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Effect of various recipes on chemical characteristics of mango RTS

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Abstract
The present investigation was carried out at the Post Harvest laboratory of the Department of Horticulture, College of Agriculture, JNKVV Jabalpur (M.P) during the year 2014-15. The experiment comprised of 12 treatment combinations consisting of 3 levels of sugar, 2 levels of citric acid and two cultivars of mango (Totapuri & Neelum). The chemical characteristics (TSS, Acidity, TSS Acid Ratio, pH and Ascorbic acid) of mango RTS was evaluated. Effect of total soluble solid with various recipes (1 to 3) with 100g, 120g, 140g, of sugar + 0.50g, 0.75g of citric acid per liter of RTS also persisted for 80 days of storage, percent of acidity was increased in accordance with the increasing storage period gradually up to 80 days of storage affected the highest (%) acidity (0.079) was recorded with the recipe 2nd, The maximum value of TSS acid ratio (382.85) was registered with the recipe 11th (0.50g citric acid + 120g sugar per liter of RTS) in Totapuri variety and it was resulted with the increasing quantity of sugar in all the treatments, the maximum pH (4.84) was recorded with RTS of 11th recipe and The value of ascorbic acid content (26.00g/100ml of RTS) was recorded slightly more with RTS of recipe 4th. This might be due to less sugar and high citric acid content, acidity and different variety.

Keywords: RTS, Totapuri, Neelum, TSS, acidity, pH

Introduction
Mango (*Mangifera indica* L.) is the most important and commercially cultivated fruit crop belongs to the Family Anacardiaceae. It is originated in South Asia mainly Indo-Burma region. Mango was introduced in Jamica around 1782. In 1869 grafted mango trees were taken to florida from India. Mango was introduced in Israel in 1929 through seed brought from Egypt. The cultivars grown in India are Amrapali, Mallika. Langra, Dashehari, Chausa, Totapuri, Alphonso, Sunderja, Bombay green etc. This fruit occupies an important place in the Horticultural wealth of our nation and ranks second with respect to area and production (NHB, Database 2012-2013). It is commercially cultivated in different states, viz. Utter Pradesh, Andhra Pradesh, Karnaataka, Bihar, Gujrat, Tamilnadu, Orissa, West Bengal, Jharkhand, Maharashtra, Kerala, and M.P. and together contribute for about 93% of the total production in india. The total mango production of India is 18002.4 thousand MT with an area of 2500.0 thousand hectares and average productivity of 7.2 MT ha^{-1} fruit per year in (2012-13), whereas, in Madhya Pradesh it is grown in 25.8 thousand ha area with an annual production of 376.00 thousand MT with productivity of 14.2 MT ha^{-1}. The fruit is rich in pre-biotic dietary fiber, vitamins, minerals, and poly-phenolic flavonoid antioxidant compounds. According to new research study, mango fruit has been found to protect against colon, breast, leukemia and prostate cancers. Several trial studies suggest that polyphenolic antioxidant compounds in mango are known to offer protection against breast and colon cancers. Mango fruit is an excellent source of Vitamin-A and flavonoids like beta-carotene, alpha-carotene, and beta-cryptoxanthin. 100 g of fresh fruit provides 765 mg or 25% of recommended daily levels of vitamin A. Together, these compounds are known to have antioxidant properties and are essential for vision.

Fresh mango is a good source of potassium. 100 g fruit provides 156 mg of potassium while just 2 mg of sodium. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure. It is also a very good source of vitamin-B_6 (pyridoxine), vitamin-C and vitamin-E. Consumption of foods rich in vitamin C helps the body develop resistance against infectious agents and scavenge harmful oxygen-free radicals. Vitamin B_6 or pyridoxine is required for GABA hormone production within the brain.

mango peel is also rich in phytonutrients, such as the pigment antioxidants like carotenoids and polyphenols The fresh fruits of mango have limited shelf life. Therefore, it is necessary to utilize the fruit for making different products to increase its availability over an extended period and to stabilize the price during the glut season. Mango can be consumed fresh or can be processed into juice, nectar, pulp, jam, jelly, slices, syrup, fruit bar or dehydrated products, as well as being used as an additive to other fruit juices or pulps. These products have good potential for internal as well as external trade. The utilization of mango for preparation of beverages and intermediates moisture products has not been explored much and mango pulp can be used as base for the preparation of these products. In the food industry, knowledge of the physical properties of food is fundamental in analysing the unit operations. They influence the treatment received during the processing and are good indicators of other properties as well as the qualities of food. These are beneficial the producer, industry and the consumer (Ramos and Ibarz, 1998).

Method and Material

The present investigation was conducted during the year 2014-15 was carried out in the Post-Harvest Laboratory, Department of Horticulture, JNKVV, Jabalpur **(**M.P.). The fresh and uniform size mature fruits of mango (cv. Totapuri & Neelum) were procured during the summer season (2014) from the whole sale fruit market and used for experimentation. The unripe, diseased, damaged and off type fruits were discarded. The experiment comprised of 12 treatment combinations consisting of 3 levels of sugar, 2 levels of citric acid and two cultivars of mango (Totapuri & Neelum). The details of various treatments and their combinations are

Details of treatment combinations

Treatment Symbols	Treatment Combinations	Treatment details
T_1	P_1R_1	10% Pulp + 100g sugar + 0.50g Citric acid / litre
T_2	P_1R_2	10% Pulp + 100 g sugar + 0.75g Citric acid / litre
T_3	P_1R_3	10% Pulp + 120 g sugar+0.50 g citric acid / litre
T_4	P_1R_4	10% Pulp + 120 g sugar+0.75 g citric acid / litre
T_5	P_1R_5	10% Pulp + 140 g sugar+0.50 g citric acid / litre
T_6	P_1R_6	10% Pulp +140 g sugar+0.75 g citric acid / litre
T_7	P_2R_1	10% Pulp + 100g sugar + 0.50g Citric acid / litre
T_8	P_2R_2	10% Pulp +100 g sugar + 0.75g Citric acid / litre
T_9	P_2R_3	10% Pulp +120 g sugar+0.50 g citric acid / litre
T_{10}	P_2R_4	10% Pulp +120 g sugar+0.75 g citric acid / litre
T_{11}	P_2R_5	10% Pulp +140 g sugar+0.50 g citric acid / litre
T_{12}	P_2R_8	10% Pulp +140 g sugar+0.75 g citric acid / litre

Extraction of pulp

The fruits were padded with the help of stainless steel knife, then some quantity of water was added with trats and steamed for pulp preparation. The steamed pulp was prepared with the help of mixer cum grinder and the fiber and other pulp waste were separated with stainless steel sieve.

Procedure for preparation of RTS

The extracted pulp was used for the preparation of mango RTS. The required quantity of pulp was added to measured quality of water and grinded sugar, citric acid were also added to it. In all the twelve treatments similar method was used (as per ratio of pulp, quantity of sugar & citric acid in each treatments as given in the table). The pulp and sugar was mixed thoroughly and heated up to 65°C to dissolve it properly. It was homogenized with juicer cum mixture and then strained with muslin cloth to remove impurities if any. The sodium benzoate @ 700 ppm was used as preservative for the prepared RTS. The RTS was than filled in sterilized glass bottles (200ml capacity) and sealed with crown cork.

Physico-chemical analysis

The present investigation was carried out in the Post-Harvest Laboratory, Department of Horticulture, JNKVV, Jabalpur **(**M.P.) the composition of fruits, prepared pulp and prepared RTS was evaluated for various physic-chemical properties like Fruit colour, texture, fruit wt., fruit diameter, wt. of pulp, wt. of peel, pulp stone ratio, wt. of stone, pulp colour, TSS, acidity, ascorbic acid and pH etc. By Panse and Sukhatme, (1967) Ascorbic acid and acidity as per the standard method suggested by Rangann, (2000).

Result and Discussion

Quality evaluation of fruit and fruit pulp of mango

The physico-chemical characteristics of mango fruits of totapuri & Neelum cultivars were also recorded. It was noted that the fruit colour was golden & greenish yellow from outside with attractive Cadimum-yellow & dark yellow pulp respectively. The fruit was firm, fibreless texture and long shape. It is also clear from Table 4.1 that the TSS (%) is 14.05, 16.3 acidity (%) is 0.30, 0.24 & and ascorbic acid content recorded 34, 18.70 mg/100g of pulp of Totapuri and Neelam respectively. Similar findings were also reported by other workers (Manchekar *et al*. 2011, Singh *et al*. 2010 and Roshan *et al*. 2013) [6, 11].

The sensory evaluation indicates the physical parameters of the pulp. The better organoleptic rating consists with general appearance, in Totapuri variety have yellow colour, excellent flavour, moderately sweet in taste and good texture, similarily in Neelum variety have bright yellow colour, exxelent flavour, sweet in test and good texture of the pulp of fruits. It is revealed from the data presented in Table 4.2. in both variety (Totapuri & Neelum) (%) TSS of pulp was observed (14.9 & 18.3) Similar finding were reported by Singh *et al*. (2010), (%) Acidity was observed (0.35 & 0.24) similar finding were also reported by Chalke *et al*. (2012) [1] with pulp of two mango varieties. Ascorbic acid content was observed (28.5 & 15.30 mg / 100g of pulp) and PH of fruit pulp was 3.64 & 3.85.

TSS (%)

The result obtained from the present investigation revealed that the higher concentration of sugar and lower concentration of citric acid increased the TSS per cent of mango RTS and this effect was observed up to 80 days of storage. Similar, effect of sugar contents with various recipes (1 to 3) with 100g, 120g, 140g, of sugar + 0.50g, 0.75g of citric acid per liter of RTS also persisted for 60 days of storage. These findings are in confirmation with the findings of Kumari and sandal (2011) [4] who reported a decreasing trend in TSS of mango RTS during 70 days of storage. Dattatreya *et al*. (2012) [2] reported that TSS of mango pulp increases with the increasing storage period (60 days). The reason assigned for the increased TSS content in pulp during storage might be due to the conversion of left polysaccharide into soluble sugar. However, there increasing trend in TSS content was recorded in all the recipes up to 60 days of storage after which a gradual decrease in TSS value was noticed up to 80 days of storage. These decreases in TSS value might be due to the conversion of sugars. Similar findings were reported by Mishra *et al*. (2013) [6], Tandon *et al.* (2010) [16]. Whereas, Ali *et al*. (2011) also reported that the gradual increase in TSS, titrable acidity, reducing sugars and total sugars while ascorbic acid content and consumer acceptance decreased during 80 days of storage. Saravanan *et al.* (2004) [12] reported increase in TSS of papaya jam during storage which might be due to solubilisation of pulp constituents during storage hydrolysis of polysaccharides. Singh *et al*. (2013) [14] revealed that during storage of the Mango Jam, TSS increased up to 3 months.

Acidity (%)

As per the result recorded for the % acidity value, the observations revealed that the order of % acidity was increased in accordance with the increasing storage period gradually up to 80 days of storage. Similar trend was observed with the increasing pulp content with the RTS. Higher, values were recorded for % acidity with 0.75g citric acid content as compared to 0.50g citric acid added to RTS. The quantity of sugar added to RTS and varietal difference also affected the % acidity and the highest (%) acidity (0.079) was recorded with the recipe 2nd. These findings are in confirmation with the findings of Kumari and Sandal, (2011) [4] who observed that there was gradual increase in acidity values with an increase in the storage period in mango RTS. The increase in acidity in RTS during 80 days of storage might be due to formation of organic acid by ascorbic acid degradation as well as progressive decrease in pectin content. Datey, Rabbani (1989) [9] indicated that there was an increase in titratable acidity and reducing sugar and a decrease in pH and ascorbic acid with the advancement of storage period. Similar results were also reported by Zambare *et al.* (2009) [17] with wood apple RTS beverage.

Tss/Acid Ratio

The results presented in Table 4.9 clearly indicate that TSS/Acid ratio was influenced by various treatments and it was noticed that reduction in TSS/Acid ratio was continuous at every stage of periodic observations up to 80 days storage and this reduction was highly significant. Further, it was observed that the TSS/Acid ratio was also influenced by the various recipes used for preparation of the RTS. The maximum value (382.85) was registered with the recipe 11th (0.50g citric acid + 120g sugar per liter of RTS) in Totapuri variety and it was resulted with the increasing quantity of sugar in all the treatments. This might be due to increased quantity of sugar and lower quantity of citric acid which directly correlated with the TSS/Acid ratio of mango RTS as influenced by quantity of sugar added with different variety. These findings are in conformation with those as reported by Singh, *et al.,* (2007) [15] who reported that there was decrease in quality characters of mango + bael beverage with the advance storage period but it remained above the acceptable rating even after 6 months of storage. Similar findings have been reported by (Pandey 2004 and Sharma *et al*. 2008) [8, 13].

pH

The pH value of a product plays an important role in preservation of pulp. Lowering of pH value is the result of increased acidity. The low pH inhibits the activity of microorganism specially the bacteria. The data presented in Table 4.10 revealed that an overall pH value was observed during the study period less than 7.0 i.e., acidic. However, the pH value recorded at initial period of storage (0 days) was higher in all the recipes and the maximum (4.84) was recorded with RTS of 11th recipe. It was also revealed that pH values were increased with the increase in ratio of citric acid and also with the higher concentration of sugar with different cultivar. Moreover, the pH value also reduced as the storage period increased in all the recipes. These results supported by the results obtained by Zambare *et al* (2009) [17] also reported the slight decrease in pH value during 90 days storage of mango pulp. Zambare *et al.* (2009) [17] reported that the acidity of the samples increased while the pH of the samples decreased as the storage period increase. This might be due to the formation of organic acid by ascorbic acid degradation. Nilugin *et al.* (2010) [7] and Rustagi *et al.* (2013) [11] also noticed that the pH decreased significantly during storage of aonla, mango RTS.

Ascorbic Acid

The data presented in table 4.11 revealed that the ascorbic acid content of RTS prepared from the mango cultivar had decreasing trend with an increase in the level of sugar content and acidity levels. The value of ascorbic acid content (26.00g/100ml of RTS) was recorded slightly more with RTS of recipe 4th. This might be due to less sugar and high citric acid content, acidity and different variety. An increase in sugar content (TSS) decreased the ascorbic acid value in different recipe of RTS. These findings are in conformation with reported by Singh *et al*. (2007) [15] who reported that there was decrease in ascorbic acid of guava and pineapple beverage with the 80 days storage period. Rustagi *et al.* (2013) [11] reported that there was gradual increase in total soluble solids, titrable acidity, reducing sugar and total sugar while, ascorbic acid content decreased it might be due to oxidation of the content. during 80 days of storage. Similar findings have been reported by other workers (Harnanan *et al*. 1980, Chalke *et al*. 2012 and Kumar *et al*. 2013) [3, 1, 11].

Table 1: Effect of recipes and storage period on the TSS (%) of mango RTS

Recipies (Factor B)	Cultivar(factor A)														
	0 days			20 days			40 days			60 days			80 days		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
1	9.23	12.11	10.67	10.12	13.32	11.75	11.18	14.83	12.86	12.29	15.75	14.02	11.05	13.94	12.50
2	8.95	11.90	10.42	9.90	12.97	11.44	10.75	13.85	12.30	11.55	14.62	13.08	11.25	12.63	11.39
3	10.40	13.25	11.82	11.49	13.55	12.52	12.63	14.65	13.64	13.85	15.96	14.90	11.97	14.32	13.14
4	10.14	13.03	11.59	10.72	14.05	12.38	11.92	15.25	13.58	12.97	16.25	14.51	11.90	14.78	12.84
5	10.26	13.40	11.83	12.06	14.60	13.33	13.25	16.05	14.65	14.45	17.30	15.87	12.73	16.05	14.39
6	9.97	13.17	11.57	10.88	14.08	12.48	11.38	14.31	12.85	12.82	15.82	14.32	11.06	14.65	12.85
Mean	9.82	12.81	11.31	10.87	13.76	12.32	11.83	14.79	13.31	12.95	15.96	14.46	11.31	14.39	12.85
Factor	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B
$SE_m \pm$	0.010	0.017	0.024	0.013	0.022	0.031	0.009	0.016	0.022	0.034	0.060	0.084	0.039	0.067	0.095
CD at 5% level	0.029	0.050	0.071	0.038	0.065	0.092	0.027	0.046	0.065	0.101	0.175	0.248	0.113	0.196	0.278

Table 2: Effect of recipes and storage period on the acidity (%) of mango RTS

Recipies(Factor B)	Cultivar(factor A)														
	0 days			20 days			40 days			60 days			80 days		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
1	0.059	0.071	0.065	0.072	0.083	0.077	0.081	0.094	0.086	0.092	0.108	0.100	0.105	0.117	0.111
2	0.079	0.064	0.049	0.090	0.077	0.064	0.104	0.087	0.075	0.121	0.097	0.085	0.115	0.116	0.114
3	0.056	0.069	0.063	0.068	0.081	0.074	0.078	0.091	0.084	0.088	0.103	0.096	0.109	0.117	0.113
4	0.065	0.044	0.055	0.074	0.058	0.066	0.082	0.067	0.085	0.094	0.077	0.086	0.133	0.095	0.102
5	0.065	0.035	0.050	0.076	0.052	0.083	0.088	0.062	0.096	0.098	0.073	0.106	0.111	0.092	0.105
6	0.053	0.070	0.072	0.067	0.079	0.073	0.078	0.089	0.084	0.090	0.098	0.094	0.105	0.118	0.112
Mean	0.052	0.070	0.061	0.066	0.081	0.072	0.075	0.091	0.085	0.086	0.103	0.094	0.103	0.119	0.112
Factor	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B
$SE_m \pm$	0.001	0.001	0.002	0.001	0.001	0.002	0.001	0.002	0.003	0.000	0.001	0.001	0.001	0.001	0.002
CD at 5% level	0.002	0.004	0.005	0.002	0.003	0.004	0.001	0.002	0.003	0.001	0.002	0.003	0.002	0.004	0.006

Table 3: Effect of storage period and blend ratio on the TSS/Acid ratio of mango RTS

Recipes (Factor B)	Cultivar (factor A)														
	0 days			20 days			40 days			60 days			80 days		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
1	154.48	158.69	162.52	141.38	155.48	150.93	136.54	149.76	147.15	133.58	145.83	139.70	105.23	119.14	112.18
2	128.35	185.93	161.81	119.11	168.44	151.11	110.37	159.19	145.14	107.19	150.72	136.79	92.47	108.87	105.11
3	185.71	192.02	188.86	168.97	167.28	168.12	161.92	160.98	161.45	157.38	154.95	156.16	109.81	122.39	116.10
4	137.69	295.30	211.82	133.78	242.24	180.67	131.09	227.94	169.15	122.87	177.69	142.44	101.35	155.23	123.85
5	157.84	382.66	270.25	153.68	304.16	231.42	150.56	258.87	204.71	147.43	236.98	192.20	110.49	174.45	142.47
6	188.11	188.14	188.12	162.38	178.22	170.30	148.89	160.78	154.83	142.77	156.32	149.54	105.33	124.15	114.74
MEAN	158.69	235.77		147.38	203.47		139.895	187.58		135.20	170.41		104.11	134.03	
Factor	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B
$SE_m \pm$	0.700	1.212	1.715	1.204	2.085	2.949	1.050	1.819	2.573	4.253	7.366	10.417	0.711	1.232	1.743
CD at 5% level	2.055	3.560	5.034	3.534	6.122	8.658	3.084	5.342	7.555	12.486	21.627	30.586	2.089	3.618	5.117

Table 4: Effect of recipes and storage period on the P^H of mango RTS

Recipies (Factor B)	Cultivar(factor A)														
	0 days			20 days			40 days			60 days			80 days		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
1	4.50	4.77	4.63	4.25	4.43	4.34	4.05	4.19	4.12	3.89	4.02	3.96	4.06	4.20	4.13
2	4.30	4.58	4.44	4.05	4.32	4.18	3.91	4.13	4.02	3.66	3.90	3.78	3.96	4.15	4.05
3	4.43	4.71	4.57	4.28	4.46	4.37	4.03	4.15	4.09	3.80	3.94	3.87	4.07	4.20	4.13
4	4.36	4.51	4.43	4.10	4.20	4.15	3.97	4.08	4.02	3.70	3.75	3.75	3.87	3.94	3.90
5	4.60	4.84	4.72	4.15	4.55	4.35	4.01	4.28	4.15	3.88	3.97	3.97	4.13	4.29	4.21
6	4.31	4.35	4.33	4.13	4.05	4.09	3.94	3.94	3.94	3.70	3.70	3.70	4.03	3.99	4.01
Mean	4.41	4.62	4.52	4.16	4.33	4.25	3.98	4.13	3.8	3.77	3.90	3.68	4.02	4.13	4.07
Factor	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B
$SE_m \pm$	0.012	0.021	0.030	0.010	0.017	0.024	0.010	0.018	0.025	0.010	0.017	0.024	0.013	0.023	0.033
CD at 5% level	0.036	0.063	0.089	0.029	0.050	0.071	0.030	0.053	0.074	0.029	0.051	0.072	0.039	0.068	0.096

Table 5: Effect of storage period and blend ratio on the Ascorbic acid of mango RTS

Recipies (Factor B)	Cultivar(factor A)														
	0 days			20 days			40 days			60 days			80 days		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
1	19.85	15.55	17.70	17.58	14.11	15.84	15.80	12.98	14.39	13.88	12.02	12.95	11.38	10.04	10.71
2	24.56	17.46	21.01	22.81	15.77	19.29	21.257	13.84	17.54	19.77	12.36	16.06	16.97	10.69	13.83
3	23.09	14.75	18.92	21.87	13.31	17.59	19.827	12.42	16.12	18.32	11.08	14.70	16.56	9.78	13.17
4	26.00	16.71	21.36	24.24	15.14	19.69	22.970	13.95	18.46	20.52	12.63	16.57	18.80	11.01	14.90
5	18.75	12.22	15.48	16.50	11.16	13.83	15.157	10.03	12.59	13.85	9.233	11.54	12.77	7.55	10.16
6	22.84	13.88	18.36	21.21	12.08	16.65	19.510	13.04	16.27	18.05	11.83	14.94	16.79	9.64	13.21
Mean	22.51	15.09	18.80	20.70	13.59	17.15	19.087	12.71	15.82	17.39	11.52	14.46	15.55	9.78	
Factor	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B
$SE_m \pm$	0.056	0.097	0.138	0.043	0.075	0.106	0.035	0.060	0.085	0.050	0.087	0.123	0.086	0.149	0.211
CD at 5% level	0.165	0.286	0.404	0.127	0.220	0.311	0.102	0.177	0.250	0.147	0.255	0.360	0.253	0.438	0.620

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