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Study of Physico-Chemical Properties and Sensory Attributes of Beetroot-Orange RTS Drink

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Abstract: ***Fruit and Vegetable juices are valuable source of antioxidants because it contains a significant amount of bioactive compounds. The root plants like Beta vulgaris (beetroot) and Daucus carota (carrot) and Zingiber officinale (ginger) possesses wide range of compounds like flavonoids, phenolic acid, amino acid, ascorbic acid, tocopherol and pigments. The antioxidant rich extracts of above roots can be added in fresh juice of Citrus sinensis (orange) for the preparation of refreshing, thirst quenching & energizing Ready to serve beverage that not only improve the health but also fulfils the nutritional requirements. The formulation was prepared by combination of different proportions of orange juice, beetroot juice, ginger juice and carrot juice. The formulation prepared in the ratio of 50:30:10:10 containing (ml) of beetroot: orange: ginger: carrot was rated most acceptable by a panel of judges on a nine point hedonic scale and composite scoring test. Proximate composition revealed that sample BOGC 2 contains (0.288%) proteins, (13.2%) carbohydrates (0.06%) fat and (21.454 mg) of vitamin C. The prepared health drink was packed in glass bottles with cork cap and stored at refrigerated temperature satisfactorily for the period of more than 30 days. While, the juice of these roots can be used as valuable ingredients for the production of health beverage with all the important properties and medicinal characteristics.***

Keywords: Ready to serve, Bioactive, Sensory evaluation, Antioxidants

1. Introduction

Ready to serve beverages are sold in a packaged form, ready for consumption. Fruit based beverages are relished when served chilled, particularly during summers. These are delicious as well as nutritious containing the goodness of fresh fruit. The advantage of RTS beverage is that there is no need to dilute it whereas squash, syrup, cordial, crush are diluted with water before use. Ready-to-serve beverages are made out of juice, sugar, water and consumed as such. The fruits like pineapple, orange, lime, banana, litchi, passion fruit and other local fruits can be used for RTS preparations.

1.1 Beet Root

The beetroot (*Beta vulgaris*) is the taproot portion of the beet plant, also known as the table beet, garden beet, red or golden beet or informally simply as the beet. In recent years increased attention has been focused on utilization of healthy foods. The beetroot (*Beta vulgaris*) being an alkaline food with pH from 7.5 to 8.0 has been acclaimed for its health benefits, in particular for its disease fighting antioxidant potential, significant amount of vitamin C and vitamins B_1, B_2, niacin, B_6, B_{12} whilst the leaves are an excellent source of vitamin A [1].The juice of beetroot is also consumed as a natural remedy for sexual weakness and to expel kidney and bladder stones [2]. The claimed therapeutic use of beetroot includes its antitumor, carminative, emmenagogue and hemostatic and renal protective properties and is a potential herb used in cardiovascular conditions [3]. Beetroot is known to be a powerful antioxidant [4]. The balance between the production of reactive oxygen species (ROS) and reactive nitrogen species (RNS), collectively termed „RONS" and the protective mechanisms against them is considered important in preserving good health [5]. Consumption of natural produce beetroot juice which is rich in antioxidant compounds may help to redress the balance between RONS production and endogenous protection when the body is under oxidative stress [6]. Beetroot being an alkaline food having pH 7.5 to 8.0 contains higher antioxidant compounds [1]. Other than used as a food, beet is also used as colouring agent and in medicinal applications. Beetroot is an excellent source of folate and a good source of manganese [7]. Betaine has several noted effects related to human health and function, including acting as an osmolyte (protecting cells against dehydration), as an antioxidant agent (protecting cells against free radicals), as a methyl group donor (lowering potentially harmful levels of homocysteine), and as a vascular protectant [8].

1.2 Orange

Orange is tasty & juicy fruit, belongs to the family Rutaceae is botanically known as *Citrus sinensis. Citrus sinensis* is one of the most important and widely grown fruit crop, with total global production reported to be around 120 million tons [9]. Orange pulp is an excellent source of vitamin C providing 64% of the daily requirement of an individual [10]. Citrus juices are considered to be a rich source of antioxidants including vitamin C, phenolic compounds (flavonoids) and carotenoids that the human body cannot synthesize [11]. Numerous other essential nutrients are present in low amounts. Orange juice contains diverse phytochemicals including carotenoids (beta-carotene, lutein and beta-cryptoxanthin), flavonoids (e.g., naringenin) [12] and numerous volatile organic compounds producing orange aroma, including aldehydes, esters, terpenes, alcohols, and

ketones [13]. Being a citrus fruit, the orange is acidic: its pH levels are as low as 2.9, and as high as 4.0 [14].

1.3 Carrot

The carrot (*Daucus carota* sub sp. *sativus*) is a root vegetable, usually orange in colour, also exist in purple, red, white and yellow colored varieties. The carrot juice is an appreciable source of carotene and acceptable for its vitamin and mineral contents [15]. It has a crispy texture when fresh. The most commonly eaten part of a carrot is a taproot, although the green leaves are sometimes eaten as well. Carrots are widely used in many cuisines, especially in the preparation of salads and carrot salads are a traditional in many regional cuisines. The carrot gets its characteristic bright orange colour from β-carotene and lesser amounts of α-carotene, γ-carotene, lutein and zeaxanthin [16]. α and β-carotenes are partly metabolized into vitamin A, providing more than 100% of the Daily Value (DV) per 100 g serving of carrots [17],[18]. Carrots are also a good source of vitamin K (13% DV) and vitamin B6 (11% DV) (USDA 2014). Carrots are 88% water, 4.7% sugar, 2.6% protein, 1% ash, and 0.2% fat [19]. Carrot dietary fiber comprises mostly cellulose with smaller proportions of hemicellulose, lignin and starch [20]. Free sugars in carrot include sucrose, glucose and fructose (USDA, 2014).

1.4 Ginger

Ginger (*Zingiber officinale* Roscoe) is a flowering plant belongs to the family *Zingiberaceae* whose rhizome, ginger root or simply ginger is widely used as a spice or a folk medicine. Other members of the family *Zingiberaceae* include turmeric and cardamom. The distantly related dicots in the genus *Asarum* are commonly called wild ginger because of their similar taste. It is widely claimed as a Stomachic, aromatic, carminative, aphrodisiacs, diaphoretic, antiemetic, allergic rhinitis and gastric stimulant and for treating migraine headache [21]. It is also used an antispastic against intestinal colic [22]. Ginger oil is used in mouthwashes and liquors 3 [23].

In limited studies, ginger was found to be more effective than placebo for treating nausea [24] caused by seasickness [25], morning sickness [26], and chemotherapy [27], although it was not found superior to placebo for pre-emptively treating postoperative nausea. Some studies advice against taking ginger during pregnancy [25], suggesting that ginger is mutagenic, though some other studies have reported antimutagenic effects [25].

2. Materials and Methods

2.1 Procurement of Raw Materials

The vegetables and fruit used for this study: beetroot, carrot, ginger was purchased from a local market. All the preliminary operations like washing, peeling, cutting, slicing were carried out. The vegetable juice was prepared by using centrifugal juicer. While the fresh citrus fruit orange was purchased from the local market. The procured fruits was washed, peeled and juiced with fruit juicer.

2.2 Preparation of Beetroot Juice

Beetroot was peeled out and sliced, crushed in a grinder with addition of subsequent water, then pulped by using hydraulic press and the extracted juice was again filtered by using a four layer muslin cloth to remove remaining pomace.

2.3 Preparation of Orange Juice

Oranges were cleaned with tap water, peeled and then orange juice was extracted using juice blender.

2.4 Preparation of Carrot Juice

The carrots were washed with tap water and peeled by using Sodium hydroxide (40 g/l) at 95ºC for 1 min then washed again in tap water [28]. This was followed by blanching in citric acid solution (60 g/l) at 95ºC for 5 min then cooled in iced water to inactivate their endogenous enzymes and soften their tissues. At the end, they were sliced and grounded with addition of distilled water 1:1 (v/w) and filtered by muslin cloth to get fresh juice.

2.5 Preparation of Ginger Juice

The rhizome of ginger was cleaned and scrapped to remove superficial skin, cut into small pieces and then water was added to prepare ginger juice with the help of mixer-grinder. The juice was then filtered through muslin cloth to remove fibres.

2.6 Formulations and Preparation of RTS

The three different blends were prepared. Sample BOGC 1, BOGC 2 and BOGC 3 respectively. While each combination possessed Carrot and ginger juice in equal proportion as given in table no. 2.6.1

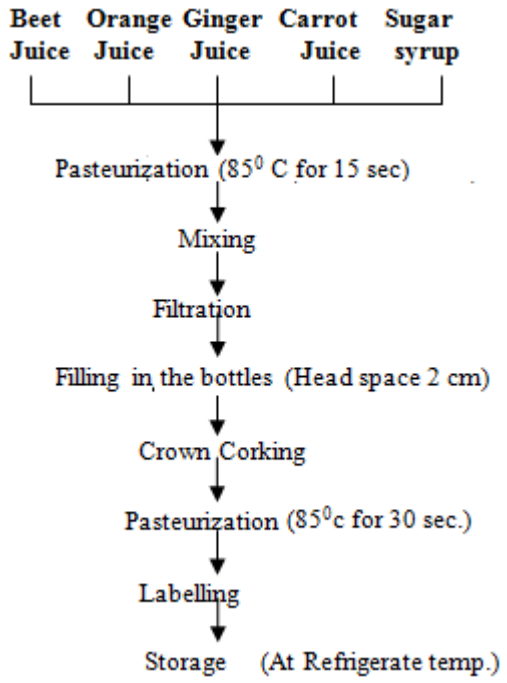
Table 2.6.1: Formulation of Beetroot-Orange RTS

Sr.no.	Sample	Juice: (ml) Beetroot: Orange: Ginger: Carrot
1.	BOGC 1	40:40:10:10
2.	BOGC 2	50:30:10:10
3.	BOGC 3	30:50:10:10

*where BOGC- Beetroot, Orange, Ginger & Carrot

The juices of beetroot, Orange, carrot and ginger were blended as per the different formulations such as 40:40:10:10, 50:30:10:10, 30:50:10:10 respectively. Then sugar and citric acid was added to juice as per required and then the mixture was filtered through muslin cloth. The product was then filled in glass bottles which was earlier washed with 1% Cl and presterilized at 121^0 C for 15 minutes and then sealed. After that, bottle was pasteurized at 85^0C for 30 sec, cooled and stored at refrigerated temperature for more than 30 days and studied for shelf life. The flow chart of blend is shown in table no. 2.6.2

Table 2.6.2: Process Details and Flow Chart



2.7 Chemical Composition

Total acidity (as % citric acid) and vitamin C were determined by titrimetric method Ranganna [29]. TSS was determined directly with a refractometer ATAGO (0-32^0 Brix). pH values were measured by using pH meter A.O.A.C [30]. Moisture, Ash, Fat and Protein content were determined according to A.O.A.C methods [30].

A panel of semi-trained members carried out the overall acceptance test of different formulations with the help of 9-point Hedonic scale and composite scoring test.

2.8 Sensory Analysis

Sensory evaluation of RTS samples was performed by 20 semi trained panellists. The 9-point hedonic scale and composite scoring tests were used to carry out sensory evaluation. They assessed RTS in terms of Colour, Flavour, Clarity, Taste properties. Overall acceptability score was calculated as average of the whole sensory attributes.

2.9 Physico-Chemical Analysis

Moisture, Ash, Fat and Protein content were determined according to A.O.A.C methods [30]. Protein content was obtained by using conversion factor of 6.25. Total carbohydrate content was determined by using total carbohydrate estimation using anthrone method Ranganna [29]. The pH values were determined with the help of an electronic pH meter (Thermo Scientific, 2 star), TSS measurement was done using a hand refractometer ATAGO (0-32^0 Brix) and values were expressed as ^{o}Brix. Acidity of various samples was determined by titrating against 0.1 N NaOH according to A.O.A.C method [32]. Ascorbic acid content was determined by the titration method using 2,6-dichlorophenol endophenol dye ($C_{12}H_7NC_{l2}$) as recommended by Ranganna [29].

3. Results and Discussions

3.1 Proximate composition of raw materials:

3.1.1 Beetroot juice

Results show that Beetroot juice is rich source of carbohydrates, vitamins, minerals and poor in fats. The results are shown in table no.3.1.1.

Table 3.1.1: Proximate analysis of beetroot

Components	Value
Carbohydrates	8.8 ± 0.3 (%)
Proteins	1.7 ± 0.2 (%)
Fat	0.1 ± 0.1 (%)
Minerals	0.8 ± 0.2 (%)
Vitamins	5.2 ± 0.5 (mg)
Moisture	87.7 ± 0.3 (%)
Fibres	0.9 ± 0.1 (%)

Values are the mean ± standard deviation of means. All samples were taken in triplicates.

3.1.2 Orange juice

It was found that Orange juice is rich source of carbohydrates, Calcium, vitamin C and low in fats. The results are shown in table no.3.1.2.

Table 3.1.2: Proximate analysis of Orange

Components	Value
Carbohydrates	11.75 ± 0.31 (%)
Proteins	0.94 ± 0.02 (%)
Fat	0.12 ± 0.4 (%)
Vitamin	62.909 ± 0.008 (mg)
Minerals	1.34 ± 0.2 (%)
Calcium	40.0 ± 02 (mg)
Moisture	85.85 ± 0.6 (%)
Fibres	2.4 ± 0.5 (%)

Values are the mean ± standard deviation of means. All samples were taken in triplicates.

3.1.3 Ginger juice

It was reported that Ginger juice is rich source of carbohydrates, calcium, phosphorus, protein and low in fats. The results are shown in table no.3.1.3.

Table 3.1.3: Proximate analysis of Ginger

Components	Value
Carbohydrates	12.30 ± 0.1 (%)
Proteins	2.30 ± 0.3 (%)
Fat	0.90 ± 0.2 (%)
Minerals	1.20 ± 0.8 (%)
Calcium	20 .0 ± 0.2 (mg)
Phosphorus	60.0 ± 0.6 (mg)
Moisture	80.90 ± 0.2 (%)
Fibres	2.40 ± 0.5 (%)

Values are the mean ± standard deviation of means. All samples were taken in triplicates.

3.1.4 Carrot juice

It was found that carrot juice is rich in carbohydrates, minerals and low in protein and fats. The results are shown in table no. 3.1.4.

Table 3.1.4: Proximate analysis of Carrot

Components	Value
Carbohydrates	10.6 ± 0.3 (%)
Proteins	0.90 ± 0.2 (%)
Fat	0.20 ± 0.4 (%)
Minerals	1.10 ± 0.2 (%)
Moisture	86.0 ± 0.1 (%)
Fibres	1.20 ± 0.3 (%)

Values are the mean ± standard deviation of means. All samples were taken in triplicates.

3.2 Proximate composition of RTS samples

In this present investigation of research, it was found that protein content was in the range of 0.213 to 0.288 gm. The highest protein content was recorded in sample BOGC 2 i.e. (0.288 gm./ 100 gm.) while, minimum protein content was found in sample BOGC 3 i.e. (0.213 gm./100 gm.). Carbohydrates content was in the range of 13.9 to 14.3 gm. The highest Carbohydrate content was recorded in sample BOGC 3 i.e. (14.3 gm./ 100 gm.) while, minimum protein content was found in sample BOGC 2 i.e. (13.9 gm./100 gm.). Vitamin C content was in the range of 21.45 to 30.24 mg. The highest Vitamin C content was recorded in sample BOGC 3 i.e. (30.24 mg./ 100 gm.) while, minimum Vitamin C content was found in sample BOGC 2 i.e. (21.54 mg./100 gm.) as shown in table no. 3.2.

Table 3.2: Proximate composition of RTS (/100 gm)

Sample. No	Protein (gm)	Energy value (kcal)	Carbohy drates (gm)	Fats (gm)	Vitamin C (mg)
BOGC 1	0.243 ± 0.23	57.51 ± 0.19	14.0 ±0.21	0.06 ± 0.02	25.247 ± 0.13
BOGC 2	0.288 ± 0.12	57.20 ± 0.17	13.9 ±0.11	0.06 ± 0.01	21.454 ± 0.54
BOGC 3	0.213 ± 0.37	58.50 ± 0.13	14.3 ± 0.15	0.05 ± 0.02	30.243 ± 0.27

Values are the mean ± standard deviation of means. All samples were taken in triplicates.

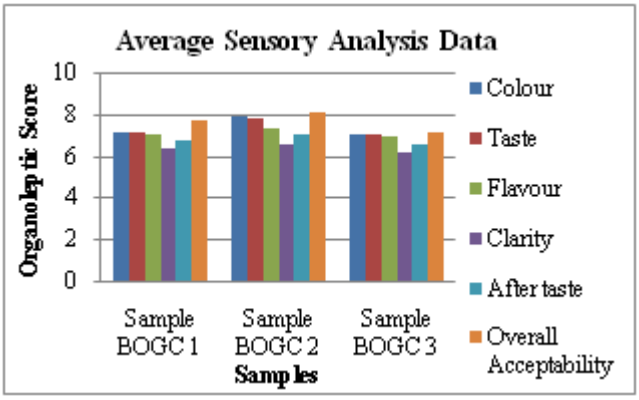
3.3 Sensory Analysis

The 3 blends prepared were analysed by 9 point hedonic scale and composite scoring test. Results obtained by composite scoring test were shown in Table no. 3.3.1. While, average sensory analysis data analysed by 9 point hedonic scale were shown in figure no. 3.3.2.

Table 3.3.1: Average of Sensory analysis Data

Sample	Organoleptic Score*					
	Color	Taste	Flavour	Clarity	After taste	Overall Accept-ability
BOGC 1	7.1	7.1	7.0	6.3	6.7	7.7
BOGC 2	7.9	7.8	7.3	6.5	7.05	8.1
BOGC 3	7.0	7.0	6.9	6.2	6.5	7.1

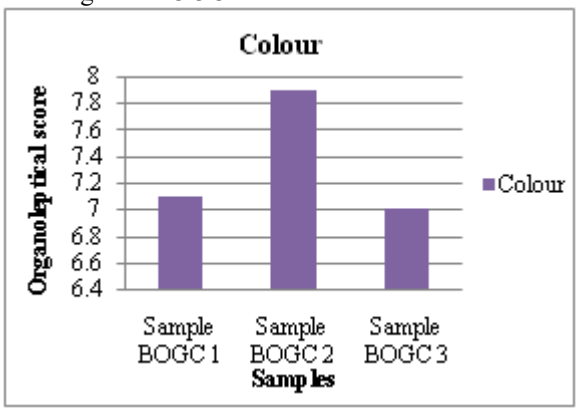
Score between 1- 9 as per liking



*where BOGC- Beetroot, Orange, Ginger & Carrot

Figure 3.3.2: Average sensory analysis data

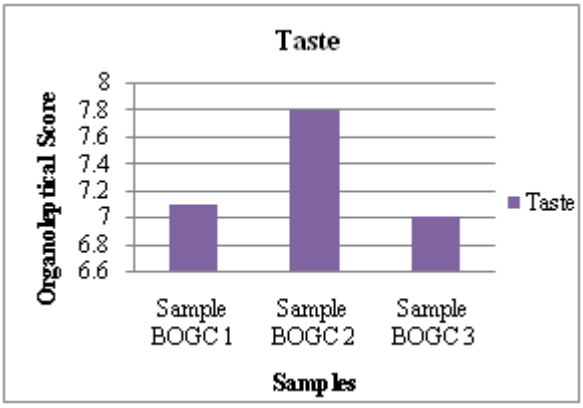
The sensory scores obtained for attribute of colour were shown in figure no. 3.3.3.



*where BOGC- Beetroot, Orange, Ginger & Carrot.

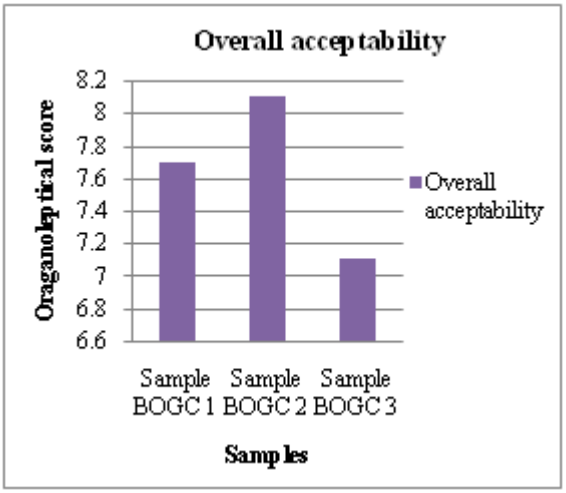
Figure 3.3.3: Average sensory analysis data of colour

The sensory scores obtained for attribute of taste were shown in figure no. 3.3.4. The overall acceptability were shown in figure no. 3.3.5.



*where BOGC- Beetroot, Orange, Ginger & Carrot

Figure 3.3.4: Average sensory analysis data of taste



*where BOGC- Beetroot, Orange, Ginger & Carrot

Figure 3.3.5: Average sensory analysis data of overall acceptability.

It was observed that beverage sample BOGC 2 prepared in the ratio 50:30:10:10 was found most acceptable by panel members as compared to BOGC 1 and BOGC 3 in terms of colour, taste and overall acceptability.

4. Conclusion

It was concluded that sample BOGC 2 was found accepted during sensory evaluation then BOGC 1 and BOGC 3. Beetroot juice, orange juice, carrot juice and ginger juice can be blended in the ratio of (50:30:10:10) to get most effective taste. Proximate composition revealed that sample BOGC 2 contains (0.288%) proteins, (13.2%) carbohydrates, (0.06%) fat and (21.454 mg) of vitamin C and was stored satisfactorily for the period of more than 30 days. Thus, blend can be recommended for production at commercial level to make nutritious and healthy RTS.

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