Research Article

Stabilization, physiochemical and sensory evaluation of mango jam with jaggery stored at ambient temperature (25-30°C)

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Abstract

The aim of this work was to study physicochemical and sensory characteristics of mango jam prepared with sugar and jaggery individually and in combination. Five treatments were prepared (Mj₁, Mj₂, Mj₃, Mj₄ and Mj₅) and were stored at ambient temperature (25-30°C). These were analyzed both physicochemically and organoleptically for total time period of 30 days at 15 days interval. During storage the average value of titratable acidity and total soluble solids were increased. Ascorbic acid content, pH and average score of judges for color, taste, texture and overall acceptability of all samples were decreased ($p < 0.05$). On the basis of different parameters and analysis, Mj₁ (mango pulp 50% + sugar 50% + 0.99% Citric Acid + 0.06% potassium meta bi sulphite) was found very acceptable both physicochemically and organoleptically during storage. Addition of jaggery to fruit products gives molassic flavor and helps in controlling different diseases in population such as anaemia, asthenia, cough and chest congestion by providing long chain sugars, iron and salts. Future study is recommended to determine microbial count, approximate analysis and mineral content.

Keywords: Jaggery; Jam; Mango; Physicochemical; Sensory characteristics

Introduction

Jam is a semi-solid food product made by mixing of fruit pulp, sugar along with thickening agent and acids with continuous heating practice. Sometimes other ingredients such as (preservatives, colors, and tasty ingredients) are also added for the

best stability and increased edibility [1, 2]. According to Codex Alimentarius commission, the total soluble solids of jam should not be less than 68°brix. The food products development and formation is the main objective of food industry. Consumer demands for new, best quality and hazard free

products. It is important to know all the factors and their effects on quality of food products. Consumers are very health conscious towards fruit and vegetable products enriched with nutrients, natural flavor and taste [3].

Mango (*Mangifera indica* L.) is generally called "king" of fruits because of very attractive color, taste, flavor and very high nutritional value [4]. It is very important commercial and tropical export fruit and about 25.1 million tonnes is produced in almost 90 countries of the world. Pakistan is the 5th largest mango producing country in the world producing about 938 thousand tones (7.6% share in world market). Mango Ancharian family is one of the most popular tropical fruit [5]. Gallic acid, chlorogenic acid, vanillic acid, gentisyl-protocatechuic acid and mangiferin are phenolic compounds found in mango fruit pulp. These are natural antioxidants used in food, pharmaceutical and cosmetics industries [6].

Jaggery also known as "gur" is very popular un-centrifuged sugar. It is produced from cane juice, beet juice and palm sap. It is un-centrifuged and unrefined sweet product obtained from vacuum boiling of cane syrup. It is consumed worldwide under different names such as gur in Pakistan, rappadura in Brazil, and hakura in Sri Lanka [7]. It is mainly produced and consumed in India, Burma, Indonesia and Pakistan. It has dark colour because of impurities and molasses [8]. Jaggery has about 50% non-reducing sugars, 20% reducing sugars and about 20% moisture content. It provides essential vitamins such as Vit A, D, E and B complexes, Proteins and Minerals (Ca, Cu, Mn, Cl, P, K, Na and Mg) [9]. It has complex carbohydrates which are digested slowly and are less harmful for the body. It is not cleared whether jaggery is suitable for diabetic

patients or not. It collects considerable amount of ferrous salt (Iron) during its preparation in iron vessels. This iron is good for health especially for those who are anaemic. It is a good source of minerals and salts which are beneficial for body and act as cleansing agents and prevents asthma, cough, cold and congestion in chest [10].

The main objective of this study was to standardize the mango jam with jaggery and to check its physiochemical, organoleptic properties and storage stability at ambient temperature.

Materials and methods

Collection of raw materials

Best quality fresh, mature and juicy mangoes were selected and bought from local fruit market of Peshawar. Jaggery and sugar were purchased and brought to Food processing laboratory of Nuclear Institute for Food and Agriculture Peshawar KPK, Pakistan where research work was carried out.

Extraction of Pulp

Mangoes were washed, peeled and pulp was extracted with the help of pulper.

Preparation of mango jam

Pulp was taken into kettles. Jaggery and sugar were added to pulp separately and in combination and cooked until total soluble solid was reached to 63—68 ° Brix. Five glass bottles were taken and labelled as Mj₁, Mj₂, Mj₃, Mj₄, and Mj₅ and preserved with the same quantity of potassium metabisulphite (0.06 %), Citric acid (0.90 %) and pectin (0.5 %). All the samples were stored at ambient temperature (25-30 °C) and analyzed physicochemically (Titratable acidity, Ascorbic acid, pH, TSS) and organoleptically (Color, Taste, Texture and over all acceptably) for 30 days at 15 days interval (Table 1).

Table 1. Proposed plan of study

Treatments	Pulp (%)	Sugar (%)	Jaggery (%)
Mj ₁	50	50	—
Mj ₂	50	—	50
Mj ₃	50	25	25
Mj ₄	50	20	30
Mj ₅	50	50	20

Physicochemical analysis

Total soluble solids (°brix) were determined using method no 920.183 by ATAGO Japan hand refractometer (Range 0 -90 °Brix), pH was determined by digital pH meter using method no 920.183, titratable acidity was determined using method no 920.183 and ascorbic acid determination was done using method no 967.2 as described by [11].

Organoleptic evaluation

All the samples were analyzed organoleptically (color, flavor, taste, texture and overall acceptability) using nine-points hedonic scale by 10 members as judges who used the standard method as described by [12]. They analyzed all products at fifteen days interval for total time period of 30days.

Statistical analysis

All the results were statistically analyzed by using CRD (completely randomized design) two factorial design conducting two way ANOVA at significance level ($p < 0.05$) as

shown in steel and torrie (1997), All mean values were separated by LSD (least significance difference) test applying All pair wise comparison with the help of statistical software “Statistix 8.1” (Analytical software, Tallahassee, FL USA).

Results and discussion

Physicochemical analysis

Acidity (%)

Mean value of % acidity in all samples was increased from 1.76 to 2.50. Highest mean value was observed in Mj₃ (2.35) followed by Mj₂ (2.28) and lowest in Mj₁ (1.90) followed by Mj₅ (2.00). Highest percent increase was found in Mj₄ (38.02) followed by Mj₂ (29.85) and lowest in Mj₁ (19.04) followed by Mj₃ (28.09) (Table 2). The work of [13] also showed the same increasing trend of acidity in their samples of kinnow juice. The same trend of increase in acidity of apple juice samples was also reported by [14].

Table 2. Effect on the Acidity of different mango jaggery jam samples

Treatments	Storage Interval			%increase	Mean
	Initial	15	30		
Mj ₁	1.70	1.90	2.10	19.04	1.90d
Mj ₂	1.88	2.28	2.68	29.85	2.28ab
Mj ₃	1.95	2.35	2.75	28.09	2.35a
Mj ₄	1.63	2.13	2.63	38.02	2.13bc
Mj ₅	1.65	2.00	2.35	29.78	2.00cd
Mean	1.76c	2.13b	2.50a		

Ascorbic acid (mg/100g)

Mean values of ascorbic acid in all samples was decreased from 26.81 to 26.25 at ($p < 0.05$). Highest mean values was observed in Mj₁ (28.44) followed by Mj₂ (27.22) while lowest was observed in Mj₄ (24.74) followed by Mj₃ (25.92). Highest percent decrease was observed in Mj₄ (2.39%) followed by Mj₃ (2.28) while lowest was observed in Mj₁

(1.39%) followed by Mj₂ (2.18) (Table 3). The same declining trend in ascorbic acid content was observed by [13] in kinnow juice during storage. Decrease of ascorbic acid in apple fruit beverage was reported by [14]. The same lowering trend in ascorbic acid was observed in the work of [15] on aqueous orange juice samples.

Table 3. Effect on ascorbic acid content of different mango jaggery jam samples

Treatments	Storage Interval			%Decrease	Mean
	Initial	15	30		
Mj ₁	28.64	28.44	28.24	1.39	28.44a
Mj ₂	27.52	27.22	26.92	2.18	27.22b
Mj ₃	26.22	25.92	25.62	2.28	25.92d
Mj ₄	25.04	24.74	24.44	2.39	24.74e
Mj ₅	26.66	26.36	26.06	2.25	26.36c
Mean	26.81a	26.53b	26.25c		

pH

Mean value of pH significantly ($p < 0.05$) decreased from 3.83 to 3.71. Highest mean value was observed in Mj₂ (4.16) followed by Mj₄ (3.85) while lowest in Mj₁ (3.48) followed by Mj₃ (3.66). Highest percent decrease was observed in Mj₂ (3.30%) followed by Mj₃ (3.22) and lowest was observed in Mj₁ (2.27%) followed by Mj₄ (3.06) (Table 4). The same decreasing trend

in pH of kinnow juice was reported by [16]. The decrease in pH is due to formation of acidic compounds by degradation of reducing sugars as discussed by [17]. The reduction in pH could be attributed to simultaneous increase in acidity and total soluble solids of nectar at storage temperature as reported by [18] in the squash of pomegranate.

Table 4. Effect on pH of different mango jaggery jam samples

Treatments	Storage interval			%Decrease	Mean
	Initial	15	30		
Mj ₁	3.52	3.48	3.44	2.27	3.48e
Mj ₂	4.23	4.16	4.09	3.30	4.16a
Mj ₃	3.72	3.66	3.60	3.22	3.66d
Mj ₄	3.91	3.85	3.79	3.06	3.85b
Mj ₅	3.78	3.72	3.66	3.17	3.72c
Mean	3.83a	3.77b	3.71c		

Total soluble solids (°brix)

Mean value of total soluble solids was significantly ($p < 0.05$) increased from 64.4 to 67.8 °brix. Highest mean value was observed

in Mj₅ (67.66) followed by Mj₄ (66.00) while lowest in Mj₂ (64.66) followed by Mj₁ (65.00). Highest percent increase was found in Mj₂ (5.97%) followed by Mj₃ (5.88) while

lowest in Mj₁ (3.03) followed by Mj₅ (4.34) (Table 5). The same increasing trend in total soluble solids of pineapple juice samples were reported by [19] in his orange and

pineapple juice samples. The same increase in total soluble solids in apple pulp samples were reported by [20].

Table 5. Effect on total Soluble Solids of different mango jaggery jam samples

Treatments	Storage Interval			%Increase	Mean
	Initial	15	30		
Mj ₁	64	65	66	3.03	65.00cd
Mj ₂	63	64	67	5.97	64.66d
Mj ₃	64	66	68	5.88	66.00bc
Mj ₄	65	66	69	5.79	66.66ab
Mj ₅	66	68	69	4.34	67.66a
Mean	64.4c	65.8b	67.8a		

Organoleptic evaluation

Color

Mean score of judges for color significantly decreased from 6.82 to 6.00 at (p<0.05). Highest average score for color was observed in Mj₁ (8.66) followed by Mj₂ (7.26) and lowest in Mj₄ (4.50) followed by Mj₃ (5.50). Highest percent decrease was observed in Mj₄ (20.00) followed by Mj₂

(7.26) while lowest in Mj₁ (5.55) next was Mj₂ (6.66) in (Table 6). The [21] also reported the same decreasing trend in judges score for color of samples. These findings are in similarity with the findings of [22] who worked on different fruit juice blends and studied gradual decrease in score for color.

Table 6. Effect on color points of different mango jaggery jam samples

Treatments	Storage Interval			%Decrease	Mean
	Initial	15	30		
Mj ₁	9.0	8.5	8.5	5.55	8.66a
Mj ₂	7.5	7.3	7.0	6.66	7.26b
Mj ₃	6.0	5.5	5.0	16.66	5.50d
Mj ₄	5.0	4.5	4.0	20.00	4.50e
Mj ₅	6.6	6.0	5.5	16.66	6.03c
Mean	6.82a	6.36b	6.00c		

Taste

Mean score of judges for taste was significantly decreased from 6.96 to 6.06 (p<0.05). Highest mean score for taste was observed in Mj₁ (8.66) followed by Mj₂ (7.50) and lowest in Mj₄ (4.50) followed by Mj₃ (5.73). Highest % decrease in judges score for taste was observed in Mj₄ (20.00) followed by Mj₃ (15.87) and lowest in Mj₁ (5.55) followed by Mj₂ (12.50) (Table 7).

These results are in agreement with the work of [16] who observed that the flavor of spiced beverages has higher rating at initial stage but decrease significantly with time.

Texture

Mean score of judges for texture was significantly decreased from 6.60 to 5.70 (p<0.05). Highest mean score of judges for texture was observed in Mj₁ (8.66) followed by Mj₂ (7.00) and lowest in Mj₄ (4.50)

followed by Mj₃ (5.00). Highest % decrease in taste score was observed in Mj₄ (20.00) followed by Mj₃ (18.18) and lowest in Mj₁ (5.5) followed by Mj₂ (13.33) (Table 8). These results are in agreement with the results of [23] on orange drink.

Overall acceptability

Mean score of judges for overall acceptability was significantly decreased from 7.06 to 6.24 ($p < 0.05$). Highest mean score of judges was observed in Mj₁ (8.60)

followed by Mj₂ (7.53) while lowest was observed in Mj₅ (5.06) followed by Mj₄ (5.50). Highest % decrease in score for overall acceptability was observed in Mj₄ (16.66) followed by Mj₅ (14.54) and lowest in Mj₁ (4.54) followed by Mj₂ (11.25) in (Table 9). The results are in agreement with the results of [24, 25] who showed that organoleptic rating of freshly prepared product were high and reduced significantly with storage.

Table 7. Effect on taste of different mango jaggery jam samples

Treatments	Storage Interval			%Decrease	Mean
	Initial	15	30		
Mj ₁	9.0	8.5	8.5	5.55	8.66a
Mj ₂	8.0	7.5	7.0	12.50	7.50b
Mj ₃	6.3	5.6	5.3	15.87	5.73d
Mj ₄	5.0	4.5	4.0	20.00	4.50e
Mj ₅	6.5	6.0	5.5	15.38	6.00c
Mean	6.69a	6.42b	6.06c		

Table 8. Effect on texture of different mango jam samples

Treatments	Storage Interval			%Decrease	Mean
	Initial	15	30		
Mj ₁	9.0	8.5	8.5	5.55	8.66 a
Mj ₂	7.5	7.0	6.5	13.33	7.00 b
Mj ₃	5.5	5.0	4.5	18.18	5.00 d
Mj ₄	5.0	4.5	4.0	20.00	4.50 e
Mj ₅	6.0	5.5	5.0	16.66	5.50 c
Mean	6.60 a	6.10 b	5.70 c		

Table 9. Effect on overall acceptability of mango jam samples

Treatments	Storage Interval			%Decrease	Mean
	Initial	15	30		
Mj ₁	8.8	8.6	8.4	4.54	8.60 a
Mj ₂	8.0	7.5	7.1	11.25	7.53 b
Mj ₃	7.0	6.5	6.0	14.28	6.50 c
Mj ₄	6.0	5.5	5.0	16.66	5.50 d
Mj ₅	5.5	5.0	4.7	14.54	5.06 e
Mean	7.06 a	6.62 b	6.24 c		

Conclusion and recommendations

From this study it was concluded that Potassium metabisulphite, citric acid, pectin

and sugar has strong effect on overall quality of Mj₁ (50% mango pulp+ 50% Sugar + Citric acid (0.90%) + potassium metabisulphite

(0.06%+pectin (0.5) and remained acceptable during 30 days of storage. In future further study is recommended on microbial count, approximate analysis and mineral content.

Authors' contributions

Conceived and designed the experiments: M Yaseen & S Rani, Performed the experiments: M Yaseen, H Wahab & U Shahni, Analyzed the data: N Khan, B Saeed & Z Rahman, Contributed materials/ analysis/ tools: JA Shah & JA Nasi, Wrote the paper: S Rani, U Shahni & B Saeed.

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