Asian J. Dairy & Food Res, 36(2) 2017 : 161-165
Print ISSN:0971-4456 / Online ISSN:0976-0563
AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com

Effect of storage conditions and duration on quality of passion fruit (*Passiflora edulis* Sims.) nectar

S.M.Charan [*], Saji Gomez[1], K.B.Sheela[1], P.B.Pushpalatha[2] and K.T.Suman[3]

Department of Horticulture,
RSK, Kasaba, Nagamangala-571 401, Mandya District, Karnataka, India.
Received: 11-01-2017 Accepted: 17-04-2017 DOI: 10.18805/ajdfr.v36i02.7963

ABSTRACT

Passion fruit nectar was developed from yellow and purple passion fruit separately and also by blending both yellow and purple fruits, in different combinations of TSS and juice. It was initially subjected to organoleptic evaluation to determine the best combination of TSS and juice content in nectar. Organoleptic evaluation revealed that passion fruit nectar containing 20% juice and 20°Brix was more acceptable in all the three categories (yellow and purple separately, and yellow blended with purple). Total soluble solids, non-enzymatic browning, reducing, non- reducing and total sugars increased while, titratable acidity, vitamin C, total carotenoids, total phenols and total flavanoids decreased during storage. Organoleptic quality of passion fruit nectar declined during storage in all the treatments. The rate of decline was faster in nectar stored under ambient conditions compared to those stored under refrigerated condition. Microbial load in all the samples was within the acceptable limits even after three months of storage.

Key words: Passion fruit, Nectar, Biochemical, Organoleptic, Microbiological

INTRODUCTION

Passion fruit (*Passiflora edulis* Sims.) is a perennial, climbing, woody vine which produces round or ovoid fruits having a tough, smooth, waxy dark purple/yellow coloured rind with faint, fine white specks. It contains orange coloured pulpy juice with large number of small, hard, dark brown to black pitted seeds. The juice is delicious with good flavour, intense aroma and sweet-acid taste and is well known for its excellent blending quality. As people are more concerned about their health, demand for passion fruit juice is increasing not only because of its exotic flavour but also for its high nutritional and medicinal properties. There is a lot of evidence that the passion fruit could be a powerful medicinal source. The juice contains very good proportion of acids, sugars, Vitamin-A, fibre, phenolic compounds, ascorbic acid (Ramaiya *et al.,*2012)and minerals such as sodium, magnesium, sulphur, chlorides, etc. (Rao *et al.,*2014).The juice of yellow type is more acidic and its recovery is comparatively less (25-30%) than the purple type (35-38%) (Rao *et al.,* 2014).Even though the high acidity of passion fruit limits its utilisation for table purpose, its intense flavour offers ample scope for processing into numerous value added products like fruit beverages, concentrate, etc. Fruit nectars are unfermented beverages that occupy a prominent place in the processed food sector. By far the greatest benefit of passion fruit to humankind is fruit and the delicious juice. Passion fruit juice is highly acidic due to predominance of citric and malic acid. The strong and intense flavour of passion fruit offers ample scope for processing in to a refreshing fruit nectar .In India, limited work has been done on the post harvest technology of passion fruit. So, the intervention on this aspect has better scope in processing the juice of passion fruit in to a refreshing beverage.

MATERIALS AND METHODS

Passion fruit nectar was prepared from yellow and purple types separately and also from blended juice of both with specifications of. 15°brix, 20% juice(yellow), 20°brix, 20% juice(yellow), 15°brix, 20% juice (purple), 20°brix, 20% juice (purple), 15°brix, 20% juice (yellow and purple in 1:1 ratio) and 20°brix, 20% juice (yellow and purple in 1:1 ratio). Organoleptic quality of passion fruit nectar developed from juice of yellow and purple fruit separately and also from blended in different formulations of TSS and juice content revealed that passion fruit nectar containing 20% juice and 20°Brix was more acceptable in all the three categories (yellow and purple separately and yellow blended with purple). Therefore, the nectar developed with 20% juice and 20°Brix was used for storage studies *viz.*Nectar [20°brix, 20% juice (yellow)] at ambient temperature (T1), Nectar [20°brix, 20% juice (yellow)] at low temperature (5-7°C)

*Corresponding author's e-mail: saji.gomez@kau.in
[1]Department of Processing Technology, College of Horticulture (KAU), Vellanikkara, Thrissur, Kerala-680656.
[2]Banana Research Station (KAU), Kannara, Thrissur, Kerala-680652.
[3]Krishi Vigyan Kendra, Thrissur, Kerala-680656.

(T2), Nectar [20°brix, 20% juice (purple)] at ambient temperature (T3), Nectar [20°brix, 20% juice (purple)] at low temperature (5-7°C) (T4), Nectar [20°brix, 20% juice (yellow + purple)] at ambient temperature (T5) and Nectar [20°brix, 20% juice (yellow + purple)] at low temperature (5-7°C) (T6). The change in quality of nectar was evaluated during storage at monthly intervals. Titratable acidity, ascorbic acid, total carotenoids and total phenols were estimated as per the procedure suggested by AOAC (1998), non-enzymatic browning, reducing, non-reducing and total sugars were determined as per the procedure suggested by Ranganna (1997). Total flavanoids were estimated as per the procedure suggested by Chang *et al*. (2002). Total soluble solids (TSS) were determined by using hand refractometer. Quality of passion fruit nectar was judged by a panel of judges having different age groups for appearance, colour, flavour, texture, odour, taste, after taste and overall acceptability, based on a 9 point hedonic scale rating (Amerine *et al*., 1965).

RESULTS AND DISCUSSION

Total soluble solids (TSS) in all three types of passion fruit nectar increased throughout the storage period, irrespective of storage conditions (Table 1). Nectar stored under ambient temperature showed higher rate of increase compared to those stored under refrigerated condition. Significant increase in TSS content of passion fruit nectar was not observed after second and third month of storage. Increase in TSS could be due to solubilisation of passion fruit pulp constituents during storage and degradation of complex starch into simple sugars due to hydrolysis of polysaccharides (Jawanda *et al.,* 1978).Titratable acidity and vitamin C in all three types of passion fruit nectar decreased throughout the storage period irrespective of storage conditions (Table 1). Nectar stored under ambient temperature showed higher rate of decrease compared to low temperature. Decrease in titratable acidity could be due to the biochemical reactions between sugars and organic acids which get accelerated at higher temperatures (Lakhanpal and Vaidya, 2015).The reason behind decrease in ascorbic acid could be due to oxidation of vitamin-C to furfural and hydroxyl methyl furfural (Aruna *et al.*, 1997).Reducing, non-reducing and total sugars in all three types of passion fruit nectar increased during storage irrespective of storage conditions (Table 2). However significant difference between the treatments was observed after three months of storage. Increase in sugar content may be due to breakdown of complex starch into simple glucose and sucrose (Selvaraj *et al*. 1989).Total phenols, total flavanoids decreased throughout the storage period irrespective of storage conditions (Table 3). Nectar stored under ambient

Table 1: Total soluble solids (TSS), titratable acidity and vitamin C content of passion fruit nectar during storage

Treatments	Total soluble solids (°Brix)				Titratable acidity (%)				Vitamin C (mg 100gÉ¹)			
	Initial	1MAS	2MAS	3MAS	Initial	1MAS	2MAS	3MAS	Initial	1MAS	2MAS	3MAS
T1	20.00	21.20	21.30	21.90	0.96	0.91	0.83	0.70	12.24	8.07	7.68	5.25
T2		21.00	21.10	21.70		0.96	0.86	0.73		11.15	7.68	6.57
T3		21.15	21.40	21.80	0.99	0.96	0.86	0.83	15.30	12.30	10.88	9.19
T4		21.00	21.15	21.45		0.97	0.96	0.86		14.61	12.30	10.51
T5		20.90	21.40	21.80	0.97	0.86	0.83	0.73	11.56	8.84	7.68	5.91
T6		20.35	21.15	21.70		0.96	0.86	0.80		11.53	9.60	7.22
SE	-	0.17	0.10	0.12	-	0.02	0.02	0.01	-	0.81	0.78	0.37
CD	-	0.52	NS	NS	-	NS	0.06	0.04	-	2.44	2.34	1.13

Table 2: Reducing, non-reducing and total sugar content of passion fruit nectar during storage

Treatments	Reducing sugars (%)				Non-reducing sugars (%)				Total sugars (%)			
	Initial	1MAS	2MAS	3MAS	Initial	1MAS	2MAS	3MAS	Initial	1MAS	2MAS	3MAS
T1	8.52	9.06	9.65	10.51	6.62	7.82	9.18	9.40	15.14	16.88	18.83	19.91
T2		8.54	8.85	9.50		7.15	7.79	7.82		15.69	16.64	17.32
T3	8.85	9.25	9.50	12.34	7.52	7.87	7.98	9.55	16.37	17.12	17.48	21.89
T4		8.75	8.85	9.00		7.79	7.80	8.14		16.54	16.65	17.14
T5	8.75	9.00	9.65	12.21	6.83	7.54	7.79	8.37	15.58	16.54	17.44	20.58
T6		8.85	9.25	9.50		6.98	7.48	7.82		15.83	16.73	17.32
SE	-	0.36	0.24	0.54	-	0.62	0.72	0.30	-	0.40	0.70	0.49
CD	-	NS	NS	1.64	-	NS	NS	0.92	-	NS	NS	1.49

MAS: Months after storage

T1- Nectar (yellow fruit) at ambient temperature

T2- Nectar (yellow fruit) at low temperature (5-7°C)

T3- Nectar (purple fruit) at ambient temperature

T4- Nectar (purple fruit) at low temperature (5-7°C)

T5- Nectar (blend of yellow and purple) at ambient temperature

T6- Nectar (blend of yellow and purple) at low temperature (5-7°C)]

Table 3: Total phenols and total flavanoids in passion fruit nectar during storage

Treatments	Total phenols (mg 100gÉ¹)				Total flavanoids (mg 100gÉ¹)			
	Initial	1MAS	2MAS	3MAS	Initial	1MAS	2MAS	3MAS
T1	9.50	9.00	8.50	7.50	4.50	4.00	3.50	3.00
T2		9.50	9.00	8.50		4.25	4.00	3.50
T3	8.00	7.00	6.50	6.00	3.25	2.75	2.25	2.00
T4		7.50	7.00	7.00		3.00	2.75	2.75
T5	8.50	7.50	6.50	6.00	3.75	3.00	2.75	2.00
T6		8.00	7.50	6.50		3.50	3.00	3.00
SE	-	0.45	0.50	0.39	-	0.47	0.42	0.15
CD	-	1.36	1.49	1.17	-	NS	NS	0.46

Table 4: Total carotenoids and non-enzymatic browning in passion fruit nectar during storage

Treatments	Total carotenoids (mg 100gÉ¹)				Non-enzymatic browning (absorbance)			
	Initial	1MAS	2MAS	3MAS	Initial	1MAS	2MAS	3MAS
T1	0.40	0.33	0.28	0.11	0.01	0.01	0.02	0.03
T2		0.38	0.33	0.28		0.01	0.02	0.02
T3	0.91	0.59	0.43	0.38	0.02	0.04	0.06	0.06
T4		0.69	0.59	0.47		0.03	0.05	0.05
T5	0.69	0.47	0.30	0.28	0.02	0.02	0.03	0.04
T6		0.59	0.43	0.33		0.02	0.02	0.03
SE	-	0.06	0.009	0.05	-	0.002	0.06	0.003
CD	-	0.18	0.02	0.17	-	0.007	0.01	0.009

MAS: Months after storage

T1- Nectar (yellow fruit) at ambient temperature

T2- Nectar (yellow fruit) at low temperature (5-7°C)

T3- Nectar (purple fruit) at ambient temperature

T4- Nectar (purple fruit) at low temperature (5-7°C)

T5- Nectar (blend of yellow and purple) at ambient temperature

T6- Nectar (blend of yellow and purple) at low temperature (5-7°C)]

temperature showed higher rate of decrease as compared to low temperature stored. Decrease in total phenols might be due to impact of thermal processing on passion fruit nectar and also, non-enzymatic reaction of organic acid with sugar and/or oxidation of phenols, which results in formation of brown pigments (Simenthy, 2015).Higher retention of flavanoids under refrigerated condition may be due to slower rate of bio chemical reactions at low temperature compared to ambient condition. Total carotenoids in all three types of passion fruit nectar decreased throughout the storage period irrespective of storage conditions (Table 4). Nectar stored under ambient temperature showed higher rate of decrease as compared to low temperature storage. Decrease in total carotenoid content might be due to the oxidative reactions during storage. Maximum retention of carotenoids under refrigerated condition might be attributed to minimum degradation and lesser oxidation of these pigments under lower temperature (Deka *et al.,* 2004). Non-enzymatic browning in all three types of passion fruit nectar increased throughout the storage period irrespective of storage conditions (Table 4). Nectar stored at ambient temperature showed higher rate of browning increase as compared to low temperature. This is due to non-enzymatic reaction between organic acids and sugars and/or oxidation of phenols which in turn helped in the formation of brown pigments (Deka *et al.,* 2004).Higher non-enzymatic browning under ambient condition may be due to faster rates of bio chemical reactions at higher temperature compared to low temperature.

Table 5: Organoleptic quality of passion fruit nectar during storage (1 MAS)

Treatments	Appearance	Colour	Flavour	Texture	Odour	Taste	After taste	Overall acceptability	Total score
T1	6.3	6.3	6.4	7.2	6.6	6.6	6.4	6.3	52.1
T2	6.9	6.5	7.4	7.1	7.3	8.0	7.4	7.5	58.1
T3	8.0	8.0	6.9	7.6	6.6	6.9	6.6	6.9	57.5
T4	8.2	8.2	7.4	7.9	7.6	8.1	7.9	8.1	63.4
T5	7.6	7.6	7.0	7.5	7.3	7.7	7.3	7.7	59.7
T6	7.6	6.7	7.6	7.9	7.7	7.7	6.4	7.6	59.2
Kendal's W test	0.453	0.673	0.229	0.230	0.207	0.167	0.279	0.262	

Table 6: Organoleptic quality of passion fruit nectar during storage (2 MAS)

Treatments	Appearance	Colour	Flavour	Texture	Odour	Taste	After taste	Overall acceptability	Total score
T1	6.3	6.0	6.6	6.5	6.3	6.7	6.5	6.0	50.9
T2	6.8	6.3	7.4	7.2	7.3	7.8	7.4	7.3	57.5
T3	8.2	8.5	6.4	6.8	6.6	6.8	6.8	6.5	56.6
T4	8.0	8.2	7.2	7.2	7.1	7.5	7.6	7.5	60.3
T5	7.4	7.5	5.8	6.5	6.0	6.0	5.6	6.2	51.0
T6	7.7	7.6	6.9	7.3	7.3	7.5	7.3	7.4	59.0
Kendal's W test	0.272	0.419	0.181	0.360	0.248	0.227	0.198	0.201	

Table 7: Organoleptic quality of passion fruit nectar during storage (3 MAS)

Treatments	Appearance	Colour	Flavour	Texture	Odour	Taste	After taste	Overall acceptability	Total score
T1	6.1	5.8	5.7	6.1	5.7	6.1	6.0	5.8	47.3
T2	6.4	6.0	6.4	6.5	6.2	6.8	6.5	6.7	51.5
T3	7.5	7.8	5.4	6.7	5.2	5.5	5.7	5.7	49.5
T4	8.0	7.8	7.4	7.4	7.1	7.7	7.5	7.3	60.2
T5	6.4	6.0	5.8	6.5	6.2	5.5	6.1	5.8	48.3
T6	7.1	6.7	7.1	7.1	6.8	7.5	6.8	7.0	56.1
Kendal's W test	0.659	0.777	0.457	0.199	0.293	0.364	0.242	0.454	

MAS: Months after storage
T1- Nectar (yellow fruit) at ambient temperature
T2- Nectar (yellow fruit) at low temperature (5-7°C)
T3- Nectar (purple fruit) at ambient temperature
T4- Nectar (purple fruit) at low temperature (5-7°C)
T5- Nectar (blend of yellow and purple) at ambient temperature
T6- Nectar (blend of yellow and purple) at low temperature (5-7°C)]

Data on mean sensory scores of passion fruit nectar during first, second and third month of storage are presented in Tables 5, 6 and 7 respectively. Sensory scores of passion fruit nectar declined during storage in all the treatments. The rate of decrease was faster in nectar stored under ambient condition as compared to refrigerated condition. After three months of storage, nectar developed from the juice of purple fruit stored under refrigerated condition recorded maximum sensory score (60.20) while the minimum (47.3) was seen in the samples from the juice of yellow fruit stored under ambient condition. These results are in accordance with those reported by Ladaniya *et al.* (2004) wherein the organoleptic scores for body, taste, colour and aroma of sweetened 'Nagpur' Mandarin orange juice decreased with increase in storage period irrespective of storage conditions. However, scores for overall acceptability topped in refrigerated condition as compared to ambient temperature. Nectar stored at ambient temperature had higher microbial load than those

Table 8: Microbial load in passion fruit nectar during storage

Treatments	Bacterial load (10^5 cfu gÉ^1)				Fungal load (10^3 cfu gÉ^1)				Yeast load (10^3 cfu gÉ^1)			
	Initial	1MAS	2MAS	3MAS	Initial	1MAS	2MAS	3MAS	Initial	1MAS	2MAS	3MAS
T1	ND	ND	ND	1.0	ND	1.0	1.0	2.00	ND	ND	1.0	2.0
T2		ND	ND	ND		ND	1.0	1.0		ND	ND	1.0
T3	ND	ND	ND	1.0	ND	1.0	2.0	2.0	ND	ND	1.0	2.0
T4		ND	ND	ND		ND	1.0	2.0		ND	1.0	1.0
T5	ND	ND	ND	ND	ND	ND	1.0	2.0	ND	ND	ND	1.0
T6		ND	ND	ND		ND	ND	1.0		ND	ND	1.0
SE	-	-	-	0.22	-	0.15	0.33	0.33	-	-	0.19	0.45
CD	-	-	-	NS	-	NS	NS	NS	-	-	NS	NS

MAS: Months after storage; ND: Not detected
T1- Nectar (yellow fruit) at ambient temperature
T2- Nectar (yellow fruit) at low temperature (5-7°C)
T3- Nectar (purple fruit) at ambient temperature
T4- Nectar (purple fruit) at low temperature (5-7°C)
T5- Nectar (blend of yellow and purple) at ambient temperature
T6- Nectar (blend of yellow and purple) at low temperature (5-7°C)

stored at low temperature. Bacteria were not detected up to two months of storage and yeast did not survive up to one month of storage, in any treatments. Even though, fungi were not detected initially, it was found one month after storage. However, the microbial load in all the samples was within the acceptable limits. According to Tchango-Tchango *et al.* (1994) the acidity in processed passion fruit juice inhibited the growth and multiplication of pathogenic microorganisms like *Escherichia coli*, *Streptococcus* or *Staphylococcus*, but might contain non-pathogenic fungi, yeasts or lactic acid bacteria. Sandi *et al.* (2004) also reported that the yellow passion fruit juice pasteurized at 75°C for 60 sec showed complete inhibition of microbial population, and also the juice stored under refrigeration remained microbiologically safe throughout the storage period.

It may be concluded that the passion fruit nectar having 20% juice and 20^{0}Brix is organoleptically acceptable and its storage at low temperature helps to retain better quality as compared to ambient conditions.

REFERENCES

Amerine, M. A., Pangborn, R. N. and Rossler, E. B. (1965). Principles of sensory evaluation of food. Acad. Press, London.

AOAC [Association of Official Agricultural Chemists] (1998). *Official method of analysis of AOAC International* (16th Ed.). Association of Official Agricultural Chemists, Wasington, D. C. p. 899.

Aruna, K., Vimala, V., Giridhar, N. and Raio, D. G. (1997). Studies on preparation andstorage of nectar prepared from papaya. *Beverage Food World***24**(1): 29-32.

Chang, C., Yang, M., Wen, H. and Chern, J. (2002).Estimation of total flavonoid content in propolis bytwo complementary colorimetric methods.*J. Food Drug Anal.* **10**(3): 178-182.

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

Jawanda, J. S., Singh, R. and Kumar, K. (1978). Studies on extending post harvestlife of Kinnow Mandarin. *Punjab Hort. J.* **18**:149-153.

Ladaniya, M. S., Das, A. K., Khan, N. A., Mahalle, B. and Kumar, A. (2004). Changes in quality of sweetened 'Nagpur' Mandarin orange juice in crown corked glass bottles at ambient and refrigerated conditions. *J. Food Sci. Technol.***41** (3): 344-348.

Lakhanpal, P. and Vaidya, D. (2015). Development and evaluation of honey based mango nectar *J. Food Sci. Technol.***52** (3): 1730–1735.

Ramaiya, S. D., Bujang, J. S., Zakaria, M. H., Kinga, W. S. and Sahrira, M. A. S. (2012). Sugars, ascorbic acid, total phenolic contentand total antioxidant activity in passion fruit(*Passiflora*) cultivars. *J. Sci. Food Agric.* **93**: 1198–1205.

Ranganna, S. (1997). *Handbook of Analysis and Quality Control for Fruit and Vegetable Products* (2nd Ed). Tata McGraw Hill Publishing Company Limited, New Delhi. 1112p.

Rao, T. M., Tripathi, P. C., Karunakaran, G., Sakthivel, T., Sankar, V. and Kumar, R. S. (2014). Passion fruit cultivation in India. Technical bulletin No. 3, Central Horticultural Experiment Station (CHES), ICAR – Indian Institute of Horticulture Research (IIHR), Chettalli- 571248, Kodagu, Karnataka, India,17p.

Sandi, D., Chaves, J. B. P., de Sousa, A. C. G., Parreiras, J. F. M., da Silva, M. T. C., and Constant, P. B. L. (2004). Hunter colour dimensions, sugar content and volatile compounds in pasteurized yellow passion fruit juice (*Passiflora edulis* var. *flavicarpa*) during storage. *Brazilian Arch.Biol. Technol.***47**(2): 233-245.

Selvaraj, Y., Kumar, R. and Pal, D. K. (1989). Changes in sugars, organic acids, amino acids, lipid constituents and aroma characteristics of ripening mango (*Mangifera indica* L.) fruit. *J. Food.Sci. Tech.* **26**: 308-13.

Simenthy, T. (2015). Proximate analysis and product development in nutmeg rind (*Myristica fragrans*Houtt.). Msc thesis. Kerala Agricultural University, Thrissur, Kerala.

Tchango-Tchango, J., Tailiez, R., Eb, P., Njine, T., and Hornez, J. P. (1994). Heat resistance of the spoilage yeasts *Candida pelliculosa* and *Kloeckera apis* and pasteurization values for some tropical fruit juices and nectars. *Food Microbiol.* **14**: 93-99.