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Development and standardization of ready to serve (RTS) beetroot drink

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Abstract
The present research entitled "Development and Standardization of Ready to Serve Beetroot Drink" was carried out at college of Food Science and Technology, Rudrur, Nizamabad, Telangana State. Beetroot (*Beta vulgaris*), ginger (*Zingiber officinale Roscoe*), mint (*Menta piperita*. L) and holy basil (*Ocimum tenuiflavum*) have nutritional and medicinal values. Beetroot and beetroot juice have been associated with numerous health benefits. Despite the numerous health benefits beetroot remains underutilized. Therefore, the utilization of beetroot as an ingredient in different food products and as juice imparts beneficial effects on human health. Present study was conducted to develop a Ready to Serve Beetroot drink and checking the Standards of RTS. Beetroot juice was extracted from beetroot in different concentrations *viz*., S1 of 10 ml, S2 of 15 ml, S3 of 20 ml and added with different concentrations of sugar and citric acid to optimize the best suited combination of ingredients by conducting the sensory evaluation. Three variants of ginger, mint and holy basil was added and standardized. Standardization for beetroot flavored RTS was done using sensory evaluation. The ingredients optimized after sensory evaluation for RTS was found to be 15 ml beetroot juice, 0.1 g citric acid & 7.5 g of sugar with TSS of 13 °C Brix. The ginger variant was standardized at 2 ml, mint variant standardized at 2 ml, and holy basil was standardized at 4 ml. The beetroot drink and its variants were analyzed for their chemical properties at 1, 3, 5, 7, 14 days of storage and also observed that the TSS was found to be increasing from day 1 to day 14 for ginger flavoured RTS (12.3% to 17%) for mint flavoured RTS (10.6% to 17.35%) for holy basil flavoured RTS (13.3% to 17.03%) and microbial properties. Shelf- life analysis for one month at 7-day intervals was also carried out under room temperature and under refrigerated conditions. The beverage was organoleptically acceptable up to 1 week of storage in case of both room temperature condition, refrigerated condition

Keywords: RTS, beetroot, ginger, mint, holy basil, organoleptic quality, shelf -life analysis

Introduction
Beverages are the most essential of human diet all over the world. Beverages are very much popular among all age groups including children, adults and elderly (Brag *et al*., 2018) [3]. Fruits and vegetables tend to have very limited shelf life due to its perishable nature. In order to preserve, they are processed to Ready to Serve (RTS) beverages. RTS beverage is a non-fermented beverage prepared from fruits and vegetables of different concentrations in addition of sugar, water, and additives (Rathinasamy *et al*., 2021) [12]. Red beetroot (*Beta vulgaris*) is a popular vegetable throught the world (Latorre *et al.* 2011) [10]. Beetroot belongs to *Chenopodiaceae* family (Chawla *et al*., 2016) [4]. Beetroot is produced all over the world for its vegetable and juice value.

Beetroot contains of 87.57% water, 9.56% carbohydrates (29.3% fibre and 70.7% sugar), 1.61% protein and 0.17% lipids (Varner 2014) [14]. Beetroot contains minerals such as magnesium, calcium, iron, phosphorous, sodium and zinc and excellent source of manganese (Wootton-Beard and Ryan, 2011) [15]. It also contains significant amount of vitamin C, biotin, folic acid, niacin, vitamin B6 and excellent source of folates. Beetroot is known for its Antioxidant that fight cell damage and reduce the risk of heart diseases. High concentrations of betalains, a water –soluble pigment is responsible for the intense red color of beetroot (Georgiev *et al*. 2010) [6]. Betalains reduce inflammation and may help to protect against cancer and other disease. Betalain is divided into betaxanthins giving yellow orange color and betacyanin's giving purple color to beetroot. Carotenoids, betalains, polyphenols, flavonoids and saponins are the active compounds found in red beetroot (Figiel, 2010) [5]. Beetroot pigment is used as a food dye. It changes colour when heated so can only be used in ice- cream and other confectionery. Beetroot is used in tomato paste, jam and jellies, ice cream, sweets, sauces, etc as a red food colorant to improve the color (Gokhale and Lele 2011) [7].

The present study was conducted to develop an acceptable quality of RTS beverage with different ratio of ginger, mint and holy and to assess the physico-chemical, sensory properties along with the shelf life of different juice blends.

Ginger (*zingiber officinale Roscoe*) belongs to family Zingiberacea is one of the most important plants with several medicinal, nutritional and ethnomedical values therefore, used extensively worldwide as a spice, flavouring agent and herbal remedy (Grzanna *et al*., 2005) [8]. Because of their refreshing flavours as well as preservative and curative medicinal values ginger extracts can be added in the beverages. Ginger possesses medicinal properties due to its bioactive compound, antioxidants such as gingerols, zingerone, vitamin C and anti-inflammatory activities.

Holy basil (*Ocimum tenuiflavum*) is one of the most widely grown herb for therapeutic use. The herb is used as a remedy for a variety of conditions including the common cold, headache, stomach disorders, heart diseases, inflammation as well as flavouring purposes. Holy basil contains vitamin C and antioxidant such as Eugenol which protects from the heart from harmful effects of free radicals. Holy basil may be a (cyclooxygenase) cox-2 inhibitor, like many other pain killers, due to high concentrations of Eugenol (Prakash *et al* 2005) [11]. It shown beneficial for reducing the cholesterol levels and blood glucose levels for its high poisoning and contracts dur to its high antioxidant content. It is also useful for respiratory disorders.

Mint (*Menta piperita* L.) is known for its medicinal properties and is a rich source of polyphenols. Mint leaves are anti-inflammatory in nature which helps in reducing any inflammation in stomach. They are rich in phosphorous, calcium, vitamins like C, A, D and E which improves the body immune system. Mint leaves are rich in antioxidants Menthol and phytonutrients that help the enzymes to digest food.

Materials and Methods

Raw materials

The materials used are beetroot, ginger, mint was purchased from Bodhan and holy basil collected from our college premises. Additives namely citric acid, sugar purchased from local market.

Extraction of beetroot juice, ginger, mint and holy basil juice

The methods which are used for the extraction of beetroot juice, ginger, mint and holy basil shown in Fig 1, Fig 2, Fig 3, Fig 4 respectively

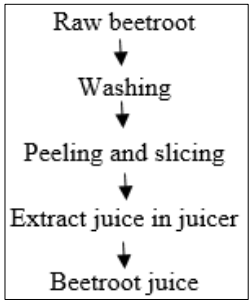

Fig 1: Flow chart of juice extraction from beetroot

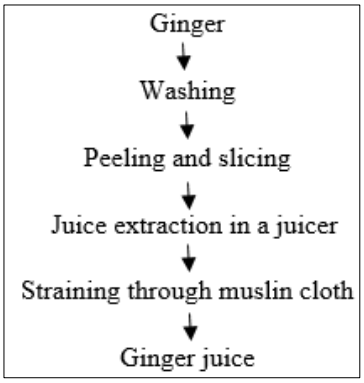

Fig 2: Flow chart of ginger juice extraction

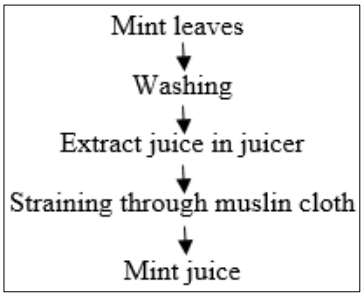

Fig 3: Flow chart of mint juice extraction

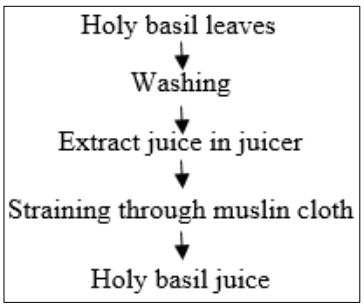

Fig 4: Flow chart of holy basil juice extraction

Standardization of blends for RTS Beverage:

The Beetroot based RTS blended with ginger, mint and holy basil juice was prepared as per the flow chart Fig 5. Standardization of the RTS was done by stepwise standardisation of beetroot juice of 15 ml, citric acid of 0.1 g and sugar of 7.5 g (Table 1) by using ranking sensory evaluation test. The RTS was prepared in three different variations of ginger, mint and holy basil. Ginger extract was added in different amounts (3 ml, 2 ml 1 ml) to prepare the ginger variant of the beetroot RTS (Table 2). Mint extract was added in different amounts (2 ml, 3 ml, 4 ml) to prepare the mint variant of the beetroot RTS (Table 3). Holy basil extract was added in different amounts (3 ml, 4 ml, 5 ml) to prepare the holy basil variant of the beetroot RTS (Table 4).

Table 1: Standardization of ingredients for beetroot RTS Beverage Drink

Sample	Beetroot juice	Citric acid	Sugar	Water
S1	10 ml	0.1 g	5 g	85 ml
S2	15 ml	0.1 g	7.5 g	78 ml
S3	20 ml	0.1 g	10 g	70 ml

Table 2: Composition of ginger flavoured RTS Beverage

Sample	Beetroot juice	Citric Acid	Sugar	Water	Ginger extract
S4	15 ml	0.1 g	7.5 g	72 ml	3 ml
S5	15 ml	0.1 g	7.5 g	73 ml	2 ml
S6	15 ml	0.1 g	7.5 g	74 ml	1 ml

Table 3: Composition of mint flavoured RTS Beverage

Sample	Beetroot juice	Citric Acid	Sugar	Water	Mint extract
S7	15 ml	0.1 g	7.5 g	72 ml	2 ml
S8	15 ml	0.1 g	7.5 g	73 ml	3 ml
S9	15 ml	0.1 g	7.5 g	74 ml	4 ml

Table 4: Composition of holy basil flavoured RTS Beverage

Sample	Beetroot juice	Citric Acid	Sugar	Water	Holy basil extract
S10	15 ml	0.1 g	7.5 g	72 ml	3 ml
S11	15 ml	0.1 g	7.5 g	73 ml	4 ml
S12	15 ml	0.1 g	7.5 g	74 ml	5 ml

Preparation of RTS

The Beetroot based RTS blended with ginger, mint and holy basil juice was prepared as per the flow chart Fig 5.

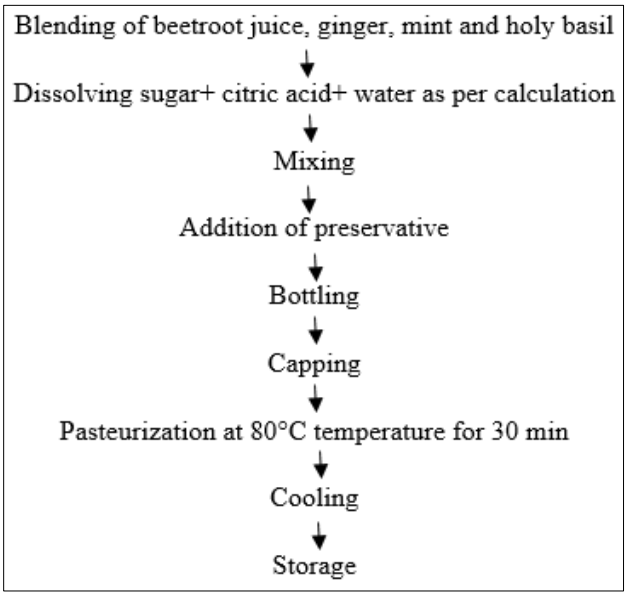

Fig 5: Flow chart of blended RTS Beverage

Physio – chemical analysis

The TSS content was measured with the help of hand refractometer and values were expressed as °brix.

Sensory analysis

Beetroot RTS and its flavoured variants were prepared using the optimized quantities of various ingredients and sensory analysis was carried out by using hedonic scales that is a 9 point scale (Amerine *et al*., 1965) [1]. The samples were evaluated by 30 semi-trained panelists.

Microbiological parameters

Total Bacterial count (TBC) and Total Mould count (TMC) were analyzed for Beetroot RTS and its flavoured variants. Microbial analysis (bacteria and mold) was carried out by using standard procedure of (AOAC,1995) [2].

Results and Discussion

Optimization of beetroot RTS by Ranking Test

The results for the sensory analysis carried out to determine the best fit of various ingredients by using ranking test is presented in Table 5-8. Sensory evaluation for beetroot juice content, sample S2 score highest rating. Most of the panelists given highest score for S2 of beetroot juice 15 ml, citric acid 0.1 g & sugar 7.5 g. shown in (Table 5). Sensory evaluation for Ginger juice content, most of the panelists given highest score for sample S5 i.e., beetroot juice 15 ml, citric acid 0.1 g, sugar 7.5 g & ginger extract 2 ml, followed by sample 4 and least by sample S6 shown in (Table 6). Sensory evaluation for Mint juice content, sample S7 score highest rating i.e., beetroot juice 15 ml, citric acid 0.1 g, sugar 7.5 g & mint extract 2 ml, followed by sample S9 and least by S8 shown in (Table 7). Among the three samples of Sensory evaluation for Holy basil juice content, sample S11 score highest rating i.e., beetroot juice 15 ml, citric acid 0.1 g, sugar 7.5 g & holy basil extract 4 ml, followed by S12 and least by S10 shown in (Table 8).

Table 5: Standardization of beetroot juice content

Sample	Beetroot juice	Citric acid	Sugar	Water	Ranking		
					1(Best)	2(Average)	3(Worst)
S1	10 ml	0.1 g	5 g	85 ml	9	6	0
S2	15 ml	0.1 g	7.5 g	78 ml	5	8	3
S3	20 ml	0.1 g	10 g	70 ml	4	5	6

Table 6: Standardization of Ginger juice content

Sample	Beetroot juice	Citric acid	Sugar	Water	Ginger extract	Ranking		
						1(Best)	2(Average)	3(Worst)
S4	15 ml	0.1 g	7.5 g	72 ml	3 ml	5	6	4
S5	15 ml	0.1 g	7.5 g	73 ml	2 ml	8	7	0
S6	15 ml	0.1 g	7.5 g	74 ml	1 ml	3	1	9

Table 7: Standardization of Mint juice content

Sample	Beetroot juice	Citric acid	Sugar	Water	Mint extract	Ranking		
						1(Best)	2(Average)	3(Worst)
S7	15 ml	0.1 g	7.5 g	72 ml	2 ml	10	5	0
S8	15 ml	0.1 g	7.5 g	73 ml	3 ml	1	3	6
S9	15 ml	0.1 g	7.5 g	74 ml	4 ml	2	1	9

Table 8: Standardization of Holy basil content

Sample	Beetroot juice	Citric acid	Sugar	Water	Holy basil extract	Ranking		
						1(Best)	2(Average)	3(Worst)
S10	15 ml	0.1 g	7.5 g	72 ml	3 ml	4	5	2
S11	15 ml	0.1 g	7.5 g	73 ml	4 ml	11	8	0
S12	15 ml	0.1 g	7.5 g	74 ml	5 ml	6	4	7

Chemical properties of different flavoured RTS beverage

The optimized beetroot RTS and its variants were analyzed for TSS and the results were given in table 9. The TSS content of RTS beverage and its variants were measured at different storage conditions using digital refractometer. The TSS content was increased from 10.15% to 16% in case of beetroot drink. TSS content was increased from 12.3% to 17% in case of ginger flavored RTS Beverage. Similar result was observed in case of mint and Holy basil the TSS content was also increased from 10.06% to 17.35% in mint flavored RTS Beverage and 13.3% to 17.03% in holy basil flavored RTS beverage.

Table 9: TSS of Beetroot RTS beverage during storage at different intervals

Storage period (days)	Total soluble solids (TSS)			
	Sample1 (Control)	Sample 2 (Ginger)	Sample 3 (Mint)	Sample 4 (Holy basil)
1	10.15	12.3	10.06	13.3
3	12.00	13.3	14.00	14.3
5	12.07	15.00	16.07	15.00
7	15.00	16.00	16.67	16.00
14	16.00	17.00	17.35	17.03

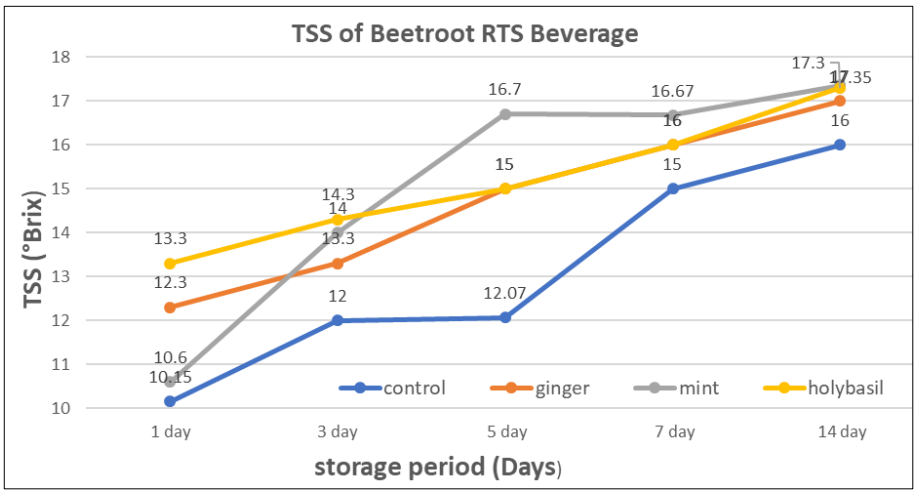

Fig 6: TSS of Beetroot RTS Beverage

Changes in TSS

TSS increased from 10.15% to 16% in case of beetroot RTS over the period of 4 weeks storage at room temperature as shown in Fig 2. The similar result was observed in the case of ginger variant where the TSS increased from 12.3% to 17% and Mint variant increased from 10.06% to 17.35% and similarly in case of holy basil variant where the TSS increased from 13.3% to 17.03%.

Microbiological analysis

All the three samples of beetroot drink were analyzed for Total bacterial count and mould count. TPC was found gradually increasing in all the samples with time. The data obtained with respect to microbial load are summarized in table 10, 11. Under refrigerated conditions the total bacterial count of fresh beverage samples i.e., ginger, mint, holy basil was 7 $\times 10^{-6}$ CFU/mL, 9×10^{-6} CFU/mL, 6×10^{-6} CFU/mL. As the storage period proceed the total bacterial count increases and after the completion of 2nd week (14 days) storage it reaches to Too many to count in the beverage samples ginger, mint, holy basil. Total mould count of three samples at 1st day storage condition was 3×10^{-6} CFU/mL, 1×10^{-6} CFU/mL, 2×10^{-6} CFU/mL whereas it increases to too many to count at 14th day of storage period. Under room temperature conditions the total bacterial count of fresh beverage samples i.e., ginger, mint, holy basil was 67×10^{-6} CFU/mL, 23×10^{-6} CFU/mL, 75×10^{-6} CFU/mL. As the storage period proceed the total bacterial count increases and after the completion of 2nd week (14 days) storage it reaches to Too many to count in the beverage samples ginger, mint, holy basil. Total mould count of three samples at 1st day storage condition was 17×10^{-6} CFU/mL, 19×10^{-6} CFU/mL, 15×10^{-6} CFU/mL. The count was increased at 14th day of storage period.

Table 10: Microbial analysis under refrigerated conditions

Storage periods	TBC			TMC		
	Ginger	Mint	Holy basil	Ginger	Mint	Holy basil
1st day	7×10^{-6}	9×10^{-6}	6×10^{-6}	3×10^{-6}	1×10^{-6}	2×10^{-6}
3rd day	13×10^{-6}	11×10^{-6}	17×10^{-6}	7×10^{-6}	6×10^{-6}	8×10^{-6}
5th day	87×10^{-6}	80×10^{-6}	20×10^{-6}	12×10^{-6}	14×10^{-6}	13×10^{-6}
7th day	77×10^{-6}	46×10^{-6}	67×10^{-6}	52×10^{-6}	457×10^{-6}	89×10^{-6}
14th day	TMC	TMC	TMC	TMC	TMC	TMC

Table 11: Microbial analysis under room conditions

Storage periods	TBC TMC					
	Ginger	Mint	Holy basil	Ginger	Mint	Holy basil
3rd day	67×10^{-6}	23×10^{-6}	75×10^{-6}	17×10^{-6}	19×10^{-6}	15×10^{-6}
5th day	74×10^{-6}	58×10^{-6}	55×10^{-6}	50×10^{-6}	45×10^{-6}	92×10^{-6}
7th day	78×10^{-6}	84×10^{-6}	44×10^{-6}	89×10^{-6}	45×10^{-6}	92×10^{-6}
14th day	TMC	TMC	TMC	TMC	TMC	TMC

Conclusion

The results of present study revealed that the beetroot RTS and its flavoured variants were developed successfully with a fixed composition and ratio of 2:2:4 of ginger: mint: holy basil variants were found significantly better compared to other ratios. Sensorial evaluation by semi-trained panel was used at each and every step of product development to ensure the best fit of ingredients to achieve the most desirable product. The ingredients optimized after sensory evaluation for RTS was found to be 15 ml beetroot juice, 0.1 g citric acid & 7.5 g sugar. The TSS content of RTS beverage and its variants were measured at different storage conditions using digital refractometer. TSS content of 4 samples was increased during storage over a period of 4 weeks. Shelf -life analysis for one month at 7 – day intervals was also carried out under room temperature under refrigerated conditions. It can be concluded as the prepared RTS beverage could be safety consumed up to 1 week. Further, it is not acceptable for consumption.

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