Development and evaluation of honey based mango nectar

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Abstract Honey enriched mango nectar was prepared by using honey as sweetening agent because of its high fructose and glucose content and medicinal properties. The nectar having 20 % pulp, 15°B TSS and 0.30 % acidity was prepared, filled in pre-sterilized glass bottles, heat processed and stored up to 6 months under ambient (13.3–26.3 °C and 44.5–81.0 % RH) and refrigerated (4–7 °C and 73 % RH) conditions. The honey enriched mango nectar could be stored for 6 months at ambient temperature and low temperature storage conditions and only little changes in the quality parameters viz., TSS, titratable acidity, ascorbic acid, total and reducing sugars, carotenoids and hydroxymethylfurfural (HMF) were recorded as compared to sugar based nectar. These changes were more under ambient conditions than refrigerated and no microbial growth was found in nectars at fresh stage and during storage up to 6 months. The hydroxymethylfurfural (HMF) content in the mango nectars increased with prolonged storage period. The mustard honey based mango nectar had the higher carotenoids content but this decreased (725.60–689.20 mg/100 ml) during storage up to 6 months under ambient storage conditions, whereas the decrease was less under refrigerated storage conditions. Organoleptic quality score was higher in mustard honey based mango nectar (6.8) as compared to sugar based mango nectar under refrigerated conditions after 6 months storage. The results indicated that the mustard honey based mango nectar stored at low temperature was acceptable with respect to colour, taste and overall acceptability without any microbial spoilage and could be marketed as health drink.

Keywords Mango pulp · Mango nectar and honey · HMF

Introduction

Mango (*Mangifera indica* L.) is one of the most important tropical fruit crops of India, often called as ‘king of fruits’ due to its attractive colour, succulence, taste and exotic flavor (Gehlot et al. 2007). Mango fruits possess strong aroma with intense peel colouration, characterized by attractive fragrance and high nutritional value, owing to higher amounts of β -carotene, vitamin C, minerals like calcium, iron and phosphorous. β -carotene is the main compound with pro-vitamin A activity. Carotenoids are compounds of great dietary importance not only as precursors of vitamin A, but also as molecules that take part in cell protection and consumer attraction due to the visual colour they provide to food. The characteristic colour of the mango skin and edible flesh is mostly due to the presence of carotenoids (Jadhav et al. 2009). The mango fruits are consumed both in the raw and processed state. Ripe mango is processed into a variety of products viz., mango nectar, squash, juice, jam, mango slices in sugar syrup (Sagar and Khurdiya 1998). Mango fruit beverages are highly nutritive, refreshing, thirst quenching, appetizing, easily digestible and nutritionally far superior to many synthetic and aerated drinks. The acceptability of fruit drinks/beverages is very much dependent on their physico-chemical properties including flavor (Deka et al. 2005). The sweetness of these beverages is generally due to the added sugar, but it can be replaced by honey because of high concentration of fructose and glucose monosaccharides. Honey is a rich, readily assimilable energy giving food. It also serves as a source of natural antioxidants which are effective in preventing deteriorative oxidation reactions in foods, inhibiting browning reactions in fruits and vegetables (Chen et al. 2000). So, honey can also be used as a substitute for sugar for making vitaminised and nutritious beverages and these beverages made with honey have a improved flavor and nutrition value than that of sugar products.

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Material and methods

Mango (*Mangifera indica* L.) fruits, irrespective of variety were purchased from local market. Fruits after sorting and washing were utilized for pulp extraction. The pulp was stored after pasteurization under refrigerated conditions for further use. Honey and sugar were analysed for different physico-chemical characteristics, like TSS, acidity, glucose-fructose ratio, sugars, moisture, total solids, ash content, pH and hydroxymethylfurfural content. The mustard honey based (T_1) and sugar based (T_2) mango fruit nectars were prepared by following the standard recipe (Fig. 1) as per Fruit Products Order specifications (1955). The prepared fruit nectars (Fig. 2)

were packed in sterilized glass bottles, corked and then processed for 25 min at 90 ± 2 °C. Further the fruit nectars were stored in 200 ml capacity glass bottles at two different temperatures viz., room temperature (13.3–26.3 °C and 44.5–81.0 % RH) and refrigerated temperature (4–7 °C and 73 % RH). The mango nectars were analysed for various physico-chemical, sensory and microbiological characteristics at periodic intervals of 0, 3 and 6 months.

Analysis The size parameters of fruits were recorded with the help of vernier caliper and expressed in cm, the average weight of fruits was taken by using a digital weighing balance and expressed in grams and the firmness (kg/cm^2)

Fig. 1 Flow sheet for preparation of fruit nectar

Fig. 2 Fresh mango nectar

was measured by using the Magness Tayler Pressure Tester (Gould 1978), the total soluble solid contents were determined by using ERMA hand refractometer and expressed as °Brix (Ranganna 2007), the titratable acidity of fruits, pulp and developed mango nectar was determined by titration method as per given in Ranganna (2007), while that of honey was determined by AOAC method (1984), reducing sugars and total sugars by Lane and Eyon method (Ranganna 2007), fructose-glucose ratio as per the method given in manual of methods of analysis of foods (GOI 2005), sulphur dioxide was determined by Ripper Titration method, Hydroxymethylfurfural and carotenoids by methods as reported in Ranganna (2007).

The sensory evaluation of fruit nectars was done (fresh as well as at different storage intervals) for scoring sensory qualities by a panel of 9–10 members at a time using a 9-point Hedonic scale on the basis of overall acceptability (Amerine et al. 1965). Total microbial examination of samples was made aseptically by standard plate count technique at fresh stage and during storage by using Yeast Extract Mannitol Agar (YEMA) media (Ranganna 2007). The data pertaining to the sensory evaluation of fruit nectars and physico-chemical characteristics of fruits and sweetening agents were analyzed according to Randomized Complete Block Design (RBD) as described by Mahony (1985) while the data on chemical characteristics of fruit nectars were analyzed statistically by following Completely Randomized Design (CRD) (Cochran and Cox 1967).

Results and discussion

Physico-chemical characteristics of fruit and pulp The physico-chemical characteristics of mango fruits and pulp after pasteurization are presented in Table 1. The total soluble

Table 1 Physico-chemical characteristics of mango fruit and pulp

Parameters	Mean ^a ± SE	
	Fruit	Pasteurized pulp
Fruit length (cm)	12.41±0.04	—
Fruit breadth (cm)	7.15±0.06	—
Fruit weight (g)	260.53±2.75	—
Specific gravity (g/cm)	1.79±0.03	—
Pressure (kg/cm ²)	0.62±0.02	—
TSS (°B)	17.05±0.14	15.08±0.08
Titratable acidity (%) [*]	0.35±0.02	0.32±0.03
Reducing sugars (%)	11.74±0.05	12.98±0.19
Total sugars (%)	16.65±0.02	14.95±0.28
Ascorbic acid (mg/100 g)	26.38±0.03	19.64±0.06
Carotenoids (µg/100 g)	4037.03±4.41	3744.80±3.84

^{*}As citric acid SE standard error ^a Means of 3 replicates

solids, total sugars, ascorbic acid and carotenoid content in mango fruits recorded were 17.05°B, 16.65 %, 26.38 % and 4037.03 µg/100 g, while that of mango pulp were 15.08°B, 14.95 %, 19.64 mg/100 g and 3744.80 µg/100 g respectively, which were in accordance with the findings of Bhuyan and Kobra (2007), Nandini and Oommen (2002), Jadhav et al. (2009) and Veda et al. (2007).

Physico-chemical characteristics of sweetening agents The data in Table 2 reveals that the total soluble solids of mustard

Table 2 Physico-chemical characteristics of sweetening agents (mustard honey and sugar)

Parameters	Sweetening agents (Mean ^b ± SE)	
	Mustard honey	Sugar
Total soluble solids(°B)	75.0±0.12	94.0±1.15
Free acid (m.eq/100 g)	2.12±0.13	—
Lactone (m.eq/100 g)	0.95±0.11	—
Total acid (m.eq/100 g)	3.07±1.09	—
pH	3.88±0.70	6.08±0.83
Reducing sugars (%)	63.72±1.28	4.48±0.76
Non-reducing sugars (%)	7.95±0.49	89.41±1.24
Total sugars (%)	71.67±1.19	93.79±1.82
Sulphur dioxide (ppm)	—	19.7±1.01
Hydroxymethylfurfural (ppm)	14.13±0.84	—
Fructose (%)	34.79±0.74	—
Glucose (%)	28.93±0.13	—
Fructose:glucose ratio	1.20±0.12	—

^b Means of 3 replicates SE standard error

honey was 75.0°B, which was less than the observations of Kaushik et al. (1993). The total acid and pH recorded were 3.07 milli equivalent/100 g and 3.88 respectively, which were well

with in the range as recorded by Singh et al. (1988). Mishra (1995) recorded the total and reducing sugars of honey which were near to the values recorded in the investigation. The

Table 3 Changes in quality characteristics of mango nectars during storage under different storage conditions

Parameters	Storage conditions (C)	Treatments (T)	Storage intervals (I) (months)				CD at 5 %			
			0	3	6	Mean	C	C×T	C×I	C×T×I
TSS(°B)	AT	T ₁	15.00	15.27	15.34	15.20	0.01	NS	0.02	NS
		T ₂	15.00	15.23	15.32	15.18				
		Mean	15.00	15.25	15.33	15.19				
	RT	T ₁	15.00	15.20	15.25	15.15				
		T ₂	15.00	15.18	15.26	15.15				
		Mean	15.00	15.19	15.26	15.15				
	AT	T ₁	0.30	0.29	0.26	0.28	NS	NS	NS	NS
		T ₂	0.31	0.26	0.25	0.27				
		Mean	0.31	0.28	0.26	0.28				
	RT	T ₁	0.30	0.29	0.27	0.29				
		T ₂	0.31	0.28	0.26	0.28				
		Mean	0.31	0.29	0.27	0.29				
Total sugars (%)	AT	T ₁	14.62	14.48	14.40	14.50	0.01	0.02	0.02	NS
		T ₂	14.57	14.51	14.46	14.51				
		Mean	14.60	14.50	14.43	14.51				
	RT	T ₁	14.62	14.57	14.50	14.60				
		T ₂	14.57	14.54	14.48	14.53				
		Mean	14.60	14.56	14.49	14.55				
	AT	T ₁	10.63	11.31	11.80	11.24	0.01	0.02	0.02	0.03
		T ₂	6.48	7.23	7.78	7.16				
		Mean	8.56	9.27	9.79	9.20				
	RT	T ₁	10.63	11.00	11.43	11.02				
		T ₂	6.48	7.09	7.51	7.02				
		Mean	8.56	9.04	9.47	9.02				
Ascorbic acid (mg/100 ml)	AT	T ₁	3.62	3.41	3.03	3.35	0.001	0.002	0.002	0.003
		T ₂	3.87	3.61	3.37	3.62				
		Mean	3.74	3.51	3.20	3.48				
	RT	T ₁	3.62	3.50	3.25	3.45				
		T ₂	3.87	3.69	3.47	3.68				
		Mean	3.74	3.59	3.36	3.56				
	AT	T ₁	725.60	713.40	689.20	709.40	1.50	NS	2.60	NS
		T ₂	722.30	710.60	683.40	705.43				
		Mean	723.95	712.00	686.30	707.42				
	RT	T ₁	725.60	719.70	696.00	713.76				
		T ₂	722.30	717.40	694.50	711.40				
		Mean	723.95	718.55	695.25	712.58				
Hydroxymethylfurfural (mg/100 ml)	AT	T ₁	0.100	0.180	0.200	0.160	NS	NS	NS	NS
		T ₂	0.041	0.044	0.053	0.046				
		Mean	0.070	0.112	0.126	0.103				
	RT	T ₁	0.100	0.170	0.190	0.150				
		T ₂	0.041	0.043	0.051	0.045				
		Mean	0.070	0.106	0.120	0.098				

AT Ambient temperature; RT Refrigerated temperature

Hydroxymethylfurfural content recorded in honey was higher than observations of Bulut and Kilic (2009). The fructose and glucose content of honey observed were 34.79 % and 28.93 % respectively, which were in the same range as observed by Poncini and Winner (1987).

Changes in physico-chemical characteristics of mango nectar during storage The data pertaining to changes in quality characteristics of mango nectars during storage under different storage conditions is presented in Table 3. The data reveals that the total soluble solids increased during storage and statistically more increase was found under ambient conditions than refrigerated conditions, irrespective of treatments and storage intervals.

The increase in total soluble solids might be due to solubilization of pulp constituents during storage and degradation of starch into simple sugars due to hydrolysis of polysaccharides (Jawanda et al. 1978). The titratable acidity was found to be decreased during storage but this decrease was statistically non-significant among the treatments during storage under ambient as well as refrigerated conditions. The decrease in acidity might be due to chemical reactions taking place between organic acids and pigments by the action of enzymes and temperature (Kannan and Thirumaran 2001).

The Table 3 shows that the total sugars decreased during storage and the decrease in total sugars was more (14.60 to 14.51 %) under ambient storage conditions than refrigerated (14.60 to 14.55 %) storage conditions, while the interaction among conditions, treatments and intervals was nonsignificant. The decrease in total sugars might be attributed to the involvement of sugars in browning reactions and formation of Hydroxymethylfurfural (Shaw et al. 1977). The ascorbic acid content was found to be decreased during storage. The decrease in ascorbic acid content was more (3.87 to 3.47 mg/100 ml) in sugar based mango nectar than the honey based mango nectar

(3.62 to 3.25 mg/100 ml) under refrigerated storage conditions after 6 months. The reason for loss of ascorbic acid might be its oxidation to furfural and Hydroxymethylfurfural (Aruna et al. 1997).

The data in Table 3 reveals that there was more decrease in carotenoid content under ambient storage conditions than the refrigerated storage conditions. The decrease in carotenoid content could be attributed to per-oxidation because of light exposure (Deka et al. 2005). The Hydroxymethylfurfural content was found to be increased during storage but the increase was statistically nonsignificant among the treatments during storage under ambient as well refrigerated storage conditions.

Sensory evaluation of mango nectar The data pertaining to sensory evaluation of mango nectars is presented in Fig. 3. The data shows that statistically higher scores (7.5) were given to honey based nectar at fresh stage and the scores for sensory quality were decreased during storage but remained well within the acceptance. Therefore, the honey based nectar stored under refrigerated conditions showed higher acceptability score than the sugar based mango nectar by the panelists.

Conclusion

It can be concluded from the present study that we can utilize the honey successfully for the preparation of mango nectar. The preparation of mango nectar with mustard honey was found to be highly acceptable with high carotenoids content (725.60 mg/100 ml) and can be stored successfully for 6 months under refrigerated storage conditions with minimum changes in their physico-chemical and sensory quality without any microbial spoilage and it could be marketed as a health drink.

Fig. 3 Sensory evaluation of mango nectar

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