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Research Article

Effect of storage conditions, preservative levels and packing materials on ascorbic acid juice of mandarin cv. Nagpur Santra

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ABSTRACT

The research was done with the aim of considering vitamin C affectability under different storage conditions and packages at the post-harvest center of Mpkv, Rahuri Agricultural University in India. Juice of Nagpur Santra in three packaging materials glass bottles of 200 mL (B1), pet bottles of 200 mL (B2) and standy pouches (B3) which were added sodium benzoate as preservative substance in three levels 150 ppm (P1), 250 ppm (P2) and 350 ppm (P3), were kept in roam temperature range 19 to 28°C (S1) and cold storage 5±2°C (S2) were used for vitamin C consideration at days 30, 60, 90, 120, 150 and 180 of storage period. Results showed that ascorbic acid of Nagpur Santra juice was significantly influenced by storage conditions, preservative levels, packaging materials and their interactions. The ascorbic acid (AA) of fresh juice was 43.46 mg 100 mL^{-1}. During storage AA was found to be decreased in all the treatment combinations. However, the rate was faster under ambient condition (S1) as compared to cold storage (S2) condition. The minimum decrease in AA of juice was found in high preservative level when packed in glass bottle and stored in cold storage. The maximum AA was recorded in S2P3B1 (35.21 mg 100 mL^{-1}) followed by S2P3B2 (34.23 mg 100 mL^{-1}) at 180 days of storage. The minimum AA was recorded in S1P1B3 (23.69 mg 100 mL^{-1}) followed by S1P1B2 (24.60 mg 100 mL^{-1}) at 90 days of storage period and afterward it spoiled. It can be said due to high quantity of AA in Nagpur Santra even after long period of storage time the level of AA of mentioned fruit juice was at acceptable level from view point of nutritional value.

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1. Introduction

Nagpur Mandarin (Nagpur Santra) is one of the richest vitamin C source among the horticultural crops as it is reported 42.43 mg 100 mL^{-1} in LB8-9 Mandarin Dou and Gmitter (2007). Beltrán-González et al. (2008) studied that vitamin C is important part of fruit juices and its degradation is related with non-enzymatic browning. Beltran (2009) revealed that numerous complex factors can effect amount of vitamin C level of juices it related to the processing methods and packing materials which are used. The average value of AA in juice Nagpur Santra were recorded between 38 to 53.21 mg 100 mL^{-1} by (Patil et al., 2011; Shankar et al., 2012; Bharad et al., 2015). Decrease in AA during storage of pasteurized juices is related to storage time, storage conditions, pathways which are following for processing, packaging bottles and exposure to the light (Chobe, 1999; Sonawane, 2000; Polydera et al., 2003; Perez et al., 2005; Ros-Chumillas et al., 2007; Ahmed et al., 2008; Bhardwaj, 2013; Balaji, 2014; Malav et al., 2014; Nirmaljit and Anil, 2014). Beltrán-González et al. (2008) revealed that vitamin C level of juices is greatly influenced by temperature during storage and heat during processing, oxygen, metal ion contents, high oxygen content in the headspace of the containers and association of some enzymes like, cytochrome oxidase, ascorbic acid oxidase, and peroxidase can cause losses in AA contains. Same results were reported by (Bhardwaj, 2011; Pareek et al., 2011; Xu et al., 2012). The shelf life of orange juice is usually estimated from a value higher than 20 mg 100 mL^{-1} at ending storage time. (Bacigalupi et al., 2013).

2. Materials and methods

Juice of Nagpur Santra in three packaging materials glass bottles of 200 mL (B1), pet bottles of 200 mL (B2) and standy pouches (B3) which were added sodium benzoate as preservative substance in three levels 150 ppm (P1), 250 ppm (P2) and 350 ppm (P3), were kept in roam temperature range 19 to 28°C (S1) and cold storage 5±2°C (S2) were used for vitamin C consideration at day 30, 60, 90, 120, 150 and 180 of storage period. Juice sample of 10 mL was diluted to 100 mL with 3.00 per cent metaphoric acid and filtered. Ten milliliter extract of each sample was titrated with dye and L-ascorbic acid content of the sample was calculated taking into consideration the dye factor. The results were expressed as mg ascorbic acid per 100 mL fruit juice. For determination of vitamin C an aliquot (10 mL) was pipette out in a conical flask and titrated with 2, 6 dichlorophenol indophenol dye and a burette reading at pink color development for 15 secs was recorded. Ascorbic acid content in the sample was calculated in mg 100 mL^{-1} as per the formula suggested by (Association of Official Analytical Chemists, 1990; Ranganna, 2005).

$$\text{Ascorbic acid (mg 100 mL}^{-1}) = \frac{\text{(Titer-blank) x dye factor x Volume of extract}}{\text{Extract taken for titration (mL) x Volume of sample taken (mL)}} \times 100$$

3. Results

The data on individual effect of storage conditions, preservative levels, packaging materials and their treatment combinations on ascorbic acid content of Nagpur Santra juice are presented in the following Table 1. The ascorbic acid of Nagpur Santra juice was significantly influenced by storage conditions, preservative levels, packaging materials and their interactions. The ascorbic acid of fresh juice was 43.46 mg 100 mL^{-1}. The ascorbic acid was found to be decreased in all the treatment combinations during the advancement of 180 days of storage. However, the rate was faster S1 condition as compared to S2 condition.

Table 1. Effect of storage conditions, preservative levels and packing materials on ascorbic acid (mg 100 mL^{-1}) of Nagpur Santra Juice along with their treatment combinations

Particulars		Storage Period (Days)					
		30	60	90	120	150	180
Factor S	S1	30.09	28.90	27.33	26.98	27.38	26.75
	S2	38.42	37.01	35.72	34.37	32.92	31.39
	SE. m(±)	0.0056	0.0073	0.0083	0.0089	0.0088	0.0090
	CD @ 5%	0.0160	0.0210	0.0237	0.0255	0.0252	0.0259
	CD @ 1%	0.0215	0.0281	0.0318	0.0342	0.0338	0.0348
Factor P	P1	31.46	30.33	28.64	29.73	30.12	28.59
	P2	32.70	31.40	30.05	31.60	30.15	29.84
	P3	33.95	32.65	31.30	31.42	31.07	31.06
	SE. m(±)	0.0068	0.0090	0.0101	0.0109	0.0108	0.0111
	CD @ 5%	0.0196	0.0257	0.0291	0.0312	0.0309	0.0317
	CD @ 1%	0.0263	0.0344	0.0390	0.0419	0.0414	0.0426
Factor B	B1	35.51	34.38	32.70	31.46	31.47	31.18
	B2	34.57	33.27	31.92	31.98	31.77	31.70
	B3	32.69	31.22	29.96	29.91	31.35	29.82
	SE. m(±)	0.0068	0.0090	0.0101	0.0109	0.0108	0.0111
	CD @ 5%	0.0196	0.0257	0.0291	0.0312	0.0309	0.0317
	CD @ 1%	0.0263	0.0344	0.0390	0.0419	0.0414	0.0426
S x P	S1P1	27.30	26.33	24.31	24.20	*	*
	S1P2	30.74	29.44	28.09	26.69	26.48	*
	S1P3	32.24	30.94	29.59	28.19	27.83	26.75
	S2P1	35.62	34.32	32.97	31.57	30.12	28.59
	S2P2	39.02	37.72	36.37	34.97	33.52	31.99
	S2P3	40.63	39.00	37.83	36.58	35.13	33.60
	SE. m(±)	0.0097	0.0127	0.0143	0.0154	0.0152	0.0157
	CD @ 5%	0.0277	0.0363	0.0411	0.0442	0.0437	0.0449
	CD @ 1%	0.0372	0.0487	0.0551	0.0592	0.0586	0.0602
S X B	S1B1	31.33	30.37	28.35	27.28	27.38	26.75
	S1B2	30.42	29.12	27.77	27.93	27.38	*
	S1B3	28.52	27.22	25.87	25.56	*	*
	S2B1	39.69	38.39	37.04	35.64	34.19	32.66
	S2B2	38.73	37.43	36.08	34.68	33.23	31.70
	S2B3	36.85	35.22	34.05	32.80	31.35	29.82
	SE. m(±)	0.0097	0.0127	0.0143	0.0154	0.0152	0.0157
	CD @ 5%	0.0277	0.0363	0.0411	0.0442	0.0437	0.0449
	CD @ 1%	NS	0.0487	0.0551	0.0592	0.0586	0.0602
P X B	P1B1	32.40	31.60	29.25	28.35	31.05	29.52
	P1B2	31.46	30.16	28.81	31.58	30.13	28.60
	P1B3	30.52	29.22	27.87	30.65	29.20	27.67
	P2B1	36.13	34.83	33.48	32.08	30.63	33.25
	P2B2	35.19	33.89	32.54	31.14	33.80	32.27
	P2B3	33.31	32.01	30.66	29.26	31.97	30.44
	P3B1	38.01	36.71	35.36	33.96	32.51	30.98
	P3B2	37.07	35.77	34.42	33.02	31.57	34.23
	P3B3	34.23	32.43	31.36	30.18	32.90	31.37
	SE. m(±)	0.0118	0.0155	0.0176	0.0189	0.0187	0.0192
	CD @ 5%	0.0340	0.0445	0.0503	0.0541	0.0535	0.0550
	CD @ 1%	0.0455	0.0597	0.0675	0.0725	0.0718	0.0737

Continue of Table 1

Treatments							
TI	S1P1B1	28.25	27.95	24.60	24.20	*	*
T2	S1P1B2	27.30	26.00	24.65	*	*	*
T3	S1P1B3	26.34	25.04	23.69	*	*	*
T4	S1P2B1	31.98	30.68	29.33	27.93	26.48	*
T5	S1P2B2	31.08	29.78	28.43	27.03	*	*
T6	S1P2B3	29.16	27.86	26.51	25.11	*	*
T7	S1P3B1	33.78	32.48	31.13	29.73	28.28	26.75
T8	S1P3B2	32.88	31.58	30.23	28.83	27.38	*
T9	S1P3B3	30.07	28.77	27.42	26.02	*	*
T10	S2P1B1	36.55	35.25	33.90	32.50	31.05	29.52
T11	S2P1B2	35.63	34.33	32.98	31.58	30.13	28.60
T12	S2P1B3	34.70	33.40	32.05	30.65	29.20	27.67
T13	S2P2B1	40.28	38.98	37.63	36.23	34.78	33.25
T14	S2P2B2	39.30	38.00	36.65	35.25	33.80	32.27
T15	S2P2B3	37.47	36.17	34.82	33.42	31.97	30.44
T16	S2P3B1	42.24	40.94	39.59	38.19	36.74	35.21
T17	S2P3B2	41.26	39.96	38.61	37.21	35.76	34.23
T18	S2P3B3	38.40	36.10	35.30	34.35	32.90	31.37
SE. m(±)		0.0167	0.0219	0.0248	0.0267	0.0264	0.0271
CD @ 5%		0.0480	0.0629	0.0712	0.0765	0.0757	0.0778
CD @ 1%		0.0644	0.0844	0.0955	0.1026	0.1015	0.1043

* = Spoiled treatments

3.1. Effect of storage

The ascorbic acid was decreased from 30.09 to 26.75 mg 100 mL^{-1} in S1 and 38.42 to 31.39 mg 100 mL^{-1} in S2 during 30 to 180 days of storage. The decreasing trend was maximum in S1 followed S2 during 180 days of storage period.

3.2. Effect of preservative levels

Among the preservative levels, the ascorbic acid was decreased from 31.46 to 28.59 mg 100 mL^{-1} at 150 ppm (P1), followed by 32.70 to 29.84 mg 100 mL^{-1} at 250 ppm (P2) and 33.95 to 31.06 mg 100 mL^{-1} at 350 ppm (P3) during 30 to 180 days of storage. The decreasing trend was maximum in P1 followed by P2 and P3 during storage.

3.3. Effect of packaging materials

Among the packaging materials, the ascorbic acid was decreased from 35.51 to 31.18 mg 100 mL^{-1} during package in glass bottles (B1) followed by 34.57 to 31.70 mg 100 mL^{-1} during package in PET bottles (B2) and 32.69 to 29.82 mg 100 mL^{-1} during package in standy pouches (B3) during 30 to 180 days of storage. The minimum decrease in AA was found in B1 followed by B2 and B3 during 180 days of storage.

3.4. Combined effect of two factors

The minimum decrease in ascorbic acid was observed in S2P3 from 40.63 to 33.60 mg 100 mL^{-1} followed by S2P2 from 39.02 to 31.99 mg 100 mL^{-1} during 180 of storage. The minimum decrease in ascorbic acid was observed in S2B1 from 39.69 to 32.66 mg 100 mL^{-1} followed by S2B2 from 38.73 to 31.70 mg 100 mL^{-1} during 180 of storage. Whereas, maximum decrease in ascorbic acid was observed in S1B3 followed by S1B2. The minimum decrease in ascorbic acid was observed in P3B1 followed by P3B2 while maximum decrease in ascorbic acid was observed in P1B3 followed by P1B2.

3.5. Interaction

The treatment combination of storage conditions, preservative levels and packaging materials indicated that the ascorbic acid of Nagpur mandarin juice was found to be statistically significant. The minimum decrease in ascorbic acid of juice was found in high preservative level when packed in glass bottle and stored in cold storage. The maximum ascorbic acid was recorded in S2P3B1 (35.21 mg 100 mL^{-1}) followed by S2P3B2 (34.23 mg 100 mL^{-1}) at 180 days of storage. The minimum ascorbic acid was recorded in S1P1B3 (23.69 mg 100 mL^{-1}) followed by S1P1B2 (24.60 mg 100 mL^{-1}) at 90 days of storage period and afterward it spoiled.

4. Discussion

The data on effect of treatment combination of storage conditions, preservative levels and packaging materials indicated that the ascorbic acid of Nagpur Santra juice were found to be statistically significant. The minimum decrease in ascorbic acid of juice was found in high preservative level packed in glass bottle and stored in cold storage. The maximum ascorbic acid was recorded in S2P3B1 (from 43.46 to 35.21 mg 100 mL^{-1}) followed by S2P3B2 (from 43.46 to 34.23 mg 100 mL^{-1}) during 180 days of storage. The minimum ascorbic acid was recorded in S1P1B3 (from 43.46 to 23.69 mg 100 mL^{-1}) during 90 days followed by S1P1B1 (from 43.46 to 24.20 mg 100 mL^{-1}) during 120 days of storage period and afterward spoiled. The ascorbic acid content during 180 days of storage was found to be decreased which might be due to oxidation of ascorbic acid, oxidation of ascorbic acid by enzymes and various treatments applied, conversion of L-ascorbic acid into dihydro ascorbic acid oxidase (ascorbinase) because of heat processing and the presence of air at the head space of packaging materials. The similar results were also reported by Bhardwaj (2011) in Kinnow mandarin juice; Pareek et al. (2011) in Nagpur mandarin juice; Xu et al. (2012) in orange juice; Bhardwaj (2013) in Kinnow mandarin juice and Faizi et al. (2019) in Nagpur mandarin orange.

5. Conclusion

The juice of Nagpur Santra that preserved by using different preservative levels packed in different packaging materials and stored at ambient and cold storage was studied. The data regarding vitamin C composition revealed that, there was decreasing in ascorbic acid, decreased in all treatment combination of juice during 180 days of storage, but minimum decreasing of juice were packed in glass bottles with using higher preservative level and were stored at cold condition were recorded and even after long period of storage time the level of AA of mentioned fruit juice was at acceptable level from view point of nutritional value

Authors' Contributions

Zaki Ahmad Faizi: Methodology, Investigation, Conceptualization, Validation, Review and editing. Mohammad Younis Mahen: Methodology, Investigation, Conceptualization, Validation, Writing - original draft, Review and editing, Visualization.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Ahmed, M., Ahmad, A., Chatha, Z. A., & Dilshad, S. M. R. (2008). Studies on preparation of ready to serve mandarin (*Citrus reticulata*) diet drink. Pakistan Journal of Agriculture Sciences, 45(4), 470-476.

Association of Official Analytical Chemists. (1990). Official Methods of Analysis: Changes in Official Methods of Analysis Made at the Annual Meeting. Supplement (Vol. 15). Association of Official Analytical Chemists.

Bacigalupi, C., Lemaistre, M. H., Boutroy, N., Bunel, C., Peyron, S., Guillard, V., & Chalier, P. (2013). Changes in nutritional and sensory properties of orange juice packed in PET bottles: An experimental and modelling approach. Food Chemistry, 141(4), 3827-3836.

Balaji, V., & Prasad, V. M. (2014). Studies on value added kinnow-aonla blended ready to serve beverage. Journal of Food Processing and Technology, 5(1), 1-4.

Beltrán-González, F., Pérez-López, A.J., López-Nicolás, J.M., & Carbonell-Barrachina, Á.A. (2008). Effect of packaging materials on color, vitamin C and sensory quality of refrigerated mandarin juice. Journal of Food Quality, 31(5), 596-611.

Beltran, F., Perez-Lopez, A. J., Lopez-Nicolas, J. M., & Carbonell-Barrachina, A. A. (2009). Color and vitamin C content in mandarin orange juice as affected by packaging material and storage temperature. Journal of Food Processing and Preservation, 33, 27-40.

Bharad, S.G., Varane., P., Satkar., K., Nagre P.K., & Dharmik, Y.B. (2015). Studies on fruit juice physicochemical characteristics of mandarin cultivars grown under Vidarbha conditions. CCRI, Nagpur., 5,104.

Bhardwaj, R. L., & Mukherjee, S. (2011). Effects of fruit juice blending ratios on kinnow juice preservation at ambient storage condition. African Journal of Food Science, 5(5), 281-286.

Bhardwaj, R. L. (2013). Physico-chemical, sensory and microbiological quality of kinnow juice stored in refrigerated storage condition. Asian Journal of Dairying & Foods Research, 32(3), 203-213.

Chobe, R.S. (1999). Studies on extraction, clarification, preservation and storage of pomegranate (*Punica granatum* L.) juice. M.Tech. (Agri.) Thesis (unpublished) submitted to M.P.K.V., Rahuri, (M.S.).

Dou, H., & Gmitter, F. G. (2007). Postharvest quality and acceptance of LB8-9 mandarin as a new fresh fruit cultivar. HortTechnology, 17(1), 72-77.

Faizi, Z. A., Kad, V. P., Dhemre, J. K., & Musmade, A. M. (2019). Storage behavior of juice prepared from nagpur mandarin orange (*Citrus reticulata*). Journal of Krishi Vigyan, 7(2), 227-233.

Malav, M., Gupta, R., & Nagar, T. (2014). Studies on bio-chemical composition of orange based blended ready-to-serve (RTS) beverages. Bioscience Biotechnology Research Communications, 7(1), 78-83.

Nirmaljit, K., & Anil, K. (2014). Impact of post-harvest treatments on shelf life of Kinnow mandarin International Journal of Advanced Research, 2 (5), 290-295.

Pareek, S., Paliwal, R., & Mukherjee, S. (2011). Effect of juice extraction methods and processing temperature-time on juice quality of Nagpur mandarin (*Citrus reticulata* Blanco) during storage. Journal of Food Science and Technology, 48(2), 197-203.

Patil, N. B., Shedame, B. M., & Ingle, S. H. (2011). Effect of plant growth regulators and fungicides on chemical composition on Nagpur mandarin. International Journal of Plant Sciences (Muzaffarnagar), 6(1), 144-148.

Perez, A. G., Luaces, P., Oliva, J., Ríos, J. J., & Sanz, C. (2005). Changes in vitamin C and flavour components of mandarin juice due to curing of fruits. Food Chemistry, 91(1), 19-24.

Polydera, A. C., Stoforos, N. G., & Taoukis, P. S. (2003). Comparative shelf life study and vitamin C loss kinetics in pasteurised and high pressure processed reconstituted orange juice. Journal of Food Engineering, 60(1), 21-29.

Ranganna, S. (2005). Handbook of analysis and quality control for fruit and vegetable products. Tata McGraw-Hill Education.

Ros-Chumillas, M., Belissario, Y., Iguaz, A., & López, A. (2007). Quality and shelf life of orange juice aseptically packaged in PET bottles. Journal of Food Engineering, 79(1), 234-242.

Shankar, V., Prerak, B., & Aruna, Y. (2012). Physico-chemical, yield and yield attributing characteristics of Nagpur Mandarin (*Citrus reticulata* Blanco) orchards surveyed in Jhalawar district of Rajasthan. Asian Journal of Horticulture, 7(2), 437-441.

Sonawane, V. G. (2000). Studies on extraction and preservation of tamarind pulp. a M.Sc. (Agri.) Thesis (unpublished) submitted to M.P.K.V., Rahuri, (M.S.).

Xu, W. C., Li, D. L., Fu, Y. B., & Huang, S. Y. (2012). Effect of Oxygen Scavenging Packaging on Orange Juice Quality. In Advanced Materials Research (Vol. 380, pp. 248-253). Trans Tech Publications Ltd.