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Development and quality evaluation of carrot and orange blend juice

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SUMMARY :

Experimental study was conducted to evaluate the qualitative attributes of mixed juice using carrot and orange prepared with the composition of 95:05, 90:10 and 85:15 and the samples were stored at refrigeration temperature (5^0 C), B.O.D. (25^0 C) and room temperature (35^0 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 increased with increase in storage period. The TSS value scored maximum as 13.7, 13.4 and 13.1 for BOD condition after 45 days of storage period. The pH values of the sample composition 95:05, 90:10, and 85:15 after 45 days of storage were observed as 5.17, 5.14 and 5.10 at room temperature and 5.12, 5.05 and 5.01 at B.O.D. incubator condition, respectively. It was observed that pH of all the samples were decreased at 15, 30, and 45 days of storage. Decrease in the vitamin C was observed with increase in the level of storage period of carrot and orange composition in the samples. The ascorbic acid values of the samples composition 95:5, 90:10 and 85:15 after 45 days of storage were observed as 26.65, 30.61 and 34.91 mg/100ml at room temperature condition and the ascorbic acid values of the samples composition 95:5, 90:10 and 85:15 after 45 days of storage were observed as 24.33, 27.52 and 30.24 mg/100ml at B.O.D. incubator condition, respectively.The microbial growth increases with increase in storage period. The beverage samples stored at refrigeration condition was found superior over other storage condition followed by BOD incubator and room temperature conditions. Sensory panel recommended best sample containing 85:15 ratios of carrot and orange juice as colour, taste, flavour and texture points of view with the score of overall acceptability (7.7).

KEY WORDS : Blended juice, Physico-chemical, Microbial-growth, Sensory

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Vegetables are important part of healthy eating and provide a source of many nutrients, including potassium, fibre, foliate (folic acid) and vitamins A, E and C. Broccoli, spinach, tomatoes and garlic provide additional benefits, making them a super food. 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 Carrot crop in India during 2015-16 was 82 thousand hectare and the production was 1338 thousand metric tonnes (Horticultural Statistics, 2017). Carrot (*Daucus carota*) is a worldwide root vegetable that is highly nutritional, and an important source of β-carotene besides its appreciable amount of vitamins and minerals often used for juice production. A steady increase of carrot juice consumption has been reported in many countries (Schieber *et al.*, 2002). Dietz and Gould (1986) studied the effect of processing on beta carotene content of carrot juice and tomato juice and found that canning resulted in higher loss of beta carotene than pasteurization. Fruits being a seasonal crop by nature have prompted many scientists to embark on researches on how to process fruit juices and preserve them for usage during off-season. Nutritional, chemical composition and the effect of storage on various fruits (orange, pineapple and cashew apples) and their juices have been reported by Oguntola and Akinyele (1995). Fruit juices are liquid, non-alcoholic products with certain degree of clarity and viscosity obtained through pressing or breaking up of fruits with or without sugar or carbon dioxide addition. Fruits and its juices constitute one of the most important foods for man. The regular consumption maintains health and makes up for the losses in the human diet (Costescu *et al*., 2006). Juice blending is one of the best method to improve the nutritional quality of the juice. It can improve the vitamin and mineral content depending on the kind and quality of fruits and vegetables used (De Carvalho *et al*., 2007).

Orange (*Citrus cinensis*) belongs to the genus citrus of the family *Rutaceae*. It is the most consumed fruit juice world wide particularly appreciated by consumers for its organoleptic properties and its high content of potentially beneficial bioactive components. The total area under orange crop in India during 2015-16 was 397 thousand hectare and the production was 4113 thousand metric tonnes (Horticultural statistics, 2017). Its pulp is an excellent source of vitamin C providing 64 per cent of the daily requirement of an individual (Galavarna and Dall'Asta, 2014). A part from vitamin C content of orange juice, it's also rich in folic acid, potassium and excellent source of bioactive antioxidant phytochemical and they are important trade commodities in most countries (Vasavada, 2003). Orange (*Citrus cinensis*) is a distinguished, widely consumed fruit, particularly appreciated for its fresh flavour, vitamin C, and its natural antioxidants source having health benefits (Gardner *et al.*, 2000). Pareck *et al.* (2014) studied on juice extraction methods and pasteurization temperature and time on quality of mandarin juice. Juice extracted with screw type juice extractor and processed at 65^0C for 15 minute maintained better qualitative characteristics. Klimczak and Malecka (2011) studied to determine the influence of storage conditions on the sensory quality and content of P-vinylguaiacol (PVG) of pure pasteurized orange juices marketed domestically under two popular brands. No PVG was detected in fresh juices. After 12 months of slorage of the orange juices at 18, 28 and 38^0 C the PVG contents were 284, 1292 and 2,515 micro g/l, respectively. Using principal component analysis differentiation of the sensory quality of fresh and stored juices was possible. The quality of the fresh orange juices was differentiated most considerably by intersity of the sweet, sour and refreshing odors, and by intensity of the sweet sour and pungent flavour. The sensory quality of the juices stored at 18^0 C for 12 months coresponded to the quality of those stored for 2 months at 28^0 C. At 38^0 C, the juices were completely changed after 2 months and were unfit for drinking. Azzini *et al.* (2017) determined whether a commercial orange juice rich in anthocyanins could have an effect on body weight and on clinical parameters related to obesity including antioxidant status, lipid profile, and metabolic and inflammatory biomarkers. 11 women with an average BMI of 34.4±4.8 kg/m^2 were enrolled in a pilot study. Over a period of 12 weeks they received 500 ml daily dose into two doses (250 ml) of commercial red orange juice (COJ). The biochemical parameters were measured at baseline and at the end of the study (12 weeks). One month later upon free diet, a follow-up was performed measuring the same variables. The daily consumption of 500 ml of COJ had no significant effects on body weight, while there was a decrease in total cholesterol and LDL cholesterol. The grade of obesity implies different changes in inflammation biomarkers. In obese women, our data do not seem to support evidence that commercial red orange juice consumption acts as functional food preventing obesity and metabolic disorders such as insulin resistance and/or inflammatory status. Evaluation of soy/carrot drinks flavoured with beetroot was studied by Banigo *et al.* (2015) with the aim of developing new product or

improving the existing one in the market.

EXPERIMENTAL METHODS

Fresh carrots and orange consist essentially of an amount of 10 to 15 % juice. They are sweetened at least 10 °Brix with a maximum acidity of 39%. Fresh carrot, and orange were purchased from local market in Etawah. The carrots were washed with tap water, and peeled using Sodium hydroxide (40 g/l) at 95°C for 1 min then washed again in tap water. This was followed by blanching in citric acid solution (60 g/l) at 95°C for 5min 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 on cheese cloth under vacuum to get fresh juice. Oranges were cleaned with tap water, peeled and then orange juice was extracted using juice blender. After that the juice of carrot and orange juices should be blended in different ratios of 95:05, 90:10, and 85:15, respectively. After citric acid and ascorbic acid added to juice properly and then mixture filtered through muslin cloth. After that juice should be filled in glass bottles which should be sterilized at 110°C for 10 minutes, then sealed after that bottles should be pasteurized at 90°C for 25 sec., respectively. Glass bottles were cooled at room temperature. Labeled bottles was stored at different temperature in different condition. Sample containing different fruit juices ratio *viz.,* 95:05, 90:10, and 85:15 of Carrots and orange were prepared and evaluated by the sensory panel. Panel recommended sensory score for all three compositions *viz*., 95:5, 90:10 and 85:15 of Carrots and orange blend juice. Storage studies under room temperature, refrigeration temperature and B.O.D. incubator temperature were conducted. physico-chemical (TSS, pH and vitamin C) sensory characteristics (colour, flavour, taste, texture and overall acceptability) and microbial growth studies were also conducted to best Carrots and orange blended juice having best qualities and best storage period.

The value of total soluble solid (TSS) was determined by the hand refracto meter. TSS Brix measurement was done with the help of refractometer as recommended by Srivastava and Kumar (1994). Digital pH meter was used to determine the pH of the sample of blended juice with highest acceptability. The electronic pH meter (Elico, LI 127) 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. Samples of carrot and orange blend juice were analyzed for the ascorbic acid content using 2,6-Dichlorophenol indophenols dye titrimetrically as per the modified procedure of AOAC(1985). The evaluation of sensory attribute *viz*., colour, flavour, taste, texture and overall acceptability by a panel of judges using 9- point hedonic scale (Ranganna, 2001). The sensory evaluation was quantified using a sensory evaluation card in which the grades of different samples for different properties was awarded by the panel of judge. Total plate count (TPC) procedure was used to determine the number of microorganism in the blended juice. It is an ager plate method for estimating population of bacteria. The serial dilution (95:05, 90:10, and 85:15) of the fresh juice blend was prepared 1 ml of each dilution was transferred to sterilized petri plates, 10ml of the sterilized cooled ager medium was added to each plate and each plate was rotated gently, immediately after addition of the medium for uniform distribution of the organism and the ager plate was allowed to solidify. These steps were repeated for the processed juice blend after every 15 days upto 45 days. All the plates were incubated at 37^0 C for 48 hrs. The plates was exclaimed for bacterial colonies and the number of colonies formed in each plate was counted using colony count, of both fresh and processed juice blend sample. Colony count was used to count forming units (cfu) of micro-organism. The experiment was conducted by adopting Completely Randomized Design of the data recorded. During the course of investigation, product of different formulations was analyzed satisfactory by the analysis of variance (ANOVA). The significant factor of treatment was judged with the help of (variance ratio). F value was compared with the table value F at 5% level of the significance. If calculated value exceed the table value, the effect is considered to be significant. The significance in tested at 5% level.

EXPERIMENTAL FINDINGS AND ANALYSIS

The study was undertaken to develop blended juice using carrot and orange. Qualitative analysis was done during storage period at different temperature. Juice blends were prepared with various combinations of carrot and orange juice. For the evaluation of quality of juice of

carrot and orange, several physico-chemical parameters *viz.*, TSS, pH, vitamin C and microbial studies (TPC) and sensory parameters (Colour, Taste, Flavour, Texture and overall acceptability) were evaluated. Juice samples were packed in pasteurized glass bottles. Evaluation of quality parameters were carried out for fresh as well stored samples after 15, 30 and 45 days under the different storage conditions *viz.*, room temperature, refrigeration temperature and B.O.D. incubator. Shelf life study of developed juices was conducted for total plate count. Results are discussed in the following section:

The effect on TSS of different composition of carrot and orange blended juice was observed. Results showed that for all these storage condition, the total soluble solid increased with increase of storage period in all composition of juice but TSS has been decreased simultaneously in juice composition 95:5, 90:10, and 85:15 in each storage period. The reason for decreased in TSS with increase of composition of orange juice may be attribute to the final moisture content of fresh samples as these two parameters have inverse relationship. The TSS value scored maximum as 13.7, 13.4 and 13.1 ^{o}Brix for BOD incubator condition after 45 days of storage period. The minimum value of TSS (10.1 ^{o}Brix) of the sample having ratio 85: 15 was observed in Refrigeration Temperature. ANOVA was generated for TSS, and it showed that storage condition and storage period have pronounced effect on TSS.

The effect on pH of different composition of carrot and orange based blended juice was observed. The pH of the samples of carrot and orange juice 95:05, 90:10 and 85:15 were measured as 5.28, 5.23 and 5.18, respectively, in the fresh samples initially at room temperature. The decrease in the value of pH was observed with either decrease in the ratio of carrot juice or increase in the ratio of orange 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 95:05, 90:10, and 85:15 after 45 days of storage were observed as 5.17, 5.14 and 5.10 at room temperature and 5.12, 5.05 and 5.01 at B.O.D. incubator condition respectively. The decrease in pH may be due to the fact that pH has inverse relationship with acidity. The lowest pH (4.15) of the sample having ratio C_{85}: O_{15} was observed in refrigeration temperature after 45 days storage. The decrease in pH was due to increase in titrable acidity which affects the organoleptic quality of juice (Bhardwaj, 2005). ANOVA showed that calculated value of F due to treatments is greater than the tabulated value of 5% probability level. Therefore it can be concluded that significant effect of treatments on pH content of samples was observed.

Effect on ascorbic acid of different carrot and orange blended juice was evaluated. The ascorbic acid of samples of blended juice ratio of 95:05, 90:10 and 85:15 were measured as 31.17, 36.25 and 42.31 mg/100ml, respectively of fresh sample at the room temperature. During storage, it was observed that ascorbic acid 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 and orange 95:05, 90:10 and 85:15 after 45 days of storage were observed as 28.57, 30.66 and 35.81 mg/100ml at refrigeration condition, respectively. The ascorbic acid values of the samples 950:5, 90:10 and 85:15 after 45 days of storage were observed as 26.65, 30.61 and 34.91 mg/100ml at room temperature condition and the ascorbic acid values of the samples 95:5, 90:10 and 85:15 after 45 days of storage were observed as 24.33, 27.52 and 30.24 mg/100ml at B.O.D. incubator condition respectively. The lowest ascorbic acid 24.33 mg/100ml of the sample having ratio 95:5 was observed in B.O.D. incubator after storage 45 days. However, in general lower values of ascorbic acid for different samples were found lowest after 45 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 in to dehydro ascorbic acid in the presence of enzyme ascorbic acid oxidize (ascorbinase) by trapped or residual oxygen in the glass bottles was reported by Panday (2004). The Vitamin C content may decrease as due to sensitiveness of heat and air. ANOVA showed that significant effect of treatments on pH content of samples was observed.

Sensory qualities were evaluated for all fresh as well as stored samples after 15, 30 and 45 days. The samples were served to panelists. Colour, flavour, texture and taste were selected as sensory attributes on 9- point Hedonic scale. The scores awarded by the panelist for individual attributes and also the average of all attributes at 15, 30, and 45 days of storage. In general, decline in sensory score were observed in samples after 15, 30 and 45 days of storage period. In few case, increases in score were also observed unexpectedly because of inconsistency of

the samples were not very high. Table 1 shows that after the storage of 45 days, all the samples were in fairly good condition. Overall sensory score after 45 days of storage was lowest (6.3) "Like slightly" at room temperature for samples 90:10 and highest (7.7) "Like very much" for fresh sample (85:15) at refrigeration condition. Fig. 1 shows the sensory score of attributes after storage of 45 days in refrigeration storage condition. The overall acceptability was obtained highest (7.7) in juice ratio 85:15 at refrigeration temperature after 45 days storage. Sharma *et al.* (2008) reported that studies of sensory evaluation of RTS beverages revealed that highest score was 7.55 recorded in (15 % juice of 80:20 guava: papaya) and the lowest was 6.15 in (10 % juice of 50:50 guava: papaya). The microbial growth (TPC values) of the samples of different carrot and orange blended juice was observed as $1.079x10^5$ cfu/ml, $1.082x10^5$ cfu/ml and $1.075x10^5$ cfu/ml of juice composition 95:5, 90:10 and 85:15 at room temperature after 45 days, respectively. The microbial growth of the samples of different carrot and orange blended juice were observed as $1.067x10^5$ cfu/ml, $1.065x10^5$ cfu/ml and $1.069x10^5$ cfu/ml of juice composition 95:5, 90:10 and 85:15 at B.O.D. Incubator condition after 45 days, respectively. The microbial growth value after 45 days of storage was observed as $1.068x10^5$ cfu/ml, $1.057x10^5$ cfu/ml and $1.049x10^5$ cfu/ml for the sample stored at refrigeration temperature condition of carrot and orange of juice composition 95:5, 90:10 and 85:15, respectively. The study also revealed that as microbial growth increased

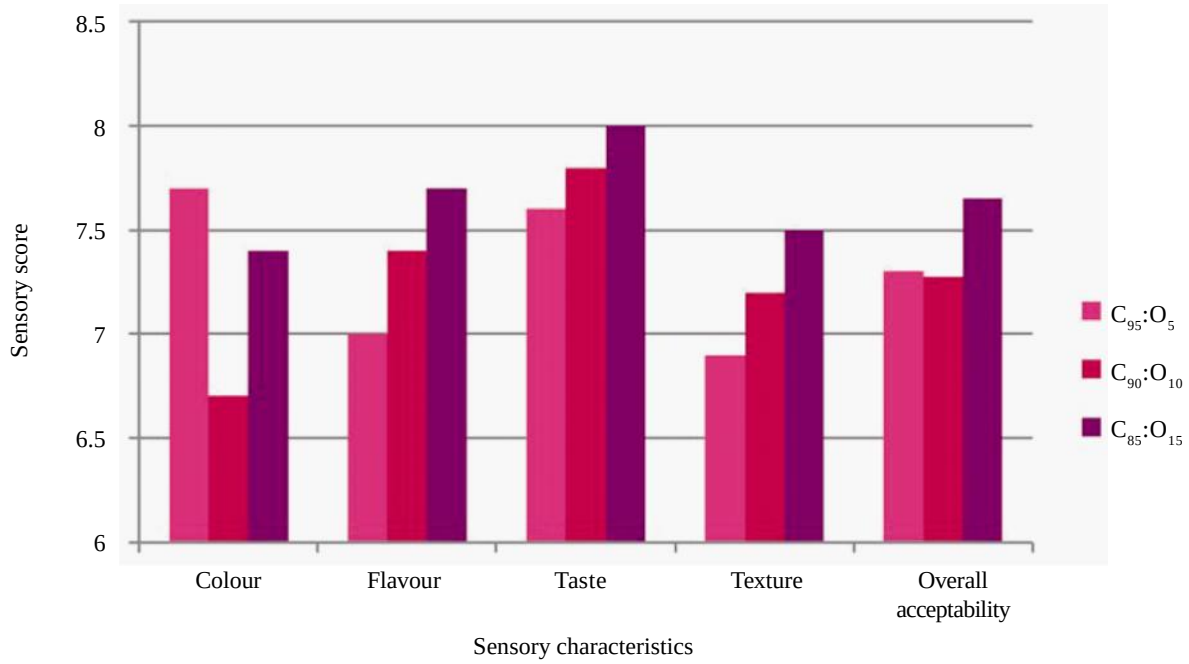

Fig. 1 : Effect of sensory attributes after storage of 45 days in refrigeration storage condition

Table 1 : Effect of different storage condition on sensory attributes of carrot and orange blended juice after 45 day of storage

Sensory attributes	Sensory score								
	Room temp. (35^0 C)			Refrig. temp.(5^0 C)			B.O.D. incubator(25^0 C)		
	$C_{95}:O_5$	$C_{90}:O_{10}$	$C_{85}:O_{15}$	$C_{95}:O_5$	$C_{90}:O_{10}$	$C_{85}:O_{15}$	$C_{95}:O_5$	$C_{90}:O_{10}$	$C_{85}:O_{15}$
Colour	6.8	6.3	6.6	7.7	6.7	7.4	6.1	6.5	6.8
Flavour	6.6	6.7	6.9	7.0	7.4	7.7	6.6	6.8	6.9
Taste	5.6	5.8	6.0	7.6	7.8	8.0	6.6	6.8	7.0
Texture	6.3	6.5	6.7	6.9	7.2	7.5	6.1	6.4	6.7
Overall acceptability	6.3	6.3	6.6	7.3	7.3	7.7	6.4	6.6	6.8

where,
C_{95}, C_{90} and C_{85} = Carrot juice level as 95%, 90% and 85% of total juice extract, respectively.
O_5, O_{10} and O_{15} = Orange juice level as 5%, 10% and 15% of total juice extract, respectively.

with increase of storage period irrespective of storage conditions. The highest microbial growth was observed as $1.082x10^5$ cfu/ml in case of sample having carrot and orange ratio 90:10 at room temperature condition after 45 days of storage. Saravana and Manimegalai (2005) reported the microbial load as $1\text{-}2\times10^6$/ml bacteria, $1\text{-}2\times10^4$/ml fungi and $1\text{-}2\times10^5$cfu/ml yeast upto 90 days of storage in refig. condition which was considered safe for consumption. Therefore TPC value considered under safe limit. ANOVA showed that all parameters have significant effect on microbial growth.

Conclusion:

Experiments were carried out to develop carrot and orange blended juice and it's qualitative evaluation of the product. The samples of carrot and orange based blended juice 95:5, 90:10 and 85:15 at room temperature, B.O.D. incubator and refrigeration storage condition were acceptable upto 45 days. However, the juice samples stored at refrigeration condition was found superior over other storage condition followed by BOD incubator and room temperature conditions.

The pH of carrot and orange blended juice decrease during storage period. The lowest pH (4.5) was found of the sample 85:15 at refrigerator temperature storage after 45 days. TSS of carrot and orange blended juice increased slightly with increase in carrot juice ratio as well as with increase in the storage period The highest TSS (13.7 ^{o}Brix) was found of the sample 95:5 at room temperature storage after 45 days. The lowest ascorbic acid 26.65 mg/100ml was obtained in the sample 95:5 at room temperature storage after 45 days. The microbial growth increased during increases of storage period irrespective of carrot and orange juice ratio at different storage condition. The highest microbial growth was obtained as 1.082×10^5 cfu/ml in the sample 90:10 at room temperature condition after 45 days storage which was considered safe for consumption. Best sensory score of fresh beverage sample containing 85:15 ratio of carrot and orange juice as colour, taste, flavour and texture points of view with the score of overall acceptability 8.45 at refrigeration condition.

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