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Research Article

Development of Fresh Turmeric Rhizome Juice-based Orange RTS Beverage

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Abstract

The study was carried out to develop fresh turmeric rhizome juice blended orange RTS beverage with the formulations of orange juice to the fresh turmeric rhizome juice in the ratio of T1 (95:05); T2 (90:10); T3 (85:15) and studied with reference to the T0 (100:0). The formulated fresh turmeric rhizome-based orange RTS beverage then subjected for sensory evaluation and the sample T2 found to be superior among all with respect to sensory qualities such as color, flavour, overall acceptability and taste. The prepared fresh turmeric rhizome juice-based orange RTS beverage can be stored and consumed safe up to 90 days at refrigerated storage with retention of 45mg/100 ml of curcumin in it.

Keywords: Turmeric; Orange; Curcuma longa; Nutraceutical; Curcumin; RTS; Rhizome.

Introduction

Oranges form a rich source of vitamin C, flavonoids, phenolic compounds and pectins. The main flavonoids found in citrus species are hesperidine, narirutin, naringin and eriocitrin. Just one orange provides 116% of the daily requirement for vitamin C. Vitamin C is the primary water- soluble antioxidant, which prevents free radical generation in the body and damage to the tissues in the aqueous environment both inside and outside cells. Drinking of orange juice without salt and sugar is associated with reduced severity of inflammatory conditions, like asthma, osteo- arthritis, and rheumatoid arthritis. Vitamin C is also necessary for the proper functioning of immune system. Vitamin C is good for preventing cold, cough and recurrent ear infections. Parle and Chaturvedi [1].

Turmeric belongs to Curcuma longa, a rhizomatous herbaceous perennial which comes under ginger family Zingiberaceae, it is native to tropical South Asia. There are as many 133 species of Curcuma have occurred globally. The turmeric plant needs temperatures between 20°C and 30°C and a considerable amount of annual rainfall to thrive. The plants having a height of up to 1 m, with long and wide spread leaves. The turmeric is derived from tuberous rhizomes having a rough and segmented skin. They have characteristic yellowish-brown colour after cutting the skin appears orange. The main rhizome is pointed or tapered at the distal end and measures 2.5–7.0 cm (1–3 inches) in length and 2.5 cm (1 inch) in diameter, with smaller tubers branching off. After drying of turmeric rhizome, it can be ground to a fine yellow powder with somewhat taste. Turmeric is most common spice largely cultivated in India, which is followed by Bangladesh, China, Thailand, Cambodia, Malaysia, Indonesia, and the Philippines. It is also cultivated on a small scale in most tropical regions in Africa, America, and Pacific Ocean Islands. Being the largest producer and consumer, India is leading exporter of turmeric in the world Ravindran [2]. Turmeric can be used as herbal medicine for rheumatoid arthritis, conjunctivitis, skin cancer, small pox, chicken pox, wound healing, urinary tract infections, and liver ailments as reported by Dixit., *et al* [3]. Turmeric is also used for digestive disorders; helps to reduce flatus, jaundice, menstrual difficulties, and abdominal pain Prasad and Agarawal [4].

Curcumin in turmeric have some promising effects have been observed in patients with various pro-inflammatory diseases including cancer, cardiovascular disease arthritis, uveitis, ulcerative proctitis, Crohn's disease, ulcerative colitis, irritable bowel disease, tropical pancreatitis, peptic ulcer, gastric ulcer, idiopathic orbital

inflammatory pseudotumor, oral lichen planus, gastric inflammation, vitiligo, psoriasis, acute coronary syndrome, atherosclerosis, diabetes. As suggested by Gupta., *et al.* [5] curcumin at doses as high as 12 g/day over 3 months is safe for consumption.

Nectar, Ready to Serve Beverages can be prepared by mixing of two or more fruits juice/pulp in different proportions as studied by Deka [6], Deka and Sethi [7]. It helps in improving aroma, taste and nutrients of beverages as there is increase in demand among consumers for natural beverages, there is great scope for the manufacturing of blended juices and other fruit-based beverages. Ready to Serve fruit beverage conations fruit juice/pulp not less than (10%), total soluble solids (10%) and acidity (0.3%). Hence the present investigation was focused to carried out and evaluate the sensorial qualities of fresh turmeric rhizome juice-based orange ready-to-serve (RTS) beverage.

Materials and Methods

Materials

Raw materials such the fresh turmeric rhizomes and oranges were procured from local fruit market of Parbhani. The proposed findings were carried out in Department of Food Engineering, College of Food Technology, Parbhani.

Methods

Extraction of fresh turmeric rhizome juice and orange juice

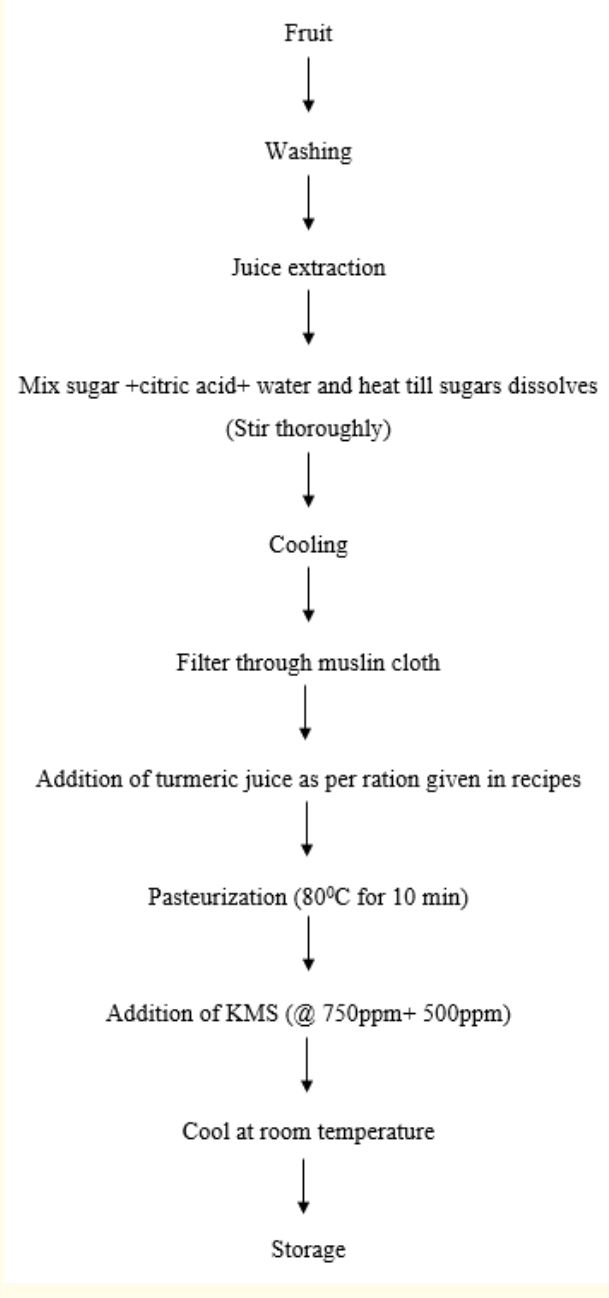
Fresh turmeric rhizomes were cleaned and washed by removing all the dirt. Then peeling was carried out for obtaining good quality juice. The rhizomes were cut into small pieces for juice extraction through juice extractor. The juice then filtered with the help of muslin cloth to obtain clear fresh turmeric rhizome juice.

Sensory evaluation of turmeric based orange RTS beverage

Sensorial evaluation of fresh turmeric rhizome juice-based orange RTS beverage was carried out for different properties such as colour and appearance, flavour, after taste and overall acceptability using standard method of Amerine *et. al.* [8]. For these semi-trained panel of judges were used. They used 1 to 9-point hedonic scale for rating the quality of the turmeric-based orange RTS beverage.

Preparation of Turmeric based Orange RTS Beverage

Source: Nitu., *et al.* [9]



Figure

The juices were subjected for analysis of its total soluble solids (TSS) and acidity. Then as per different recipe treatment, the quantity of juice, sugar, citric acid, preservative (KMS) and water were determined. Glass bottles of 200 ml capacity were used for the storage of prepared fresh turmeric rhizome juice-based orange RTS beverage. The filled bottles were kept at ambient and refrigerated storage studies.

Results and Discussions

Effect of addition of different proportion of fresh turmeric rhizome juice on organoleptic characteristics of turmeric-orange RTS beverage

The organoleptic evaluation of turmeric based orange RTS beverage was carried out by ten members of semi trained panel and the scores were given by evaluating color and appearance, flavour, taste and overall acceptability which was compared with control sample and presented in table 1.

Samples	Colour and Appearance	Flavour	Taste	Overall Acceptability
T_0 (100:00)	8.7	8.5	9	8.8
T_1 (95:05)	7.5	8.0	8.5	8.1
T_2 (90:10)	8.5	8.5	9	8.6
T_3 (85:15)	7.0	7.5	7.5	7.4

Table 1: Organoleptic evaluation of turmeric based orange RTS beverage.

*Each value represents the average of three determinations.

Control (T0) –Without addition of turmeric juice

T_1 – With addition of turmeric juice 5 per cent in beverage

T_2 – With addition of turmeric juice 10 per cent in beverage

T_3 – With addition of turmeric juice 15 per cent in beverage

The result of table 1 revealed that there was slight change in color of samples. T_2 observed highest score followed by T_1 and T_3. T_3 scores lower than all the samples due to highly darkened colour and appearance of turmeric-orange RTS beverage, which forced the panel members to rank lower. By comparing scores given by panel members it was clear that color and appearance of beverage depends on amount of turmeric juice added to the beverage.

Selected sample (T_2) scored higher for flavour followed by T_1 and T_3. Sample T_3 was significantly inferior over all, because addition of higher proportion of turmeric juice affects the flavour of the sample. Thus, increase in proportion of turmeric juice was not acceptable by the panel members due to its intense flavour.

Taste of the samples significantly changed with addition of turmeric juice. Selected sample T_2 ranked highest due to significant addition of turmeric juice followed by sample T_1 and T_3. However, T_0 scored the higher due to no addition of turmeric juice and was not acceptable by semi trained sensory panel members.

The maximum overall acceptability score was recorded for selected sample T_0 (8.8) followed by sample T_2 (8.6) for color and appearance which was higher than samples T_1 and T_3.

Moreover, among the entire turmeric-orange RTS beverage prepared with turmeric juice sample T_2 containing 10 per cent turmeric juice reported the highest score in all the sensory quality attributes and found to be overall acceptable whereas significant difference in sensory score was observed in sample T_3 and T_0.

Moreover, it could also be seen that all the samples were found to be acceptable. The sample T_2 containing 10% turmeric juice was found to be statistically significant over sample T_3 containing 15% turmeric juice. However, sample T_2 and T_1 are found to be statistically at par with each other in color, flavour, and taste except overall acceptability. Considering all the above parameters the selected sample (T_2) was found to be statistically significant over the all samples. Sample T_2 liked very much having moderate acidity content which will fulfil the taste and acceptability requirement for people serving the RTS beverage.

Effect of addition of different proportion of turmeric juice on physico-chemical composition of turmeric-orange RTS beverage

Samples	TSS (^{0}Bx)	pH	Acidity (%)	Total sugar (%)	Reducing sugar (%)	Curcumin content (mg/100g)
Control (T_0)	12	3.1	0.30	6.2	4.3	0
T_1	11.8	3.3	0.29	5.3	4.0	22
T_2	12	3.4	0.28	5.0	3.8	45
T_3	12.5	3.5	0.26	4.8	3.2	67

Table 2: Effect of addition of different proportion of turmeric juice on physico-chemical composition of turmeric-orange RTS beverage.

*Each value represents the average of three determinations.

Effects of storage on physicochemical properties of turmeric-orange RTS beverage at ambient temperature (30°C)

Data pertaining to various physicochemical parameters of turmeric-orange RTS beverage viz. pH, TSS, acidity and ascorbic acid were evaluated at ambient storage up to 90 days of storage were studied and results obtained are given in table 3.

It could be revealed that the increased TSS during storage was probably due to conversion of left-over polysaccharides into soluble sugars. The present findings are in close conformity with the findings of Tripathi., *et al.* [10], who found that the total soluble solids of pineapple and guava blended juice increased continu-

Storage Days	pH	TSS ^{0}Bx	Acidity (%)	Ascorbic Acid mg/100g
0	3.20	12.00	0.29	32.0
0-30	3.19	12.21	0.30	31.9
30-60	3.16	12.32	0.32	31.8
60-90	3.13	12.56	0.35	31.3

Table 3: Effects of storage on pH, TSS, acidity and ascorbic acid content of turmeric-orange RTS beverage at ambient storage 30^{0}C.ds

*Each value represents the average of three determinations.

ously during storage period. Similar findings were also reported by Deka., *et al*. [11], who observed that total soluble solids showed an increasing trend throughout the storage period. These results are in good agreement with the findings of Sharma and Singh [12], who reported that the TSS of lime juice increased with an increase in storage period up to 90 days.

Ascorbic acid is very important nutrient having antioxidant properties and it provides protection against free radicals formed in body as reported by Esteve., *et al*. [13]. Ayhan., *et al*. [14] studied the effects of storage temperature, processing methods and packaging materials on the rate of ascorbic acid degradation. The ascorbic acid content of prepared RTS beverage was found to be decreased significantly during storage with increase in storage period, which may be due to the fact that ascorbic acid is sensitive to oxygen, light exposure and heat that may cause oxidation in presence of oxygen by both enzymatic and non-enzymatic catalyst as reported by Davey., *et al.* [15].

Days	pH	TSS ^{0}Bx	Acidity (%)	Ascorbic Acid mg/100g
0	3.20	12.0	0.29	32.0
30	3.23	12.3	0.28	31.8
60	3.31	12.9	0.25	30.3
90	3.39	13.1	0.22	29.8

Table 4: Effects of storage on pH, TSS, acidity and ascorbic acid content of turmeric-orange RTS beverage at refrigerated storage 4^{0}C.

*Each value represents the average of three determinations.

The increase in acidity of nectar during storage might be due to formation of organic acids by ascorbic acid degradation as well as progressive decrease in the pectin content. It is also due to formation of acids from sugar.

The decrease in pH probably due to increase in acidity; as acidity and pH are inversely proportional to each other as suggested by Bhardwaj and Mukherjee [16]. This gradual decrease in pH has a significant effect as lower pH does not allow pathogenic microorganisms to grow and hence acts as a preservative. The decreased pH was probably occurred due to increase in acidity which affects the sensorial quality of prepared RTS beverage which was in accordance with the findings of Bhardwaj and Mukherjee [16]. The same was reported by Del C., *et al.* [17] in citrus segments and juices stored at 4^{0}C.

Titrable acidity was shown to be slightly decreased during entire storage. The reason behind decrease in acidity might be due to conversion of acids into salts and sugars by the action of enzyme invertase, which was also found by Tiwari [18] in guava and papaya blended RTS beverage; the same was reported by Dhaliwal and Hira [19] in carrot juice blends.

TSS was increased with increasing storage period, that may be due to hydrolysis of polysaccharides into monosaccharide and oligosaccharides were in close confirmation with Deka and Sethi [7].

The decreasing trend of ascorbic acid content with increase in the storage period was found might be due to oxidation of vitamin-C by trapped oxygen in pet bottles, which resulted in formation of dehydro-ascorbic acid and also due to the effect of processing, storage time and exposure to light. It could also be seen that from table 3 and 4 there was slight change in pH, TSS, acidity and ascorbic acid content of the samples stored at ambient and refrigerated storage.

Similar results were also noted by Mall and Tondon [20], in guava-aonla blended beverage, Sharma., *et al.* [21], in guava-papaya RTS beverage and Pebam [22], in aonla products. The losses in ascorbic acid content of fruit beverages have also been noticed by Kumar [23], in papaya and Rabbani [24], in mango beverages during storage at ambient conditions. The results are in conformity with the findings of Baramanray., *et al.* [25], who observed that ascorbic acid content in guava nectar decreased significantly with increasing storage period.

Effects of storage on total sugars, reducing sugars and non-reducing sugars of turmeric orange RTS beverage at ambient storage 30^{0}C

Data pertaining to effect of storage on reducing sugar, non-reducing sugar and total sugars of turmeric-orange RTS beverage storage at ambient condition are presented in table 5.

Days	Reducing Sugar (%)	Non-reducing Sugar (%)	Total Sugar (%)
0	6.72	5.33	12.05
30	7.18	5.32	12.50
60	8.15	5.32	13.47
90	8.24	5.30	13.54

Table 5: Effects of storage on total sugars, reducing sugars and non-reducing sugars of turmeric-orange RTS beverage at ambient storage 30^{0}C.

*Each value represents the average of three determinations.

The increase in reducing sugar during storage may be attributed due to gradual inversion of non-reducing sugars to reducing sugar by the hydrolysis process. These results are in close conformity with the findings of Brekke., *et al*. [26], who studied that the decrease in sucrose content in papaya nectar was correlated with an increase in storage temperature and sulphur di-oxide preserved pulp and showed maximum increase in reducing sugar content, whereas, the non-reducing sugar followed a decreasing trend. Tiwari [19] reported an increase in reducing sugar content during storage of the RTS beverages prepared from guava- papaya blends.

Data from table 4 revealed that the reducing sugar content were ranged from 6.72 to 7.24 per cent and varied significantly with respect storage period.

Results shown an increasing trend in reducing sugar with corresponding storage period.

The negligible deviation was observed in case of non-reducing sugar content and was varied from 5.30 to 5.20 per cent. Moreover, total sugar content found to be increased as storage advances.

Effects of storage on total sugars, reducing sugars and non-reducing sugars of turmeric-orange RTS beverage at refrigerated storage 4^{0}C

Data pertaining to effect of storage on reducing sugar, non-reducing sugar and total sugars of turmeric-orange RTS beverage under refrigerated condition storage are presented in table 6.

From the above table 5 it could be seen that the gradual decrease non-reducing sugar as the storage period increased from 0 days to 90 days i.e. from 5.30 per cent to 5.20 per cent respectively. The changes in total sugars and reducing sugars are slightly increased as the storage period increased from 0 days to 90 days.

Days	Reducing Sugar (%)	Non-reducing Sugar (%)	Total Sugar (%)
0	6.72	5.30	12.02
30	6.90	5.28	12.18
60	7.15	5.27	12.42
90	7.24	5.20	12.44

Table 6: Effects of storage on total sugars, reducing sugars and non-reducing sugars of turmeric-orange RTS beverage at refrigerated storage 4^{0}C.

*Each value represents the average of three determinations.

As there is inversion of non-reducing sugars into reducing sugars in acidic medium there was increase observed in reducing sugars during storage period.

Highest reducing sugars were observed i.e. (12.44%) on 90th day of storage. These results are in accordance with studies of Ranote and Bains [27] in kinnow juice; the same was found by Narayanan., *et al*. [28] in clarified banana RTS and Murtaza., *et al.* [29] also reported it in strawberry drinks stored at different temperatures.

Conclusion

The present study was made to develop fresh turmeric rhizome juice-based orange RTS beverage with different added quantities of fresh turmeric rhizome juice. The study showed that the sensory characteristics of fresh turmeric rhizome juice-based orange RTS beverage such as colour, taste, flavor and overall acceptability were significantly altered by different recipe treatments. It can be finally summarized that fresh turmeric rhizome juice-based orange RTS beverage with 90:10 (T1) orange to fresh turmeric rhizome scored highest sensory score (i.e., 8.6) in case of all sensory attributes. The prepared fresh turmeric rhizome juice-based orange RTS beverage can be stored and consumed safe up to 90 days at refrigerated storage with retention of 45mg/100 ml of curcumin in it.

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