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RESEARCH PAPER

Studies on chemical composition of carrot and carrot-beetroot nectar during storage under ambient condition

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SUMMARY :

In recipe standardization of nectar from carrot and carrot-beetroot, the acceptance of carrot nectar was ranked first and carrot-beetroot obtained second position in acceptance. The recipe containing 20 per cent pulp, 14 per cent TSS and 0.3 per cent acidity was found best for nectar preparation from carrot. For carrot-beetroot nectar, the recipe containing 20 per cent carrot pulp, 14 per cent TSS with 1 per cent beetroot juice having 0.3 per cent acidity was found the best. After standardization of recipe for nectar prepared from carrot and carrot-beetroot, the acceptable nectar was kept for further storage study under ambient condition. Different preservatives *i.e.*, potassium metabisulphite and sodium benzoate were also added to enhance the shelf-life of acceptable nectar. The observations for sensory qualities as well as for chemical composition were recorded at 30 days interval. The nectar prepared from carrot and carrot-beetroot remained acceptable only for 90 days under ambient condition. Total soluble solids (TSS), β-carotene and sugar : acid ratio in nectar showed a decreasing trend with increasing period of storage (0 to 90 days). The acidity, reducing sugar and total sugar in nectar showed an increasing trend with increasing period of storage (0 to 90 days).While, non-reducing sugar content in nectar showed an increasing trend from 0 to 30 days of storage.

KEY WORDS : Carrot, Carrot-beetroot, Nectar, Chemical composition, Storage, Ambient condition

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Carrot (*Daucus carota* L.) is an important root vegetable crop cultivated extensively in the country particularly during winter season. The total area under carrot cultivation in Chhattisgarh is 1157 ha and the production is 13101 metric tonnes (Anonymous, 2008). Carrot is known for its β-carotene and carotenoids content besides appreciable amounts of vitamin B_1, B_2, B_6, B_{12} and minerals (Syed *et al.*, 1986). Carrot is known to reduce cancer in animals by 40 per cent. Carrot juice, with its rapid alkalizing effect, helps in controlling anaemia, liver trouble, acidosis, blood poisoning, circulatory disorders and ulcers. It also helps in treatment of ailments such as gall stones and gout. Carrot juice can also be prepared but it is not consumed as such because of its unacceptable (slightly bitter) taste and it needs special attention for its processing to develop an acceptable beverage. Processing of carrot juice in India has not received adequate attention, though it is a vegetable of considerable economic importance.

Beetroot (*Beta vulgaris* Linn.) is grown mainly in kitchen and market gardens. It is eaten raw as salad, cooked with other vegetables and used in the preparation of pickles and chutneys. Hundred gram of edible portion of beet-root

contains 87.7g water, 1.7 g protein, 0.1 g fat, 8.8 g carbohydrates, 88 mg vitamin C, 0.8 g minerals, 1.0 mg iron, 0.04 mg thiamine, 0.09 mg riboflavin, 200 mg calcium, 55 mg phosphorus and potassium 43 mg. Vegetable beverages have an important place because they are easily digestible, highly-refreshing, thirst-quenching and nutritionally rich. Keeping in view the nutritional value of both the vegetables, carrot and carrot-beetroot nectar was prepared and kept for further storage under ambient condition to study the changes in chemical composition of preserved product.

EXPERIMENTAL METHODS

The present study was done on changes in chemical composition of carrot and carrot-beetroot nectar during storage under ambient condition was conducted at Fruit Processing Laboratory of the Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the year 2008-09.

Different recipes were prepared for carrot nectar and carrot-beetroot nectar and organoleptically tested to find out the acceptable recipe for preparation of beverages from carrot and carrot-beetroot. After the pulp/juice extraction, 20 per cent pulp/juice of carrot and beetroot was taken as per the treatments for nectar preparation. The preferable per cent of TSS and 0.3 per cent acidity were maintained by addition of sugar, citric acid and water for all the treatments. The bottles of nectar beverage were kept at ambient condition for further studies at 30 days interval. The recipe containing 20 per cent pulp, 14 per cent TSS and 0.3 per cent acidity was found acceptable for preparation of carrot nectar and 20 per cent pulp, 14 per cent TSS with 1.0 per cent beetroot juice and 0.3 per cent acidity was found acceptable for preparation of carrot-beetroot nectar. The detail of treatments was as under:

T_1: carrot pulp, T_2: carrot pulp + 0.1 % KMS, T_3: carrot pulp + 0.1 % SB, T_4: carrot pulp + 0.05 % KMS + 0.05 % SB, T_5: carrot pulp+1%beetroot juice, T_6: carrot pulp+1%beetroot juice +0.1 % KMS, T_7: carrot pulp+1%beetroot juice + 0.1 % SB, T_8: carrot pulp+1%beetroot juice + 0.05 % KMS + 0.05 %SB.

The acidity of the pulp and nectar was determined by the procedure given by Ranganna (1997).Total soluble solids (TSS) of carrot pulp and nectar were determined with the help of hand refractometer. Sugars were determined by the method of Lane and Eynon as described by Ranganna (1997). Non-reducing sugar was determined by subtracting the value of reducing sugar from total sugar. The sugar: acid ratio was determined by dividing TSS of the pulp or nectar with acidity of pulp or nectar. Data recorded on various aspects in the laboratory were subjected to statistical analysis of variance as given by Steel and Torrie (1981).

EXPERIMENTAL FINDINGS AND ANALYSIS

Data with respect to effect of different treatments on the acidity of carrot and carrot-beetroot nectar under ambient condition of storage are presented in Table 1. It is vivid from the data that acidity of nectar showed an increasing trend with increasing period of storage (0 to 90 days). A non-significant difference in acidity was observed at the time of preparation. The acidity of nectar was found to be significant between the treatments from 30 to 90 days of storage. The increase in acidity of nectar during storage may be due to formation of organic acids. Similar findings have also been reported in guava

Table 1: Effect of different preservative treatments on acidity (%) and TSS (%) in carrot and carrot-beetroot nectar during storage under ambient condition

Treatments	Acidity (%)					TSS (%)				
	Storage period (in days)					Storage period (in days)				
	0	30	60	90	Mean	0	30	60	90	Mean
T_1 (carrot pulp)	0.30	0.39	0.45	0.71	0.46	14	13.87	13.63	13.57	13.77
T_2 (carrot pulp + 0.1 % KMS)	0.30	0.39	0.59	0.70	0.50	14	13.57	13.50	13.47	13.64
T_3 (carrot pulp + 0.1 % SB)	0.30	0.38	0.63	0.72	0.49	14	13.83	13.63	13.57	13.76
T_4 (carrot pulp + 0.05 % KMS + 0.05 % SB)	0.30	0.41	0.63	0.63	0.49	14	13.83	13.77	13.63	13.81
T_5 (carrot pulp+1%beetroot juice)	0.30	0.39	0.56	0.78	0.51	14	13.87	13.63	13.57	13.77
T_6 (carrot pulp+1% beetroot juice+0.1 % KMS)	0.30	0.34	0.59	0.68	0.48	14	13.90	13.73	13.57	13.80
T_7 (carrot pulp+1%beetroot juice + 0.1 % SB)	0.30	0.37	0.57	0.70	0.49	14	13.90	13.73	13.40	13.76
T_8(carrotpulp+1%beetrootjuice+0.05% KMS+0.05 % SB)	0.30	0.39	0.59	0.72	0.50	14	13.83	13.60	13.33	13.69
Mean	0.30	0.38	0.58	0.71	0.49	14	13.83	13.65	13.51	13.75
S.E.±	-	0.01	0.01	0.01	-	-	0.06	0.05	0.05	-
C.D. at (P=0.05)	NS	0.03	0.05	0.06	-	NS	0.19	0.15	0.15	-

NS=Non-significanct

beverages (Choudhary *et al.*, 2008; Baramanray *et al.*, 1995 and Kalra and Tandon, 1984), RTS and nectar from litchi (Singh, 1988) and (Wasker and Khurdiya, 1987) from phalsa nectar.

Data recorded on the effect of different treatments on total soluble solids of carrot and carrot-beetroot nectar stored under ambient condition are presented in Table 1. It is apparent from the data that total soluble solids content in nectar showed a decreasing trend with increasing period of storage (0 to 90 days). The total soluble solids content of nectar showed non-significant differences at the time of preparation (0 day), while it was found significant from 30 to 90 days of storage. In conformity of present findings, the decreasing trend of TSS was reported by Kalra and Tondon (1984) in guava nectar.

Data pertaining to effect of different treatments on β-carotene in nectar of carrot and carrot-beetroot during ambient storage condition are presented in Table 2. It is evident from the data that β-carotene content in nectar showed a decreasing trend with increasing period of storage (0 to 90 days). The data

Table 2: Effect of different preservative treatments on β-carotene (mg/100 ml) and sugar : acid ratio in carrot and carrot-beetroot nectar during storage under ambient condition

Treatments	β-carotene (mg/100 ml)					Sugar : acid ratio				
	Storage period (in days)					Storage period (in days)				
	0	30	60	90	Mean	0	30	60	90	Mean
T_1 (carrot pulp)	0.89	0.87	0.81	0.78	0.84	46.67	35.27	30.29	19.20	32.86
T_2 (carrot pulp + 0.1 % KMS)	0.87	0.83	0.79	0.77	0.82	46.22	35.08	23.02	19.25	30.89
T_3 (carrot pulp + 0.1 % SB)	0.87	0.85	0.78	0.79	0.82	47.42	36.49	21.77	18.79	31.12
T_4 (carrot pulp + 0.05 % KMS + 0.05 % SB)	0.88	0.86	0.80	0.78	0.83	46.22	33.90	21.99	21.56	30.92
T_5 (carrot pulp+1%beetroot juice)	0.86	0.86	0.81	0.75	0.82	46.23	35.88	24.59	17.47	31.04
T_6 (carrot pulp+1%beetroot juice +0.1 % KMS)	0.84	0.82	0.83	0.74	0.81	46.67	40.97	23.15	19.96	32.69
T_7 (carrot pulp+1%beetroot juice + 0.1 % SB)	0.88	0.83	0.82	0.71	0.81	46.67	37.26	24.23	19.17	31.83
T_8 (carrot pulp+1%beetroot juice + 0.05 % KMS+0.05 %SB)	0.86	0.83	0.81	0.77	0.82	47.43	35.20	22.93	18.47	31.01
Mean	0.87	0.84	0.81	0.76	0.82	46.69	36.26	24.00	19.23	31.55
S.E.±	-	0.01	0.01	0.01	-	-	1.01	0.68	0.58	-
C.D. at (P=0.05)	0.03	0.03	0.02	0.04	-	NS	3.03	2.05	1.73	-

NS=Non-significant

Table 3: Effect of different preservative treatments on sugar contents in carrot and carrot-beetroot nectar during storage under ambient condition

Treatments	Reducing sugar (%)					Non-reducing sugar (%)					Total sugar (%)				
	Storage period (in days)					Storage period (in days)					Storage period (in days)				
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
T_1	2.33	2.40	2.42	2.68	2.46	6.82	8.87	8.73	10.06	8.62	9.14	11.27	11.15	12.74	11.06
T_2	2.21	2.47	2.55	2.63	2.47	7.71	10.50	9.76	10.03	9.50	9.92	12.97	12.31	12.66	11.97
T_3	2.37	2.63	2.76	2.93	2.67	7.18	10.45	10.50	10.10	9.56	9.55	13.08	13.26	13.04	12.23
T_4	2.59	2.51	2.62	2.79	2.63	7.02	8.75	10.03	9.60	8.85	9.61	11.27	12.65	12.39	11.48
T_5	2.12	2.42	2.66	2.86	2.52	7.62	9.60	9.33	10.03	9.15	9.74	12.02	11.98	12.88	11.66
T_6	2.18	2.61	2.71	2.97	2.62	7.55	9.90	10.09	11.11	9.66	9.73	12.51	12.81	14.09	12.29
T_7	2.11	2.40	2.78	2.88	2.54	7.94	7.94	9.74	10.66	9.07	10.05	10.34	12.53	13.54	11.62
T_8	2.15	2.51	2.67	2.90	2.56	7.58	10.35	8.73	10.60	9.32	9.74	12.86	11.41	13.50	11.88
Mean	2.26	2.49	2.65	2.83	2.56	7.43	9.55	9.61	10.27	9.22	9.69	12.04	12.26	13.11	11.77
S.E.±	0.06	0.05	0.07	0.07	-	0.16	0.32	0.34	0.37	-	0.16	0.32	0.31	0.34	-
CD at (P=0.05)	0.18	0.16	0.21	0.22	-	0.48	0.95	1.03	1.11	-	0.49	0.97	0.94	1.03	-

T_1: carrot pulp; T_2: carrot pulp + 0.1 % KMS; T_3: carrot pulp + 0.1 % SB; T_4: carrot pulp + 0.05 % KMS + 0.05 % SB; T_5: carrot pulp+1% beetroot juice; T_6: carrot pulp+1% beetroot juice +0.1 % KMS; T_7: carrot pulp+1% beetroot juice + 0.1 % SB; T_8: carrot pulp+1% beetroot juice + 0.05 % KMS + 0.05 %SB

on β-carotene content differed significantly between the treatments from 0 to 90 days of storage. The results revealed that throughout the storage period, there was degradation in the β-carotene. The decrease in β-carotene during storage period might be due to its unstable and photosensitive nature. Similar observation was made by Saravanan *et al.* (2004) in papaya nectar during storage period. The degradation in total carotenoids was also observed by Deka *et al.* (2005) in mango-pineapple spiced beverages and Tandon *et al.* (2007) in bael-papaya blended RTS beverages.

Data pertaining to effect of different treatments on the sugar: acid ratio of nectar of carrot and carrot-beetroot during ambient storage condition are presented in Table 2. Data revealed that sugar: acid ratio in nectar showed a decreasing trend with increasing period of storage (0 to 90 days). The ratio showed non-significant difference at the time of preparation. The ratio differed significantly from 30 to 90 days of storage. The lower sugar:acid ratio was due to lower TSS and/or higher acidity of prepared product. It is also an important trait of acceptable quality upto a certain limit.

Data obtained pertaining to effect of different treatments on reducing sugar in the nectar of carrot and carrot-beetroot under ambient condition storage are presented in Table 3. It is apparent from the data that reducing sugar content in nectar showed an increasing trend with increasing period of storage (0 to 90 days). The data on reducing sugar content differed significantly between the treatments from 0 to 90 days of storage. The increased level of reducing sugar was probably due to gradual loss of moisture and hydrolysis of polysaccharides into sugars. Similar findings have also been reported in beverages of guava (Choudhary *et al.*, 2008; Baramanray *et al.*, 1995; Khurdiya and Sagar, 1991), mango nectar and RTS (Jain *et al.*, 1996 and Jain *et al.*, 1997), papaya nectar (Saravanan *et al.*, 2004) and bael beverages (Verma and Gehlot, 2006).

Data with respect to non-reducing sugar as influenced by different treatments under ambient storage condition of carrot and carrot-beetroot nectar are presented in Table 3. It is evident from the data that non-reducing sugar content in nectar showed an increasing trend from 0 to 30 days.

Data recorded with respect to effect of different treatments on total sugar in nectar of carrot and carrot-beetroot during ambient storage condition are presented in Table 3. It is vivid from the data that total sugar content in nectar showed an increasing trend with increasing period of storage (0 to 90 days). The data on total sugar content differed significantly between the treatments from 0 to 90 days of storage. The increased level of total sugar was probably due to conversion of starch into simple sugar. Similar finding have also been reported in beverages of guava (Choudhary *et al.*, 2008; Baramanray *et al.*, 1995), date juice RTS beverage (Godara and Pareek, 1985), papaya nectar (Saravanan *et al.*, 2004), mango-pineapple spiced beverages (Deka *et al.*, 2005), bael beverages *viz*., RTS, nectar and squash (Verma and Gehlot, 2006) and value-added products from sapota (Sudha *et al.*, 2007).

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