

Study of qualitative attributes of mixed juice using carrot, spinach and beetroot

Rupendra Singh and Devendra Kumar

Study was conducted to evaluate the qualitative attributes of mixed juice using carrot, spinach and beetroot. Carrot, spinach and beetroot juice prepared with the composition of 90:5:5, 85:10:5 and 80:15:5 and the samples were stored at refrigeration temperature (5°C), B.O.D. incubator (25°C) and room temperature (35°C) for 0, 15, 30 and 45 days. The physico-chemical qualities (TSS, pH and vitamin C), microbial growth and sensory quality (colour, taste, flavour, texture and overall acceptability) were evaluated. The TSS (total soluble solid) increased with increase of storage period in all composition of juices but TSS has been decreased simultaneously in juices C₉₀:S₅:B₅, C₈₅:S₁₀:B₅ and C₈₀:S₁₅:B₅ in each storage period. The TSS values of the samples 90:5:5, 85:10:5 and 80:15:5 after 45 days of storage were observed as 14.83, 13.97 and 13.33 for B.O.D. incubator during storage. It was observed that pH of all the samples were decreased at 15, 30, and 45 days of storage. The pH values of the sample composition 90:5:5, 85:10:5 and 80:15:5 after 45 days of storage were observed as 4.44, 4.47 and 4.50 at room temperature and 4.40, 4.44 and 4.47 at B.O.D. incubator condition, respectively. Decrease in the vitamin C was observed with increase in the level of storage period of carrot, spinach and beetroot composition in the samples. The ascorbic acid values of the samples 90:5:5, 85:10:5 and 80:15:5 after 45 days of storage were observed as 3.95, 3.60 and 3.12 mg/100ml at room temperature condition and the ascorbic acid values of the samples 90:5:5, 85:10:5 and 80:15:5 after 45 days of storage were observed as 3.93, 3.70 and 3.12 mg/100ml at B.O.D. incubator condition, respectively. The microbial growth increases with increase in storage period. The beverage samples stored at refrigerated condition was found superior over other storage condition followed by BOD incubator and room temperature conditions. Sensory panel recommended best sample containing 90:5:5 ratio of carrot, spinach and sugarbeet juice as taste, colour and texture points of view with the score of overall acceptability (8.1).

Key Words : Blended juice, Physico-chemical, Microbial-growth, Sensory

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INTRODUCTION

Vegetables are important part of healthy eating and

MEMBERS OF RESEARCH FORUM

Author for correspondence :

Rupendra Singh, Dr. Bhim Rao Ambedkar College of Agricultural Engineering and Technology, **Etawah (U.P.) India**
Email: rupendra.singh8195@gmail.com

Associate Authors' :

Devendra Kumar, Dr. Bhim Rao Ambedkar College of Agricultural Engineering and Technology, **Etawah (U.P.) India**

provide a source of many nutrients, including potassium, fibre, folate (folic acid) and vitamins A, E and C. India is a second producer of fruits and vegetables after China. India produced 169.1 million metric tonnes vegetables from an area of 10.1 million hectare (National Horticulture Board, 2015-16). The total area under this crop in India during 2015-16 was 86 thousand hectares, and the production was 1165.32 thousand metric tones (National Horticulture Board, 2015-16). Carrot (*Daucus carota*) is a worldwide root vegetables that is highly nutritional

and an important source of S- carotene besides its appreciable amount of vitamin and minerals often used for juice production (Demir *et al.*, 2000). In recent years, a steady increase of carrot juice consumption has been reported in many countries (Schieber *et al.*, 2002). Teatota *et al.* (1973) reported that the ascorbic acid content was obtained 6.2 mg/100g of carrot juice. Grewal and Jain (1982) observed 6.0 °Brix, TSS in carrot juice. However, the TSS of carrot varies according to the time of harvesting and the total acidity as citric acid in carrot juice reported to be 0.072 per cent -0.12 per cent. Edward and Lee (1986) estimated the carotenoids content of fresh carrot by acetone and methanol extraction and found to be 13.31 mg/100g and 13.58 mg/100g, respectively. Lingappa and Naik (1997) found an ascorbic acid content of 3 mg/100g and high content in carrot to be 13.5 mg/100g.

Spinach (*Spinacia oleracea*) is an edible flowering plant in the family Amaranthaceae native to central and western Asia. Its leaves are commonly eaten as a vegetable, either fresh, frozen, canned, chipped, or dehydrated. Green leafy vegetables such as spinach are rich sources of many nutrients and form a major category of vegetable groups that have been designated as 'nature anti-aging wonders' and medicinal value (Gupta and Prakash, 2009). Spinach is a valuable crop for food and medicinal purposes with production of over 26 million tons in about 921000 ha in the world. About 25 million tons produced in Asia and China with about 24 million tons was pioneer and Iran was at 6th rank in the 2016 on spinach production world ranking by commodity about 117000 tons (FAO, 2018). Spinach-derived phytochemicals and bioactives are able to scavenge reactive oxygen species and prevent macromolecular oxidative damage, modulate expression and activity of genes involved in metabolism, proliferation, inflammation and antioxidant defence and also curb food intake by inducing secretion of satiety hormones (Roberts and Moreau, 2016).

Beetroot (*Beta vulgaris*) is a member of the Chenopodiaceae family which include silver beet, sugar beet and fodder beet (Grubben and Denton, 2004). It is a crop of temperate region where cool weather and high humidity are available (Rehman and Ali, 2000). Beetroot is widely cultivated for the production of commercial sugar forage plants, natural dye and food for human consumption (Nilson, 1970; Mornement, 2002 and Rey

et al., 2005). Beetroot should be obtained fresh and grated or juice for maximum benefits (Manfred Urs Koch, 2011). Dhillon *et al.* (1977) found that sugarbeet mandrain contain variable concentration of total sugar and reducing sugars of 4.7 per cent and 2.3 per cent. Aggarwal and Sandhu (2003) found that sugarbeet mandarin juice have a TSS 9.0 to 14.8° Brix.

Therefore, the study was undertaken to evaluate quality attributes of mixed juice using carrot, spinach and beetroot.

METHODOLOGY

Fresh carrots, spinach and beetroot consist essentially of an amount of 10 to 15 per cent juice. These were purchased from local market of Etawah. Carrots, spinach and beetroot were washed to potable water to remove the dust, dirty particles and some bacteria's. Peeling was done manually. Juice of carrot and beetroot was extracted by electric juice extractor and separately strained through muslin cloth. The beverage was prepared from the extracted carrots, spinach and beetroot juice, adjusting its soluble solid and acidity by mixing the juice with required quantity of sugar syrup prepared from sugar, citric acid, preservative (KMS) and mixed water.

The beverage filled in to bottle leaving a head space of 2.5 to 3.0 cm, crown corked and processed in water for 4 to 6 minute at 85 °C for pasteurization and then air cooled. Labeled bottles was stored at different temperature in different condition. Samples of different fruit juices of carrots, spinach and beetroot, were prepared and evaluated by the sensory panel. Panel recommended three compositions *viz.*, 90:5:5, 85:10:5, 80:15:5, of carrots, spinach and beetroot.

The samples of selected composition were prepared and storage studies under room temperature, refrigeration temperature and B.O.D. incubator temperature were conducted. Quality evaluation parameters such as physico-chemical, sensory characteristics and microbial studies were also conducted to prepare best carrots, spinach and beetroot beverage having best qualities and best storage period.

The electronic pH meter was calibrated using 7 pH and 4 pH standard buffer solutions. Then electrode was dipped in the test solution and the temperature knob was adjusted to temperature of test solution. The function selector switch was set to pH and reading of digital display was allowed to stabilize. TSS (total soluble solid) of carrot,

spinach and beetroot beverage was measured by hand refractometer of range of 0-32 °Brix and for measuring TSS of carrot, spinach and beetroot beverage, frozen carrot juice concentrate and refrigerated carrot juice concentrate, 28-62 °Brix range refractometer was used by adopting the procedure reported by Srivastava and Kumar (2009). Samples of carrot, spinach and beetroot beverage were analyzed for the ascorbic acid content using 2,6- Dichlorophenol indophenols dye titrimetrically as per the modified procedure of AOAC. Microbial analysis was done to determine the total plate count (TPC) of the sample on nutrient Agar media for bacterial count.

Samples were served to the panellist and they were asked to rate the acceptability of the product through the sense of organs. Different attributes *viz.*, colour, flavour, texture and taste were rated on the basis of hedonic scale, ranging from 1 (extremely dislike/most desirable) to 9 (extremely like/most desirable), Ranganna (2001).

OBSERVATIONS AND ASSESSMENT

The study was undertaken to develop beverage using carrot, spinach and beetroot and its qualitative analysis was done during different storage period and temperature. Juice blends were prepared with various combinations of carrot, spinach and beetroot juice. Quality attributes of juice of carrot, spinach and beetroot *viz.*, physico-chemical parameters (TSS, pH, vitamin C) microbial studies (TPC) and sensory characteristics were evaluated on different storage conditions and temperatures. Juice samples were packed in sterilized glass bottles. Evaluation of quality parameters were carried out for fresh as well

as stored samples after 15, 30 and 45 days under the different storage conditions (room temperature, refrigeration and B.O.D. incubator temp.), respectively.

Results showed that for all three storage condition, the total soluble solid increased with increase of storage period in all composition of juices but TSS has been decreased simultaneously in juices C₉₀:S₅:B₅, C₈₅:S₁₀:B₅ and C₈₀:S₁₅:B₅ in each storage period. The TSS values scored maximum as 14.83, 13.97 and 13.33 for B.O.D. conditions after 45 days storage period. The lowest value of TSS (9.20) of the sample having ratio 80:15:5 was observed at room temperature in fresh sample. The pH of the samples of carrot, spinach and beetroot composition 90:5:5, 85:10:5 and 80:15:5 were measured as 4.78, 4.80 and 4.83, respectively in the fresh samples initially at room temperature. The increase in the value of pH was observed with either decrease in the ratio of carrot juice or increase in the ratio of spinach juice in developed beverage. During storage, it was observed that pH of all the samples were decreased at 15, 30, and 45 days of storage. The pH values of the sample composition 90:5:5, 85:10:5 and 80:15:5 after 45 days of storage were observed as 4.44, 4.47 and 4.50 at room temperature and 4.40, 4.44 and 4.47 at B.O.D. incubator condition, respectively. The decrease in pH may be due to the fact that pH has inverse relationship with acidity and it may inferred from the result obtained. The lowest pH (4.34) of the sample having ratio 90:5:5 was observed in refrigeration temperature storage after 45 days. Decrease in the ascorbic acid was observed with increase in the level of storage period of carrot, spinach and beetroot composition in the fresh sample. The ascorbic acid of the samples of different carrot, spinach and beetroot juice ratio of 90:5:5,

Table 1 : Change in overall acceptability of the samples of beverages during different storage period and temperature

Storage temp.	No. of samples (Levels)	Overall acceptability			
		Storage period			
		0 days	15 days	30 days	45 days
Room temp. (35°C)	C ₉₀ :S ₅ :B ₅	7.250	7.300	6.725	7.250
	C ₈₅ :S ₁₀ :B ₅	7.775	7.400	6.825	7.500
	C ₈₀ :S ₁₅ :B ₅	7.575	7.175	6.575	7.300
Refrig. temp. (5°C)	C ₉₀ :S ₅ :B ₅	8.125	7.650	6.950	7.000
	C ₈₅ :S ₁₀ :B ₅	7.775	7.350	6.800	7.475
	C ₈₀ :S ₁₅ :B ₅	7.625	7.250	6.675	7.050
B.O.D. incubator (25°C)	C ₉₀ :S ₅ :B ₅	7.700	7.250	6.575	7.075
	C ₈₅ :S ₁₀ :B ₅	7.675	7.225	6.650	7.000
	C ₈₀ :S ₁₅ :B ₅	7.475	7.075	6.475	7.150

85:10:5 and 80:15:5 were measured as 5.61, 5.50 and 5.30 mg/100ml, respectively of fresh sample at the room temperature. During storage, it was observed that ascorbic acids of all the samples was decreased at 15, 30 and 45 days of storage. The ascorbic acid values of the samples of the ratio carrot, spinach and beetroot 90:5:5, 85:10:5 and 80:15:5 after 45 days of storage were observed as 3.96, 3.70 and 3.15 mg/100ml at refrigeration condition, respectively. The ascorbic acid values of the samples 90:5:5, 85:10:5 and 80:15:5 after 45 days of storage were observed as 3.95, 3.60 and 3.12 mg/100ml at room temperature condition and the ascorbic acid values of the samples 90:5:5, 85:10:5 and 80:15:5 after 45 days of storage were observed as 3.93, 3.70 and 3.12 mg/100ml at B.O.D. incubator condition, respectively. The lowest ascorbic acid 3.12 mg/100ml of the sample having ratio 80:15:5 was observed in B.O.D. temperature after 45 days of storage. However, in general lower values of ascorbic acid for different samples were found lowest after 40 days of storage conditions. The decrease in ascorbic acid of the RTS samples during the storage might be due to oxidation or irreversible conversion of L-ascorbic acid into dehydro ascorbic acid in the presence of enzyme ascorbic acid oxidase (ascorbinase by trapped or residual oxygen in the glass bottles) was reported by Pandey (2004).

The microbial growth (TPC values) of the samples of different carrot, spinach and beetroot beverage were observed as 1.013×10^5 cfu/ml, 1.015×10^5 cfu/ml and 1.016×10^5 cfu/ml of juice samples 90:5:5, 85:10:5 and 80:15:5 at room temperature after storage of 45 days, respectively. The microbial growth of the samples of different carrot, spinach and beetroot beverage were observed as 1.018×10^5 cfu/ml, 1.020×10^5 cfu/ml and 1.023×10^5 cfu/ml of 90:5:5, 85:10:5 and 80:15:5 at B.O.D. temperature condition after 45 days of storage period, respectively and the microbial growth value after 45 days of storage are observed as 1.015×10^5 cfu/ml, 1.017×10^5 cfu/ml and 1.019×10^5 cfu/ml for the sample stored at refrigeration temperature condition of carrot, spinach and beetroot of (90:5:5, 85:10:5 and 80:15:5) ratio, respectively. The study also revealed that as microbial growth increased with increase of storage period irrespective of storage conditions. The highest microbial growth was observed as 1.023×10^5 cfu/ml in case of sample having carrot, spinach and beetroot ratio 80:15:5 at B.O.D. temperature condition after 45 days of storage. Saravana and

Manimegalai (2005) reported that microbial load as $1-2 \times 10^6$ cfu/ml bacteria, $1-2 \times 10^4$ cfu/ml fungi and $1-2 \times 10^5$ cfu/ml yeast upto 90 days of storage in refrigeration condition which was considered safe for consumption. Therefore TPC value considered under safe limit. ANOVA were generated for all physico-chemical parameters and for microbial growth which were significant at 5 per cent level.

Sensory characteristics of samples of beverages just after preparation and after 15, 30 and 45 days of storage period were evaluated on 9 point scale of hedonic rating test method. Study revealed that the fresh samples of carrot, spinach and beetroot beverage (90:5:5) exhibited better sensory score for colour, flavour, texture, taste and overall quality attributes at refrigeration temperature (Table 1). Sensory score decreased rapidly increase with increase of storage period. Fresh beverage sample of carrot, spinach and beetroot ratio 90:5:5 gave the highest overall sensory score as 8.125 at refrigeration temperature storage.

Fig. 1 shows the effect on overall acceptability during various storage period of composition of carrot, spinach and beetroot beverage at refrigeration condition.

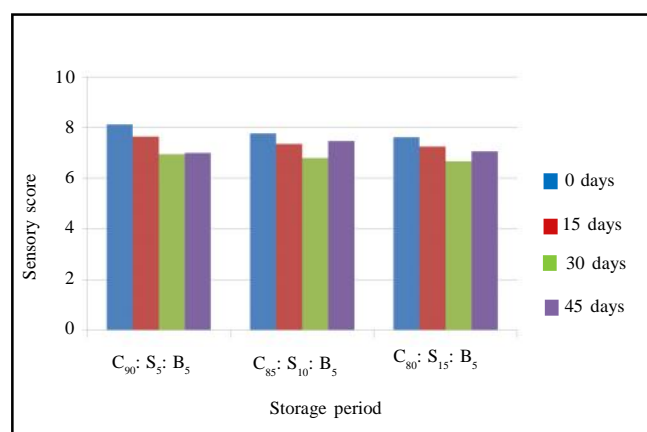


Fig. 1 : Effect on overall acceptability at refrigeration condition during different storage period and composition of carrot, spinach and beetroot juice

Conclusion:

The samples of carrot, spinach and beetroot based beverage 90:5:5, 85:10:5 and 80:15:5 at room temperature, B.O.D incubator and refrigeration storage condition were acceptable upto 45 days. However, the beverage samples stored at refrigerated condition was found superior over other storage condition followed by BOD incubator and

room temperature conditions. The pH of carrot, spinach and beetroot beverage decrease during storage period. The lowest pH (4.34) was found of the sample 90:5:5 at refrigeration temperature storage after 45 days. TSS of carrot, spinach and beetroot beverage decreased slightly with decrease in carrot juice ratio as well as with increase in the storage period. The highest TSS (14.83°Brix) was found of the sample 90:5:5 at B.O.D. temperature storage after 45 days. The vitamin-C (ascorbic acid) of the beverage samples were decreased during increase of storage period. The lowest ascorbic acid 3.12 mg/100ml was obtained in the sample 80:15:5 at B.O.D. incubator storage after 45 days. The microbial growth increased during increase of storage period irrespective of carrot, spinach and beetroot juice ratio at different storage condition. The highest microbial growth was obtained as 1.023×10^5 cfu/ml in the sample 80:15:5 at B.O.D. incubator condition after 45 days storage. Sensory score of beverage sample containing 90:5:5 ratio of carrot, spinach and beetroot juice found best as taste, flavour, colour and texture point of view with the highest score of overall acceptability (8.125).

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