_6 (6% turmeric: 3% lime + jaggery).

Inversion of non-reducing sugars into reducing sugars may have contributed to the progressive decline in non-reducing sugars in turmeric-lime blended RTS in storage. The findings provided above are in agreement with those of Lanjhiyana *et al.* (2010) [5] who studied lime-ginger beverages.

Total sugars (%)

Table 2 provides details regarding the variances in the total sugars of the turmeric-lime blended RTS in the course of the storage period. The significantly minimum rise in total sugars of turmeric-lime blended RTS was recorded in treatment T_5 (7% turmeric: 2% lime + jaggery) and the minimum increase (from 10.97 to 12.53) was 1.56 from initial to 150 days.

It is possible that the breakdown of polysaccharides and insoluble carbohydrate polymers into simple sugars during storage could have induced the overall sugar content of the turmeric-lime blend RTS to rise. The results provided above support Dhiman *et al.*'s (2017) [3] observation that the overall sugar content of pumpkin RTS beverage rose with the lengthening of storage time.

Ascorbic acid (mg/100 g)

In Table 2, observations about ascorbic acid deviations in turmeric-lime blended RTS during storage are shown. The turmeric-lime blended RTS treatment T_5 (7% turmeric: 2%

lime + jaggery) had the least ascorbic acid loss during storage (from 7.84 to 6.68) from the start to 150 days of storage, followed by treatment T_6 (6% turmeric: 3% lime + jaggery).

Due to ascorbic acid's sensitivity to oxygen, light, and heat, it was easy for both enzymatic and non-enzymatic catalysts to oxidize it in the presence of oxygen during storage of turmeric-lime blended RTS. Walhekar *et al*. (2018) [11] reported comparable outcomes for the jaggery-based kagzi lime RTS beverage.

Table 1: Effect of storage period on TSS (°B), pH, titratable acidity (%) and TSS/acid ratio of turmeric-lime blended RTS.

Treatment	TSS (°B)				pH				Titratable Acidity (%)				TSS/acid ratio			
	Storage period (days)				Storage period (days)				Storage period (days)				Storage period (days)			
	Fresh RTS	30	150	Change in TSS	Fresh RTS	30	150	Change in pH	Fresh RTS	30	150	Change in titratable acidity	Fresh RTS	30	150	Change in TSS/ acid ratio
T_1	12.00	12.42	13.38	1.38	3.13	3.28	4.20	1.07	0.30	0.26	0.18	0.12	40.00	53.90	74.85	34.85
T_2	12.00	12.48	13.42	1.42	3.11	3.30	4.23	1.12	0.30	0.25	0.17	0.13	40.00	50.29	80.17	40.17
T_3	12.00	12.50	13.47	1.47	3.08	3.33	4.24	1.16	0.30	0.25	0.17	0.13	40.00	52.37	80.61	40.61
T_4	12.00	12.51	13.52	1.52	3.06	3.41	4.29	1.23	0.30	0.24	0.15	0.15	40.00	57.15	92.26	52.26
T_5	12.00	12.22	13.06	1.06	3.16	3.18	3.68	0.52	0.30	0.28	0.22	0.08	40.00	45.03	60.55	20.55
T_6	12.00	12.20	13.12	1.12	3.15	3.16	3.73	0.58	0.30	0.27	0.21	0.09	40.00	50.96	63.50	23.50
T_7	12.00	12.25	13.19	1.19	3.11	3.19	3.75	0.65	0.30	0.27	0.19	0.11	40.00	48.60	71.00	31.00
T_8	12.00	12.31	13.21	1.21	3.09	3.25	3.91	0.82	0.30	0.26	0.18	0.12	40.00	47.48	74.60	34.60
F Test	-	Sig.	Sig.	-	NS	Sig.	Sig.	-	-	NS	NS	-	-	NS	NS	-
SE (m) +	-	0.065	0.044	-	0.033	0.031	0.040	-	-	0.042	0.017	-	-	9.628	7.14	-
CD @ 5%	-	0.195	0.132	-	-	0.094	0.120	-	-	-	-	-	-	-	-	-

Table 2: Effect of storage period on reducing sugars (%), non-reducing sugars (%), total sugars (%) and ascorbic acid (mg/100 g) of turmeric-lime blended RTS.

Treatment	Reducing Sugars (%)				Non-Reducing Sugars (%)				Total Sugars (%)				Ascorbic Acid (mg/100 g)			
	Storage period (days)				Storage period (days)				Storage period (days)				Storage period (days)			
	Fresh RTS	30	150	Change in reducing sugars	Fresh RTS	30	150	Change in non-reducing sugars	Fresh RTS	30	150	Change in total sugars	Fresh RTS	30	150	Change in ascorbic acid
T_1	6.62	6.93	8.46	1.84	3.60	3.55	3.39	0.21	10.23	10.48	11.84	1.61	7.23	7.08	5.25	1.98
T_2	6.48	6.85	8.42	1.94	3.45	3.41	3.21	0.24	9.92	10.26	11.57	1.65	7.28	7.12	5.09	2.19
T_3	6.25	6.76	8.11	1.86	3.53	3.49	3.27	0.26	9.79	10.24	11.38	1.59	7.35	7.16	4.92	2.43
T_4	6.15	6.58	8.10	1.95	3.43	3.38	3.13	0.30	9.58	9.95	11.29	1.71	7.42	7.24	4.88	2.54
T_5	7.00	7.35	8.66	1.66	3.98	3.96	3.87	0.11	10.97	11.31	12.53	1.56	7.84	7.78	6.68	1.16
T_6	6.92	7.27	8.65	1.73	3.88	3.84	3.74	0.14	10.80	11.11	12.39	1.59	7.92	7.71	6.54	1.38
T_7	6.85	7.16	8.59	1.74	3.75	3.70	3.56	0.19	10.57	10.83	12.14	1.57	8.13	7.80	6.48	1.65
T_8	6.74	7.06	8.51	1.77	3.72	3.67	3.55	0.17	10.49	10.76	12.07	1.58	8.25	7.92	6.43	1.82
F Test	Sig.	Sig.	Sig.	-	Sig.	Sig.	Sig.	-	Sig.	Sig.	Sig.	-	Sig.	Sig.	Sig.	-
SE (m) +	0.061	0.070	0.064	-	0.057	0.060	0.061	-	0.069	0.096	0.079	-	0.017	0.012	0.014	-
CD @ 5%	0.186	0.210	0.196	-	0.172	0.182	0.188	-	0.210	0.290	0.240	-	0.052	0.037	0.044	-

Conclusion

The goal of the present investigation was to prepare a turmeric-lime blended RTS beverage using different proportions of fresh turmeric pulp, lime juice, and ginger pulp. According to the study, while non-reducing sugars, titratable acidity, and ascorbic acid levels all declined throughout the course of the progressive storage time, TSS, reducing sugars, total sugars, and the TSS/acid ratio increased constantly. It can be finally concluded that, turmeric-lime blended RTS prepared with 7% turmeric: 2% lime: 1% ginger and jaggery was found to be superior among all with respect to minimum changes in TSS, pH, acidity, TSS/acid ratio, ascorbic acid, reducing sugars, non-reducing sugars and total sugars during storage period of 150 days.

References

1. Bhardwaj RL, Mukherjee S. Effects of fruit juice blending ratios on kinnow juice preservation at ambient storage condition. African Journal of Food Science. 2011;5(5):281-286.
2. Deka BC, Sethi V. Preparation of mixed fruit juice spiced RTS beverages. Indian Food Packer. 2001;55(3):58-61.
3. Dhiman, Anju K, Nagendera Babu G, Surekha Attri, Preethi Ramchandran. Development and storage stability of pumpkin based ready-to-serve (RTS) beverages. An International Quarterly Journal of Life Sciences. 2017;12(3):1481-1486.
4. Ghani A. Medicinal plants of Bangladesh: Chemical constituents and uses. 2nd Ed., (Revised and Enlarged). Asiatic Society of Bangladesh, old Nimtali, Dhaka; c2003. p. 196-197.
5. Lanjhiyana R, Sharma PK, Shukla N. Studies on effect of chemical preservatives on physico-chemical changes of beverages in lime and ginger juice with their combinations. J Hortl. Sci. 2010;5(2):151-154.
6. Mane RP, Veer SJ, Gaikwad GP. Development of fresh turmeric rhizome juice-based orange RTS beverage. Acta Scientific Nutritional Health. 2019;3(6):55-60.
7. Prasad S, Aggarwal B. Turmeric, the golden spice. Herbal Medicine: Biomolecular and Clinical Aspects; c2011. p. 1-32.
8. Shaheel SK, Swami DV, Prasanna Kumar B, Uma

Krishna K. Effect of storage period on chemical properties of RTS prepared from Karonda (*Carrisa carondas* L.) blended juices. Plant Arch. 2015;15(1):35-40.
9. Shrivastav P, Varma AK, Walia R, Praveen R, Singh AK. Jaggery- A revolution in the field of natural sweeteners. European J of Pharmaceutical and Medical Res. 2016;3(3):198-202.
10. Singh S, Gaikwad K. Studies on the development and storage stability of bitter gourd-lemon function RTS beverage. Internat. J Proc. & Post Harvest Technol., 2012;3(2):306-310.
11. Walhekar RD, Gadhe KS, Mandalik GB. Standardization of jaggery based kagzi lime RTS beverage with incorporation of spice extract. Journal of Pharmacognosy and Phytochemistry. 2018;7(2):3959-3962.
12. Zeeshan M, Saleem SA, Ayub M, Khan A. Development and quality evaluation of RTS from mandarin (*Citrus reticulata*) and carrot blend flavored with ginger extract. J Food Process Technol. 2018;9(1):714.