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Studies on bio-chemical composition of orange based blended ready-to-serve (RTS) beverages

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ABSTRACT

Studies on bio-chemical composition of orange based blended ready-to-serve (RTS) beverages were conducted in the Department of Post Harvest Management, College of Horticulture, Mandsaur. The experiment comprised of two levels of preservative (750 ppm and 500 ppm KMS), three levels of recipe (orange, pomegranate, aonla and ginger juice) and two blending ratios (90:10:0, 86:10:4). These experiments have 9 treatment combinations viz., T-0 (control, 100% orange juice with 750 ppm KMS), T-1(Orange-aonla-ginger (90:10:0) with 750 ppm KMS), T-2(Orange- aonla-ginger (86:10:4) with 750 ppm KMS), T-3 (Orange-pomegranate-ginger (90:10:0) with 750 ppm KMS), T-4 (Orange-pomegranate-ginger (86:10:4) with 750 ppm KMS), T-5 (Orange-aonla-ginger (90:10:0) with 500 ppm KMS), T-6 (Orange-aonla-ginger (86:10:4) with 500 ppm KMS), T-7(Orange-pomegranate-ginger (90:10:0) with 500 ppm KMS), T-8(Orange-pomegranate-ginger (86:10:4) with 500 ppm KMS). The different bio-chemical parameters were recorded at 30 days interval upto 90th days. At the end of storage period i.e., at 90th day of storage minimum TSS content of 13.03°Brix was observed in T-4 and maximum 13.53°Brix in T-3, the maximum acidity was found 0.60% in T-0 whereas minimum of 0.43% in T-8, the maximum ascorbic acid content was observed 36.77mg/100ml in T-2 and minimum of 10.58mg/100ml in T-8. The sugars content showed an increasing trend whereas pH showed decreasing trend with advancement of storage period. Among various treatments T-4 was adjudged the best.

KEY WORDS: BEVERAGES, READY TO SERVE STORAGE

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INTRODUCTION

Orange specially, the sweet orange (*Citrus sinensis* L.) is a deciduous tree which belongs to family Rutaceae. Sweet orange is the most commonly grown fruit in the world and widely cultivated in tropical and sub-tropical climates for the delicious sweet fruit which is peeled or cut (to avoid the bitter rind) and eaten whole, or processed to extract orange juice, ready-to-serve (RTS) beverages, cordial, nectar etc. In India, orange has been cultivated in 2,85,000 ha area with an annual production of 20.84 lakh tonnes (Anonymons, 2012). Major orange producing states are Maharashtra, Madhya Pradesh, Rajasthan, Tamil Nadu, Assam and Tripura. In some parts of Madhya Pradesh, particularly in Mandsaur, Neemuch, Chhindwada, Betul, Ujjain and Shajapur districts, orange is being cultivated on large scale. The area under orange in Madhya Pradesh is about 38,300 ha and production is 6,77,800 MT with productivity of 17.7 MT/ha (Anonymons, 2012).

Orange is quite popular as it has a greater variety of beverage. It is also used for industrial and medicinal purpose due to its attractive colour, distinctive flavour and being rich source of vitamin 'C', vitamin 'B', ß-carotene, calcium and phosphorus. Orange juice turns bitter after extraction due to conversion of a chemical compound limonite-a-ring lactone (non-bitter) to limonin (bitter compound) during storage (Premi *et al.*, 1994) and makes the processing of this fruit limited. For improving the taste, aroma, palatability, nutritive value and reducing bitterness orange juice was blended with some other highly nutritive fruit juices namely pomegranate and aonla juice with spice extracts like ginger. The utilization of these fruits for preparation of various processed product become limited, despite their high nutritional qualities. The blending of two or more fruit juices with spices extract for preparation of nutritive RTS beverages is thought to be a convenient and economic alternative for utilization of these fruits. Sandhu and Sindhu (1992), Saxena *et al*. (1996), Attri *et al.* (1998), Langthasa (1999), Deka (2000), Deka and Sethi (2001) reported that two or more fruits juice/pulp may be blended in various proportions for the preparation of nectar, RTS beverages etc. the blending of juice may also improve aroma, taste and nutrients of beverages.

The present study was carried out to develop value added blended RTS beverages of orange with aonla, pomegranate and ginger. The production of new product is necessary for the survival and growth of the processing industry, to meet new taste and demand in home as well as in export market. Hence, there is an urgent need to develop some suitable technologies for the preparation of orange based blended RTS beverages which are economical and can be made available to a large population. In India soft drink have a good demand throughout the year traditionally, our country has been well known for offering syrup or sharbat.

Looking to the demand of natural beverages, there is great scope for the preparation of juices and other fruit based beverages. RTS is a type of fruit beverage containing at least fruit juice (10%), total soluble solids (10%) and acidity (0.3%) (F.P.O.1955). RTS can be prepared from the clarified juice of orange. However, the problem encountered during processing is development of bitterness. The juice of two or more juices helps in utilization of astringent and too acidic fruits like lime, sour palm, sour cherry, etc. these fruits and spice are also famous for excellent quality with pleasant flavor, rich in sugar, vitamin-C and minerals. Therefore, keeping the above facts in view the studies on bio-chemical composition of orange based blended ready-to-serve (RTS) beverages were conducted.

MATERIAL AND METHODS

The study was carried out in the Department of Post Harvest Management, K.N.K. College of Horticulture, Mandsaur (M.P.) during the year 2011-2012. Fresh, fully mature and uniform fruits of orange were taken from the farmer's orchard and used for experimentation. The immature, brownish, damaged and off type fruits were discarded. Whereas fruits of, pomegranate, aonla and ginger were purchased from local market. Fruits free from mechanical injury and disease were selected for the study. The selected fruits were washed with tap water to remove dirt and dust particles adhering to the surface of fruit and were allowed to surface dry. Their individual juice was extracted by spiral coil type juice extractor machine and blended as per recipe treatment.

The experiment comprised of nine treatment combinations consisting four level of juice (orange juice, pomegranate juice, aonla juice and ginger juice) and two level of preservative (750 ppm + 500 ppm KMS). The details of various treatment combinations are presented in Table 1.

PREPARATION OF ORANGE BASED BLENDED READY-TO-SERVE (RTS) BEVERAGES

After extraction of juice from all the fruits its total soluble solids (TSS) and acidity were measured. Then according to different recipe treatment, the quantity of juice, sugar, citric acid, preservative (KMS) and water were calculated. For the preparation of orange based blended RTS beverage of different recipe, syrup of sugar, water and citric acid was prepared. The prepared orange based blended RTS beverage filled in clean sterilized plas-

TABLE 1: Detail of treatment combinations.

S.N.	Treatment combinations	Symbols
1.	Control (100% orange juice with 750 ppm KMS)	T-0
2.	Orang Orange-aonla-ginger (90:10:0 with 750 ppm KMS)	T-1
3.	Orange-aonla-ginger (86:10:4 with 750 ppm KMS)	T-2
4.	Orange-pomegranate-ginger (90:10:0 with 750 ppm KMS)	T-3
5.	Orange-pomegranate-ginger (86:10:4 with 750 ppm KMS)	T-4
6.	Orange-aonla-ginger (90:10:0 with 500 ppm KMS)	T-5
7.	Orange- aonla-ginger (86:10:4 with 500 ppm KMS)	T-6
8.	Orange-pomegranate-ginger (90:10:0 with 500 ppm KMS)	T-7
9.	Orange-pomegranate-ginger (86:10:4 with 500 ppm KMS)	T-8

tics bottle of 200 ml capacity. Prepared orange based blended RTS beverage bottle were stored in dries place at ambient temperature (Room temperature).The Flow chart for the preparation of orange based blended RTS beverages is shown in Plate 1.

The observation on different chemical characteristics of orange based RTS beverage viz., TSS, acidity, ascorbic acid, reducing sugars, non-reducing sugars, total sugars and pH were recorded at an interval of 30 days up to 90 days of storage. The data were analyzed statistically through ANOVA using CRD factorial design.

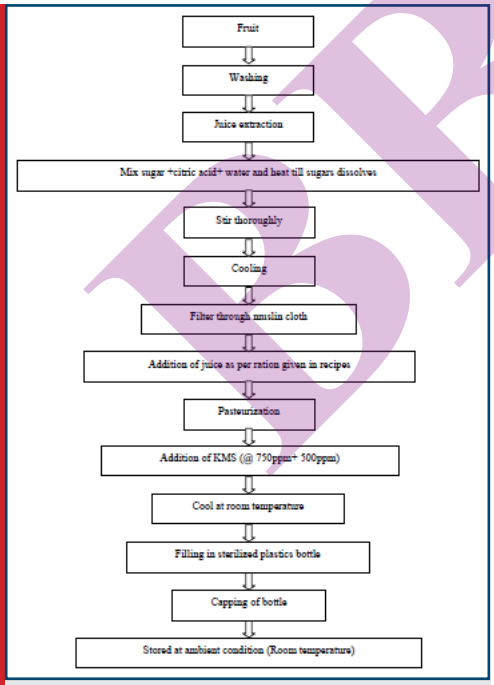

PLATE 1: Flow chart for the preparation of orange based blended RTS beverages.
(Source: Larmond, 1982 and Nitu *et al.*, 2010).

RESULTS AND DISCUSSION

The TSS content of orange based blended RTS beverages increased apparently during storage, which is possibly due to hydrolysis of polysaccharides (starch) into monosaccharide (sugars) and concentration of orange based blended RTS beverage due to dehydration. The minimum rate of increase in TSS during storage period is desirable for good quality RTS. On the 90th day of storage the minimum changes in TSS content was observed in T-4 (1.04°Brix) treatment whereas maximum in T-3 (3.22°Brix) treatment. The treatments found to be non-significant at the end period (90th day) of storage (Table 2). A similar increase in TSS content with the increase in storage period was observed in juice of mandarin, sweet orange and lemon (Mehta and Bajaj, 1983) and by Palainswamy and Muthukrishanan (1974) in lemon juice, Godara and Pareek (1985) reported an increasing trend in date palm RTS beverage and guava beverage (Baramanray *et al.*, 1995 and Pandy, 2004).

The changes in acidity of RTS beverage during storage as affected by recipe and treatment combinations during storage. The decrease in acidity observed during storage of orange based blended RTS beverages could be attributed to the chemical interaction between the organic constituents of orange based blended RTS beverage affected by the temperature and action of enzymes. At the end of storage period the maximum acidity was observed in T-0 (0.60%) treatment whereas minimum in T-8 (0.43%) treatment (Table 2). Similar findings were also observed by Negy and Manjrekar (1976) in apple cider, Kannan and Thirumran (2004) in jamun RTS, squash, syrup and jam, Bansal and Dhawan (1993) in lemone juice, Verma and Gehlot (2007) in bael RTS, Reddy and Chikkasubbanna (2008) in lime blended aonla squash during storage of 90 days.

Ascorbic acid content of orange based blended RTS beverages decreased with the advancement of storage

TABLE 2: Effect of recipe treatments on bio-checmical parameters of orange based blended RTS beverages during storage.

Parameter	Storage Period (days)	Recipe Treatments										
		T-0	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	SEm ±	CD at 5%
TSS (°Brix)	0	10.17	11.37	11.40	11.80	11.99	11.52	11.50	11.84	11.90	0.038	0.112
	30	11.09	11.63	11.69	12.13	12.05	12.22	12.08	12.29	12.19	0.113	0.335
	60	12.23	12.48	12.58	12.90	12.22	12.46	12.55	12.88	12.29	0.135	0.402
	90	13.39	13.37	13.47	13.53	13.03	13.45	13.40	13.47	13.13	0.164	NS
Acidity Content (%)	0	0.85	0.79	0.79	0.72	0.72	0.79	0.79	0.71	0.72	0.003	0.010
	30	0.72	0.73	0.74	0.69	0.69	0.74	0.73	0.67	0.69	0.010	0.031
	60	0.65	0.63	0.64	0.58	0.58	0.63	0.63	0.57	0.58	0.010	0.029
	90	0.60	0.55	0.55	0.48	0.47	0.55	0.56	0.47	0.43	0.015	0.044
Ascorbic Acid Content (mg/100ml)	0	21.28	45.69	45.68	18.95	18.38	41.87	45.61	19.20	18.95	0.155	0.460
	30	20.18	42.28	42.79	18.15	17.93	39.44	41.43	19.07	16.95	0.288	0.856
	60	17.17	37.98	40.09	15.70	14.26	36.09	38.25	16.30	13.23	0.408	1.213
	90	13.90	34.93	36.77	12.97	12.48	33.34	35.10	13.18	10.58	0.408	1.211
Reducing Sugar Content (%)	0	6.72	6.54	6.82	6.85	7.58	6.68	6.81	7.58	7.52	0.005	0.014
	30	7.18	6.87	7.55	7.19	7.79	7.65	7.55	8.10	7.80	0.010	0.030
	60	8.15	7.77	8.20	8.21	8.25	7.79	8.18	8.19	8.24	0.029	0.087
	90	8.24	8.37	8.38	8.28	8.41	8.36	8.36	8.26	8.40	0.019	0.057
Non-reducing Sugar Content (%)	0	2.30	2.39	1.88	2.37	2.22	1.89	1.86	1.71	2.30	0.017	0.049
	30	2.32	2.38	1.93	2.32	2.26	1.92	1.89	1.78	2.25	0.023	0.069
	60	2.32	2.38	2.21	2.34	2.40	2.37	2.20	2.19	2.33	0.021	0.064
	90	2.33	2.39	2.29	2.35	2.43	2.38	2.44	2.29	2.37	0.060	NS
Total Sugar Content (%)	0	9.03	8.93	8.70	9.22	9.80	8.57	8.67	9.29	9.82	0.017	0.050
	30	9.49	9.25	9.48	9.51	10.05	9.56	9.44	9.88	10.05	0.025	0.074
	60	10.47	10.16	10.40	10.55	10.64	10.15	10.38	10.37	10.57	0.029	0.085
	90	10.57	10.76	10.67	10.62	10.83	10.74	10.81	10.55	10.77	0.070	NS
pH	0	3.27	3.77	3.93	3.65	3.86	3.72	3.62	3.72	3.57	0.038	0.114
	30	3.17	3.75	3.92	3.63	3.83	3.57	3.58	3.70	3.53	0.062	0.184
	60	2.95	3.55	3.70	3.43	3.63	3.52	3.43	3.50	3.43	0.052	0.154
	90	2.93	3.46	3.59	3.38	3.61	3.41	3.31	3.44	3.38	0.050	0.150

period because the ascorbic acid is very sensitive to oxidation. This loss of ascorbic acid might be due to the oxidation or irreversible 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 plastics bottles during storage, such losses can minimized by eliminating air during bottle filling and handling as suggested by Johnson and Toledo (1975). Different recipe and treatment combinations were also found significant effect on ascorbic acid content of orange based blended RTS beverage during the entire storage period. At the end of storage period (90th day), the maximum ascorbic acid content was observed in T-2 (36.77mg/100ml) treatment whereas minimum in T-8(10.58mg/100ml) treatment (Table 2).

Loss in ascorbic acid content was also observed by Smooth and Negy (1980) in grape fruit juice, Sharma *et al.* (1981) in kinnow mandarin juice stored at room temperature over a period of 28 weeks compared to low temperature, Rabbani (1992) in mango beverages, Pandy and Singh (1999) in guava beverage, Kaul and Saini (2000) in kagzi lime juice during storage.

The increase in reducing sugars with the advancement of storage period in all the treatments could be

attributed to gradual inversion of non-reducing sugars into reducing sugars in acidic medium. The reducing sugars content increased gradually with the increasing period of storage. On the 90th day of storage highest reducing sugars was recorded in T-4 (8.41%) treatment whereas lowest reducing sugars was recorded in T-0 (8.24%) treatment (Table 2). These results are in confirmation with findings of Ranote and Bains (1982) in kinnow juice, Narayanan *et al*. (2002) in clarified banana RTS, Murtaza *et al*. (2004) in strawberry drinks stored at different temperatures.

The results showed a progressive and marked increase in total sugars content throughout the storage period. The increase in total sugars might be due to the hydrolysis of polysaccharides like pectin, cellulose, starch, etc. and its conversion into simple sugars. The total sugars content increased significantly upto 60th day and found non-significant at end of storage. On the 90th days of storage highest total sugars were recorded in T-4 (10.83%) treatment whereas lowest total sugars were recorded in T-7 (10.55%) treatment (Table 2). These results are in conformity with the results obtained by Roy and Singh (1979) in juice of mandarin and Narayanan *et al*. (2002) in enzyme clarified banana RTS. Sharma *et al*. (2004) found increase in total sugars during storage in foam mat dried hill lemon juice powder. Similar, results have also been reported by Poonam and Tandon (2007) in guava-aonla blended RTS beverage and by Verma and Gehlot (2007) in bael RTS.

The result indicated that the pH of orange based blended RTS beverages decreased with increased period of storage in all the treatments which might have resulted due to corresponding decrease in acidity. The treatment had a significant effect on pH content of orange based blended RTS beverage during entire period of storage. At the end of storage period the maximum pH content was observed in T-4 (3.61) treatment whereas minimum was observed in T-0 (2.93) treatment (Table 2). Changes in pH during storage was observed by Khurdiya (1980) in dried ber juice, Shrestha and Bhatia (1982) in apple juice, Rao and Krishnamurthy (1982) tomato crush, Doodnath and Badriel (2000) in watermelon nectars, Krishnaveni *et al*., (2001) in jack fruit RTS beverage and Murtaza *et al*., (2004) in strawberry drinks.

CONCLUSION

Data pertaining to the effect of recipe and storage period on bio-chemical changes of orange based blended RTS beverages (TSS, acidity, ascorbic acid, reducing sugars, non-reducing sugars, total sugars and pH) during storage were recorded at 30 days interval upto 90th day. On the basis of results obtained in the study it can be concluded that most of the bio-chemical characteristics of orange based blended RTS beverages were significantly influenced by different recipe treatments and storage period. The treatment T-4 (Orange-pomegranate-ginger (86:10:4) with 750 ppm KMS) was found best with regard to most of the chemical characteristics viz., TSS, reducing sugars, total sugars and pH throughout the storage period upto 90th days.

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