The Bioscan 10(2): 699-703, 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

EFFECT OF HEAT PROCESSING ON β CAROTENE AND ASCORBIC ACID CONTENT OF CARROT-FRUIT JUICE BLENDED NECTAR

T. V. YADAV*
Department of Horticulture,
S.K.N. College of Agriculture, Jobner, Rajasthan - 303 329, INDIA
e-mail: vijayyadav.t@hotmail.com

KEYWORDS
Carrot
Aonla
Pomegranate
Grapes
Nectar
Juice blending
Pasteurisation
Aascorbic acid
Beta carotene

Received on :
17.01.2015

Accepted on :
24.04.2015

***Corresponding author**

ABSTRACT
The experiment comprised of nine different treatment combinations of nectar made from juice blends with carrot juice as base juice, blended with aonla, pomegranate and grape juice at the ratio of 85:15 each and exposed to pasteurisation temperatures of 80°, 85° and 90°C for 5, 2 ½ and ½ minutes, respectively. They were then stored at ambient conditions (20 ± 4°C) for 90 days and tested for nutritional, physico-chemical and sensory evaluation.It was observed that among all the treatments, at the end of 90 days the nectar made from carrot-aonla (85:15) juice blend, processed at 90°C for ½ minute, proved to be better in respect of all the quality parameters viz., ascorbic acid (12.61 mg/100mL), â carotene (0.48 mg/100mL) and organoleptic score (6.91), pH (5.76), acidity (0.231%), TSS (15.27), Total Sugar (12.11%), Reducing Sugar (4.89%) and also B: C ratio (3.69: 1) of carrot-aonla (85:15) juice blends. The results showed that processing treatment at 90°C for ½ minute was most effective and possessed better values for all the quality parameters.

INTRODUCTION

The carrot (Daucus carota L.subsp. sativus) has been called the "poor man's ginseng" as it contains more than 490 phyto-chemicals and is an excellent nutritive food as it is rich source of α and β-carotene. Heinonen (1990) found 1200 and 2300 retinol equivalents (RE µg/100g) Vitamin-A, while Recommended Daily Allowance (RDA) according to FAO is 375 to 850 retinol equivalents (RE). Preservation of carrot juice is difficult due to its low acidity which provide ideal environment for the growth of many spoilage and spore forming bacteria. Acidification by blending carrot juice with acidic fruit juice such as aonla juice, grape juice etc. could act as a natural barrier against most microorganisms. The aonla or Indian gooseberry (*Emblica officinalis* Gaertn) is known for its medicinal and therapeutic properties It is richest source of vitamin C and possess anti-oxidant properties (Khomdram and Devi, 2010). Pomegranate (*Punica granatum* Linn) fruits are favourite table fruit with pharmacological properties as anti-carcinogenic and anti-inflammatory (Mohammad and Kashani, 2012). Grapes (*Vitis vinifera*) contain a large proportion of sugars and minerals, thirst-quencher, a stimulant to the kidneys and laxative. Blending of carrot juice with other acidic fruits improved quality and storage life of the blended beverage (Dhaliwal and Hira, 2001). The present paper deals with experiment conducted to find out effect of heat processing on β-carotene, ascorbic acid, organoleptic values and other physico chemical qualities of the carrot-fruit juice blended nectar.

MATERIALS AND METHODS

Blended nectar preparation

The carrot of variety Pusa Kesar, aonla of variety NA-7, pomegranate of variety Bhagwa and Grape of variety Beauty seedless were thoroughly washed in clean water. The aonla fruits were cut into pieces and stony seeds were removed. The peeled carrot pieces and aonla pieces were blanched in boiling water with 1% sodium bicarbonate for 3 minutes, followed by cooling. After suitable processing, the juice of each one was separately extracted using electric centrifugal juice extractor. The extracted juice was again filtered using muslin cloth. The calculated amounts of juices as per the blending ratio were mixed thoroughly. A known amount (20%) of blended juice was added to the Sugar syrup of desired strength (15°Brix). The TSS was adjusted by adding required amount of sugar while making up the total volume with water for each treatment. Acidity was checked and adjusted to the desired level (0.3%) by using citric acid. The prepared product was filtered with the help of muslin cloth and was filled into pre-sterilized glass bottles of 200ml capacity each. Calculated amount of sodium benzoate (100ppm) was added to the product as preservative. The bottles were then sealed with crown caps using crown corking machine.

Pasteurisation treatment

The blended nectar were made into three lots and exposed to pasteurisation temperatures of 80º, 85° and 90ºC for 5, 2½ and ½ minutes, respectively in water bath with thermostat to control temperature and stored at room temperature (20 ±4ºC). Before exposing to processing temperatures, all the treatments were kept in water bath at 50ºC for 5 minutes, followed by respective processing treatments.

Methods of analysis

The ascorbic acid content was measured using xylene extraction method (Robinson and Stotz, 1945), while β-carotene was estimated by chromatographic separation method of pigments by using suitable solvents (A.O.A.C., 1995). The pH of juice was directly determined by pH meter (Systronics) after standardisation with buffer and titrable acidity was determined by titrating against standard N/10 NaOH solution using phenolphthalein indicator as suggested by A.O.A.C. (1995). Total Sugars content was estimated by using anthrone reagent method (Dubois *et al.,* 1951) and reducing sugar content was measured by Nelson's modification of 'Somogyis method' (Somogyi, 1952) using arsenomolybdate colour forming reagent and two Copper reagents 'A' and 'B'. The total soluble solids content of juice of fruit juice was recorded with the help of "Zeiss" Hand Refractometer (0-30º Brix) on percentage basis. In order to find out the consumer preference juice blend ratio, organoleptic evaluation was done by panel of five judges using 9 point hedonic scale (Amerine *et al.,* 1965). All estimations were carried out in triplicate, determinations were made for each attribute and data pertaining were statistically analysed by using analysis of variance technique of completely randomised design given by Cochran and Cox (1992).

RESULTS AND DISCUSSION

Ascorbic acid

The significant reduction in ascorbic acid content was observed in all the treatments but higher reduction rate was observed under processing temperature of 80ºC for five minutes (Table 1). The treatment carrot: aonla (85:15) blended nectar at 90ºC for ½ min, retained significantly higher as compared to other treatments. This difference in reduction rate of ascorbic acid, a heat sensitive vitamin, may be due to longer exposure time of juice blends to high temperatures (Calskantur *et al.,* 2011). Besides that Nagy (1980) reported that loss of ascorbic acid in processed products is due to aerobic and anaerobic reaction of non-enzymatic nature also. The incorporation of air into the juice during extraction, finishing and bottle filling have long been recognised by Farnsworth *et al.* (2001) as cause for ascorbic acid loss.

Beta carotene

The β-carotene levels were significantly affected by processing temperature and decreased in all the treatments during storage period (Table 1). The maximum β-carotene levels were observed in treatment of carrot: aonla (85:15) blended nectar at 90ºC for ½ min and lesser than plain carrot juice which is because the blended beverages had less carotene comparatively (Saldana *et al.,* 1976). The vitamin A content

Table 1: Effect of different pasteurization temperatures and holding time on Ascorbic acid and Beta carotene levels of blended nectar

Juice Blends	Ascorbic acid(mg/100ml)							Beta- Carotene (mg/100ml)						
	0 days	15 days	30 days	45 days	60 days	75 days	90 days	0 days	15 days	30 days	45 days	60 days	75 days	90 days
Carrot: aonla (85:15) at 80ºC for 5 min	13.36	13.00	12.60	12.13	11.97	11.64	11.21	1.05	0.94	0.85	0.67	0.58	0.43	0.37
Carrot: aonla (85:15) at 85ºC at 2 ½ min	14.08	13.70	13.40	12.74	12.68	11.96	11.46	1.10	0.99	0.92	0.71	0.64	0.47	0.42
Carrot: aonla (85:15) at 90ºC at ½ min	15.29	14.90	13.80	13.25	13.00	12.91	12.61	1.14	1.07	0.99	0.72	0.67	0.51	0.48
Carrot: pomegranate (85:15) at 80ºC for 5 min	1.43	1.35	1.21	1.01	0.96	0.88	0.79	0.96	0.87	0.79	0.58	0.47	0.35	0.25
Carrot: pomegranate (85:15) at 85ºC for 2 ½ min	1.64	1.52	1.34	1.17	1.04	0.91	0.82	1.01	0.94	0.82	0.65	0.54	0.42	0.31
Carrot: pomegranate (85:15) at 90ºC for ½ min	1.78	1.57	1.43	1.21	1.19	0.98	0.94	1.04	0.98	0.86	0.78	0.59	0.44	0.36
Carrot: Grape(85:15) at 80ºC for 5 min	1.14	1.08	1.01	0.94	0.80	0.73	0.65	0.99	0.84	0.72	0.60	0.48	0.39	0.27
Carrot: Grape(85:15) at 85ºC for 2 ½ min	1.27	1.19	1.12	0.98	0.92	0.86	0.70	1.01	0.89	0.74	0.64	0.52	0.40	0.30
Carrot: Grape(85:15) at 90ºC for ½ min	1.48	1.33	1.28	1.11	1.01	0.92	0.81	1.05	0.93	0.80	0.69	0.58	0.49	0.36
SEm ±	0.093	0.090	0.088	0.083	0.083	0.079	0.075	0.012	0.011	0.010	0.007	0.006	0.005	0.004
CD (p = 0.05)	0.275	0.268	0.260	0.248	0.246	0.234	0.224	0.037	0.033	0.029	0.023	0.019	0.015	0.011

Table 2: Effect of different pasteurization temperatures and holding time on physico-chemical and sensory qualities of blended nectar

Juice Blends	Organoleptic Scores							Total Soluble Solids (%)						
	0 days	15 days	30 days	45 days	60 days	75 days	90 days	0 days	15 days	30 days	45 days	60 days	75 days	90 days
Carrot: aonla (85:15) at 80^{0}C for 5 min	8.42	8.13	7.75	7.28	7.15	7.12	6.31	15.00	15.18	15.19	15.23	15.26	15.29	15.30
Carrot: aonla (85:15) at 85^{0}C at 2 ½ min	8.43	8.14	7.71	7.39	7.21	7.27	6.82	15.00	15.13	15.15	15.23	15.24	15.25	15.29
Carrot: aonla (85:15) at 90^{0}C at ½ min	8.42	8.12	7.69	7.47	7.29	7.23	6.91	15.00	15.15	15.16	15.19	15.22	15.25	15.27
Carrot: pomegranate (85:15) at 80^{0}C for 5 min	8.55	8.24	7.64	7.34	7.24	6.86	5.83	15.00	15.30	15.58	15.67	15.75	15.83	15.84
Carrot: pomegranate (85:15) at 85^{0}C for 2 ½ min	8.54	8.22	7.65	7.37	7.31	6.91	5.92	15.00	15.21	15.45	15.55	15.69	15.71	15.81
Carrot: pomegranate (85:15) at 90^{0}C for ½ min	8.61	8.25	7.92	7.53	7.53	6.96	6.31	15.00	15.24	15.48	15.48	15.49	15.50	15.51
Carrot: Grape(85:15) at 80^{0}C for 5 min	8.64	8.27	7.17	6.58	6.02	4.48	3.15	15.00	15.28	15.60	15.68	15.74	15.76	15.81
Carrot: Grape(85:15) at 85^{0}C for 2 ½ min	8.66	8.23	7.13	6.63	6.42	4.64	3.24	15.00	15.30	15.42	15.50	15.60	15.68	15.74
Carrot: Grape(85:15) at 90^{0}C for ½ min	8.65	8.25	7.26	6.81	6.72	4.39	3.94	15.00	15.46	15.50	15.54	15.58	15.61	15.65
SEm±	0.104	0.100	0.091	0.085	0.083	0.074	0.063	0	0.185	0.187	0.188	0.189	0.190	0.190
CD (p = 0.05)	NS	NS	0.269	0.254	0.246	0.221	0.188	NS	NS	NS	NS	NS	NS	NS

Table 3: Effect of different pasteurization temperatures and holding time on physico-chemical qualities of blended nectar

Juice Blends	pH							Acidity (%)						
	0 days	15 days	30 days	45 days	60 days	75 days	90 days	0 days	15 days	30 days	45 days	60 days	75 days	90 days
Carrot: aonla (85:15) at 80^{0}C for 5 min	3.68	3.83	4.29	4.86	5.24	5.68	5.81	0.300	0.283	0.259	0.238	0.235	0.230	0.227
Carrot: aonla (85:15) at 85^{0}C at 2 ½ min	3.68	3.78	4.14	4.72	4.92	5.59	5.79	0.300	0.291	0.263	0.243	0.240	0.236	0.229
Carrot: aonla (85:15) at 90^{0}C at ½ min	3.68	3.74	4.05	4.69	4.84	5.51	5.76	0.300	0.292	0.268	0.249	0.245	0.239	0.231
Carrot: pomegranate (85:15) at 80^{0}C for 5 min	4.01	4.12	4.18	4.26	4.32	4.48	4.52	0.300	0.288	0.271	0.270	0.267	0.264	0.257
Carrot: pomegranate (85:15) at 85^{0}C for 2 ½ min	4.01	4.10	4.13	4.20	4.26	4.40	4.48	0.300	0.293	0.272	0.269	0.264	0.262	0.259
Carrot: pomegranate (85:15) at 90^{0}C for ½ min	4.01	4.14	4.17	4.24	4.27	4.29	4.35	0.300	0.291	0.279	0.276	0.270	0.260	0.260
Carrot: Grape(85:15) at 80^{0}C for 5 min	4.10	4.14	4.21	4.21	4.32	4.41	4.47	0.300	0.291	0.293	0.285	0.280	0.278	0.277
Carrot: Grape(85:15) at 85^{0}C for 2 ½ min	4.10	4.19	4.20	4.28	4.34	4.40	4.45	0.300	0.293	0.289	0.280	0.275	0.272	0.269
Carrot: Grape(85:15) at 90^{0}C for ½ min	4.10	4.11	4.16	4.20	4.24	4.28	4.30	0.300	0.296	0.284	0.279	0.274	0.269	0.264
SEm±	0.048	0.049	0.050	0.053	0.055	0.058	0.060	0	0.0035	0.0034	0.0032	0.0032	0.0032	0.0031
CD (p = 0.05)	0.143	0.146	0.151	0.158	0.163	0.173	0.177	NS	NS	0.0100	0.0097	0.0095	0.0094	0.0092

Table 4: Effect of different pasteurization temperatures and holding time on physico-chemical qualities of blended nectar

Juice Blends	Total Sugars (%)							Reducing Sugars (%)						
	0 days	15 days	30 days	45 days	60 days	75 days	90 days	0 days	15 days	30 days	45 days	60 days	75 days	90 days
Carrot: aonla (85:15) at 80ºC for 5 min	11.65	11.76	11.91	12.14	12.20	12.29	12.40	11.65	11.76	11.91	12.14	12.20	12.29	12.40
Carrot: aonla (85:15) at 85ºC at 2 ½ min	11.60	11.70	11.89	12.06	12.19	12.22	12.32	11.60	11.70	11.89	12.06	12.19	12.22	12.32
Carrot: aonla (85:15) at 90ºC at ½ min	11.47	11.61	11.71	11.82	11.98	12.03	12.11	11.47	11.61	11.71	11.82	11.98	12.03	12.11
Carrot: pomegranate (85:15) at 80ºC for 5 min	12.40	12.59	12.72	12.86	12.92	13.04	13.27	12.40	12.59	12.72	12.86	12.92	13.04	13.27
Carrot: pomegranate (85:15) at 85ºC for 2 ½ min	12.36	12.48	12.60	12.73	12.85	12.91	13.17	12.36	12.48	12.60	12.73	12.85	12.91	13.17
Carrot: pomegranate (85:15) at 90ºC for ½ min	12.31	12.44	12.64	12.76	12.82	12.89	13.08	12.31	12.44	12.64	12.76	12.82	12.89	13.08
Carrot: Grape(85:15) at 80ºC for 5 min	13.01	13.26	13.51	13.65	13.72	13.80	13.87	13.01	13.26	13.51	13.65	13.72	13.80	13.87
Carrot: Grape(85:15) at 85ºC for 2 ½ min	12.35	12.47	12.61	12.77	12.84	12.91	13.13	12.35	12.47	12.61	12.77	12.84	12.91	13.13
Carrot: Grape(85:15) at 90ºC for ½ min	12.28	12.42	12.52	12.61	12.73	12.87	13.04	12.28	12.42	12.52	12.61	12.73	12.87	13.04
SEm ±	0.149	0.151	0.153	0.155	0.156	0.157	0.159	0.149	0.151	0.153	0.155	0.156	0.157	0.159
CD (p = 0.05)	0.444	0.449	0.455	0.461	0.464	0.467	0.472	0.444	0.449	0.455	0.461	0.464	0.467	0.472

has decreased with increase in processing temperature and heating time (Gama and Sylos, 2007).

pH and titrable acidity

The significant effect of processing treatments on pH was observed throughout the storage period (Table 2). There was a gradual increase in pH levels and decrease in acidity of juice blend nectars in all treatments. The decrease rate was comparatively more among treatments processed at 80ºC for five minutes in case of nectar made from blends of carrot with aonla and pomegranate. The titrable acidity initially varied non-significantly, but later decreased significantly and this might be due to chemical reactions between organic constituents that induced upon prolonged storage and temperature (Barwal and Kalia, 1998). The increase in pH levels could be attributed to decrease in acidity of blends during storage (Deka *et al.,* 2004 and Wu and Shen, 2011)

Sugars

The total sugars content increased with advancement of storage period under all the treatments and was significantly higher under carrot: grape (85:15) blended nectar at 80ºC for 5 min treatment as compared to all other treatments during storage (Table 3). This may be due to more total sugars in grape juice and also time of processing temperature exposure (Hallmann *et al.,* 2011). Similarly there was rise in levels of reducing sugars and was higher under carrot: grape (85:15) blended nectar at 80ºC for 5 min treatment in comparison to all other treatments during storage. This might be due to hydrolysis of disaccharides at higher temperature (Agrahari and Khurdiya, 2003). Similar observations were also reported by Vijayanand and Kulkarni (2013) and Yadav *et al.* (2015)

Total soluble solids

All the treatments showed an in-significant change in TSS levels throughout the storage period.

Organoleptic evaluation

The organoleptic scores initially changed non-significantly and later decreased significantly in all the treatments during storage period (Table 1). At the end maximum score (6.91) was recorded in treatment carrot-aonla juice blended nectar processed at 90ºC for ½ minute. The highest decrease in organoleptic score from 8.64 to 3.15, where it developed unacceptable taste during storage, was recorded under treatment carrot-grape juice blended nectar processed at 80ºC for five minutes. Similar decrease during storage was observed by Satkar *et al.* (2013) and Dhaliwal and Hira (2001).

REFERENCES

A. O. A. C. 1995. Official Methods of Analysis of the Association of Official Agricultural Chemists. *16th Ed. Washington. D.C.* pp. 941-15.

Agrahari, P. R. and Khurdiya, D. S. 2003. Studies on preparation and storage of RTS beverage from pulp of culled apple pomace. *Indian Food Packer.* **57:** 56-61.

Amerine, M. A., Pangborn, R. M. and Rocssler, E. A. 1965. Principles of sensory evaluation of food. *Academic Press, London.* p. 338-339.

Barwal, V. S. and Kalia, M. 1998. Studies on quality attributes and preservation techniques of Kinnow juice. *Haryana J. Horticultural Sciences.* **27:** 1-11.

Calskantur, K. S., Soylemez, Z. and Ozdemir, Y. 2011. Effect of time and temperature on orange juice during storage. *Advances in Food Sciences*. **33:** 22-27.

Cochran, W. G. and Cox, G. M. 1992. Experimental Design, 2nd edn. John Wiley Inc., New York. pp. 106-110.

Deka, B. C., Sethi, V., Poonam, Suneja and Srivastava, V. K. 2004. Physico chemical changes of lime-aonla spiced beverage during storage. *J. Food Science and Technology*. **41(3):** 329-332.

Dhaliwal, M. and Hira, K. C. 2001. Effect of storage on physico-chemical and nutritional characteristics of carrot-spinach and carrot-pineapple juices. *J. Food Science and Technology*. **41(6):** 613 - 617.

Farnworth, E. R., Lagace, M., Couture, R., Yaylayan, V. and Stewart, B. 2001. Thermal processing, storage conditions and the composition and physical properties of orange juice. *J.Food Research Institute*. **34(1):** 25-30.

Gama, J. J. T. and Sylos, C. M. de. 2007. Effect of thermal pasteurisation and concentration on carotenoid composition of Brazilian Valencia orange juice. *Food Chemistry*.**100:** 1686-1690.

Hallmann, E., Sikora, M., Rembialkowska, E., Marszalek, K. and Lipowski, J. 2011. The influence of pasteurisation process on nutritive value of carrot juices from organic and conventional production. *J.Research and Applications in Agricultural Engineering*. **56:** 133-137.

Heinonen, M. I. 1990. Carotenoids and provitamin activity of carrot (Daucus carota L) cultivars. *J. Agricultural and Food Chemistry*. **38:** 609-612.

Khomdram, S. and Devi, G. A. S. 2010. Determination of anti-oxidant activity and vitamin C of some wild fruits of Manipur. *The Bioscan*. **5(3):** 501-504.

Mohammad, S. M. and Kashani, H. H. 2012. Chemical composition of the plant Punica granatum L. (Pomegranate) and its effect on heart and cancer. *J. Medicinal Plants Research*. **6(40):** 5306-5310.

Nagy, S. 1980. Vitamin C contents of citrus fruits and their products: A review. *J. Agricultural and Food Chemistry*. **21:** 272.

Robinson, W. B. and Stotz, E. 1945. The indophenols-xylene extraction method for ascorbic acid and modifications for interfering substances. *J. Biological Chemistry*. **2:** 217-225.

Saldana, G., Stephens, T. S. and Lime, B. J. 1976. Carrot beverages. *J. Food Science*. **41:** 1243-1244.

Satkar, K. P., Kulthe, A. A. and Chalke, P. R. 2013. Preparation of bitter gourd ready-to-serve beverage and effect of storage temperature on its keeping quality. *The Bioscan*. **8(1):** 115-117.

Somogyi, M. 1952. Notes on sugar determination. *J. Biological Chemistry*. **195:** 19-23.

Vijayanand, P. and Kulkarni, S. G. 2013. Lycopene fortification on the quality characteristics of beverage formulations developed from pink flesh guava (Psidium guajava L.) *J. Food Science and Technology*, **51(12):** 4126-4131.

Wu, J. S. B. and Shen, S. C. 2011. Processing of vegetable juice and blends. *Handbook of vegetables and vegetable processing*. pp. 335-350.

Yadav, T. V., Choudhary, M. R., Garhwal, O. P., Mahala, P. and Singh, S. P. 2015. Influence on levels of B-carotene, ascorbic acid and other physico chemicalqualities from acidification of carrot juice by blending. *The Ecoscan*. **9(1&2):** 83-86.