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STUDY ON PREPARTION AND SHELF-LIFE OF MIXED JUICE BASED ON WOOD APPLE AND PAPAYA

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ABSTRACT

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The experiment was conducted jointly in the laboratory of the Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh and Postharvest Technology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during 2004 and 2005 to develop a suitable formulation for preparation of mixed wood apple–papaya juice. The fruits pulps were analyzed for its chemical composition and different formulations of mixed juices were prepared by different proportions of mixed wood apple-papaya pulp. Gum (acacia) and CMC (car boxy methyl cellulose) were used as a thickening agent. The prepared mixed juices were packed in glass bottle with lug cap and stored at room temperature for a period of 6 months. The products were analyzed for its keeping quality and acceptability at intervals of one month. It was revealed that the sedimentation was minimized by using CMC and found to be more effective for minimizing the sedimentation than gum (acacia). The prepared mixed juices were evaluated by a taste-testing panel for sensory attributes. The taste-testing panel opined that formulation T_8 (13% mixed wood apple-papaya pulp+ 12.38% sugar + 0.25% citric acid + 0.5% CMC + 0.06% KMS) had the highest overall acceptability among other treatments.

Key words: Mixed juice, wood apple, papaya, shelf-life

INTRODUCTION

The wood apple (*Aegle marmelos correa*) is an important and an indigenous fruit of Bangladesh. Its Bengali name is 'Bel'. It grows in a particular season and is available in almost all districts of Bangladesh but abundant in the East-West and Northern region of the country speciallly in Rajshahi, Rangpur, Dinajpur, Bogra, ChapaiNowabgonj, Gazipur, Tangail, Jamalpur, Sherpur, Mymensingh, Comilla, Sylhet, Chittagong and Faridpur districts (Ahmed and Khan, 1988). Wood apple is a nutritious fruit and is consumed as a juice during the harvesting season for their low cost and thirst quenching beverage. It is also used as homemade drinks popularly known as 'Sarbat'. According to Gopalan *et. al*. (1971), it contains 61.5 g water, 1.89 g protein, 0.39 mg fat, 1.79 mg minerals, 31.8 g carbohydrate, 55 g carotenes, 0.13 mg thiamine, 1.19 mg riboflavin, 1.1 mg niacin and 8 mg vitamin-C/100 g of edible portion. It has high religious, cultural, nutritional and medicinal value.

Papaya (*Carrica Papaya* L.*)* is a common fruit in all the tropical and sub-tropical countries. It is grown all over the country as a home yard fruit (Ahmed, 1984). It occupies 17000 acres of land and total production is about 103000 Mt with an average yield of 2.58 Mt per acres (BBS, May-2006). This is considerably a low yield compared to other countries such as 50-55 t/ha in Hawaii (Hamilton, 1987). It is widely cultivated in Rajshahi, Rangpur, Jessore, Faridpur, Mymensingh and Dhaka. Due to its high moisture content it spoils quickly and at room temperature it can be stored only for 15-20 days (Hossain *et al.*, 1990). It is nutritionally very rich, particularly in vitamins-A, C and iron. According to FAO and WHO (1972), the proximate composition of green papaya per 100 gm of edible portion as purchased, moisture 92.1%, protein 1%, fat 0.1%, carbohydrate 6.2%, fibre 0.9%, ash 0.6%, calcium 38 mg, phosphate 20 mg, iron 0.3 mg, sodium 7 mg, potassium 215 mg, β-carotene 15 µg, thiamin 0.02 mg, riboflavin 0.03 mg, niacin 0.3 mg and ascorbic acid 40 mg/100g.

Wood apple and papaya are two common nutritious juicy fruits. They are wonderful for their colour, flavour and taste. These fruits are not preserved for a long time. On the other hand, lack of knowledge for processing, preservation, packaging technology and transport facilities, a large quantity of papaya and wood apple is being spoiled and damaged during harvesting season, the growers faced economic loss and they lose their interest to produce more wood apple and papaya. This problem would be overcome by the use and application of aforesaid technology. Their pulp could be preserved in the form of alternative product such as beverage, squash, mixed juice, etc.

Objectives

1. To find out an acceptable formulation for mixed juices based on wood apple and papaya
2. To minimize the expected settling of the pulps.
3. To study the shelf life of the prepared juices.

MATERIALS AND METHODS

The experiment was conducted jointly in the laboratory of the Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh and Postharvest Technology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during 2004 to 2005.

Materials

The fresh, mature and ripe wood apple and papaya were procured from the local market. The pulp from a single variety of wood apple and papaya were used in this experiment. Citric acid, gum (acacia), car boxy methylcellulose (CMC), potassium meta bisulphite (KMS), sugar and other materials were collected from the local market. The glass bottle was used in the bottling of juice.

Extraction of wood apple pulp

Fresh, fully ripe and sound wood apples were used for extraction of pulp. Wood apples were washed thoroughly and then peeled with gloved hand. The pulp was collected by squeezing out fresh of the wood apples. After blending the wood apple pulp was screened through a mosquito net cloth and pasteurized at a temperature of 75°C for two minutes .The pasteurized pulp was stored in a deep freeze at a temperature of –20°C for future use.

Extraction of papaya pulp

Fresh papayas were washed thoroughly and peeled .The edible portions were separated from non-edible portion by knives. The edible portion was cut into slices. Then the crushed pieces were transferred to the juicer for separating the juice and pulp. The juice was collected after sieving the pulp and it was stored at -20^0C temperature for further use.

Analysis of raw wood apple and papaya pulp

These pulp were analyzed for its moisture content, total soluble solid (TSS), acidity (as citric acid), pH, vitamin-C content (ascorbic acid), reducing sugar, non-reducing sugar and total sugar were determined according to Ranganna (1994).

Formulations of mixed juice

Eight different treatments coded as T_1, T_2, T_3, T_4 T_5, T_6, T_7 and T_8, were selected for the study. Two types of thickening agents gum (acacia) and carboxy methyl cellulose (CMC) were used in the formulations. The treatments were as follows:

T_1=10% mixed pulp+9.38%sugar+0.25%citric acid+1.5%gum(acacia)+0.06%KMS

T_2=11% mixed pulp+10.19%sugar+0.25%citric acid+1.5 %gum(acacia)+0.06%KMS

T_3=12% mixed pulp+11.01%sugar+0.25%citric acid+1.5%gum(acacia)+0.06%KMS

T_4=13% mixed pulp+11.82%sugar+0.25%citric acid+1.5%gum(acacia)+0.06%KMS

T_5=10% mixed pulp+10.38%sugar+0.25%citric acid+0.5%CMC+0.06%KMS

T_6=11% mixed pulp+11.19%sugar+0.25%citric acid+0.5%CMC+0.06%KMS

T_7=12% mixed pulp+12.01%sugar+0.25%citric acid+0.5%CMC +0.06%KMS

T_8=13% mixed pulp+12.38%sugar+0.25%citric acid+0.5%CMC+0.06%KMS

Preparation of mixed juice

The wood apple and papaya pulp (1:1) was taken for using different treatment on the basis of TSS (14%) and acidity (0.39%). Calculated amount of wood apple pulp, papaya pulp, sugar, citric acid, KMS, gum (acacia), CMC and water were weighed out. Sugar and citric acid were mixed with water and then the mixer was heated to prepare syrup. Then the syrup was filtered through a fine mosquito net cloth. Measured amount of gum (acacia) or CMC were mixed with hot syrup and then cooled. The measured quantity of mixed pulp was added to the syrup and blended for 2-3 minutes. After blending, the required KMS was added and stirred thoroughly

for uniform mixing. This prepared juice was then centrifuged by Disc Bowl Centrifuger (model: anmfield FT15) to separate heavy particles. Blended beverage was again filtered through a fine net cloth and the 0.06% KMS were added and stirred thoroughly for uniform mixing. After centrifugation the prepared mixed juice was blended again and heated at 75^0C for 2 minutes. Then the mixed juice was bottled into a sterilized bottle and stored at room temperature (28-32^0 C) for future use.

Microbiological studies

The prepared juice was studied for microbial load. The total microbial load was calculated by standard plate count method. The standard plate count was done according to the method described in "Recommendation method for the microbiological examination of food"(American Public Health Association, 1967).

Sensory Evaluation

Sensory evaluations of all the formulated mixed wood apple and papaya juices were done by taste testing panel. The taste testing panels were consisting of 10 test panelists. They were asked to evaluate colour, flavour, sweetness, sourness, stickiness, thickness and overall acceptability by a scoring rate on a 9 point hedonic scale. In this scale 'like extremely' is given the highest score of 9 and 'dislike extremely' is given the lowest score of 1. Others are given intermediate scores. The difference preferences as indicated scores were evaluated by statistical methods. The analysis of variance method (ANOVA) was used for this evaluation. The difference was quantified by Duncan's Multiple Range Test (DMRT).

Analysis of formulated mixed juice

Mixed juice was formulated using 10-13% mixed pulp and adding thickening agents gum (acacia) and CMC and other additives as shown in treatment. To recommend optimum condition, mixed juice was analyzed for selected compositions for storage periods up to 6 months at room temperature. Selected mixed juices were subjected to organoleptic taste test.

Storage studies

Processed mixed juices were stored at room temperature (28-32^0C). The different parameters for assessing deterioration and spoilage of mixed juices were observed at one month of interval.

RESULTS AND DISCUSSION

Physico-chemical parameters of processed mixed juices

The Physico-chemical composition of studied wood apple and papaya pulp were presented in the Table 1 which reveals that the moisture content 68.45% and 87.50%, total soluble solid 18.52% and 10.50%, acidity 0.52% and 0.31%, total sugar 12.10% and 8.70%, reducing sugar 4.20% and 3.40%, non-reducing sugar 7.90% and 5.30%, vitamin-C, 8.52 mg/100g and 28.75mg/100g, ash 0.75% and 0.35%, pH 5.3 and 4.22, respectively. Similar result was also observed by Singh and Roy (1984).

Table 1. Chemical compositions of wood apple and papaya juice

Components /Parameters	Wood apple pulp	Papaya pulp
Moisture (%)	68.45	87.50
TSS (%)	18.52	10.50
Reducing sugar (%)	4.20	3.40
Non-reducing sugar (%)	7.90	5.30
Total sugar (%)	12.10	8.70
Ash (%)	0.75	0.35
P^H	5.31	4.22
Acidity (%)	0.52	0.31
Vitamin-C (mg/100g)	8.52	28.75

Moisture content

Moisture content of the formulated samples was decreased slightly during the six months storage. Initial moisture content of T_1, T_2, T_3 and T_4 was observed 85.85%, 86.51%, 86.28% and 85.70% and T_5, T_6, T_7 and T_8 were 86.21%, 87.09%, 85.25% and 83.65% respectively. After 6 months, moisture content of T_1, T_2, T_3 and T_4 was observed 80.01%, 80.55%, 81.10%, 78.21% respectively and T_5, T_6, T_7 and T_8 were found 80.00%, 78.88%, 78.90%, 76.89% respectively. Moisture content of all treatments negligible changed during the storage period due mechanical and/or experimental error (Table 2).

Total soluble solids (TSS)

The total soluble solids initially adjusted in formulations showed a negligible change throughout 6 months of storage period at room temperature (28-32^{0}C). From the Table 2, it was observed that the initial TSS range was found 11-14% in all treatments and after 1, 2, 3, 4, 5 and 6 months of storage the TSS range were slightly increased and found 11.01-14.05%, 11.06-14.13%, 11.024-14.21% and 11.03-14.16%, 11.11-14.12% and 11.20-14.66% respectively. The increased TSS might be due to conversion of sugar during the storage periods. This result was similar to that of range as reported by Ranganna (1991) and Jacob (1959).

Acidity

Acidity was calculated on the basis of titrable acidity based on citric acid. Acidity for all the formulations at various storage periods was observed (Table 2). The initial acidity of all treatments was ranged between 0.48-0.60%. After 1, 2, 3, 4, 5 and 6 months of storage periods the acidity range were decreased to 0.46-0.57%, 0.43-0.54%, 0.39-0.50%, 0.35-0.46%, 0.30-0.42% and 0.30-0.41% respectively. The decreased acidity might be due to inverse relation with the increased of storage periods. The results were in agreement with Singh and Roy (1984).

Table 2. The effect of storage on the composition of mixed juice

Treatment	Storage period (months)															
	0				1				2				3			
	MC (%)	Acidity (%)	TSS (%)	pH	MC (%)	Acidity (%)	TSS (%)	pH	MC (%)	Acidity (%)	TSS (%)	pH	MC (%)	Acidity (%)	TSS (%)	pH
T_1	85.85	0.49	11	3.91	84.10	0.48	11.02	3.93	83.43	0.44	11.10	3.94	82.10	0.41	11.02	3.69
T_2	86.51	0.55	12	3.85	85.06	0.52	12.00	3.88	85.10	0.49	12.03	3.90	83.39	0.46	12.21	3.91
T_3	86.28	0.59	13	3.67	85.15	0.56	13.01	3.71	84.09	0.52	13.04	3.74	83.21	0.49	13.13	3.77
T_4	85.70	0.60	14	3.88	84.07	0.57	14.05	3.90	83.19	0.54	14.13	3.92	81.02	0.50	14.16	3.94
T_5	86.21	0.48	11	3.81	85.10	0.46	11.01	3.84	84.41	0.43	11.06	3.86	82.93	0.39	11.31	3.88
T_6	87.09	0.53	12	3.63	86.02	0.51	12.05	3.66	84.01	0.47	12.10	3.67	82.06	0.44	12.12	3.69
T_7	85.25	0.58	13	3.86	84.25	0.54	13.00	3.89	83.12	0.50	13.08	3.91	81.31	0.46	13.30	3.93
T_8	83.65	0.59	14	3.78	82.16	0.56	14.00	3.80	80.09	0.52	14.02	3.83	79.56	0.49	14.21	3.85

Table 2. (contd.) The effect of storage on the composition of mixed juice

Treatment	Storage period (months)											
	4				5				6			
	MC (%)	Acidity (%)	TSS (%)	pH	MC (%)	Acidity (%)	TSS (%)	pH	MC (%)	Acidity (%)	TSS (%)	pH
T_1	80.12	0.38	11.03	3.97	80.12	0.33	11.14	3.99	80.01	0.30	11.20	3.99
T_2	82.69	0.43	12.01	3.93	81.59	0.38	12.24	3.94	80.55	0.36	12.30	3.96
T_3	81.52	0.45	13.12	3.78	81.14	0.40	13.03	3.80	81.10	0.38	14.00	3.81
T_4	80.48	0.46	14.07	3.95	79.18	0.42	14.09	3.96	78.21	0.41	14.56	3.96
T_5	81.11	0.35	11.03	3.90	80.86	0.30	11.11	3.92	80.00	0.30	11.20	3.94
T_6	81.51	0.40	12.11	3.70	79.09	0.35	12.26	3.73	78.88	0.33	12.32	3.78
T_7	80.48	0.42	13.04	3.94	79.46	0.38	13.33	3.95	78.90	0.37	14.21	3.96
T_8	78.19	0.44	14.16	3.87	77.12	0.40	14.12	3.89	76.89	0.39	14.66	3.93

Vitamin-C

Vitamin-C or ascorbic acid content of different formulated mixed juice was observed very low compared to citrus fruit (Table 3). The Table 3 showed that vitamin–C or ascorbic acid was reduced to negligible amount in mixed juices due to dilution effect. The initial vitamin-C of all treatments was ranged between 19.27-23.98 mg/100g. After 1, 2, 3, 4, 5 and 6 months of storage periods vitamin-C range were decreased to 18.52-22.78 mg/100g, 17.14-20.56 mg/100g, 14.47-19.29 mg/100g, 12.10-18.47 mg/100g, 11.90-16.53 mg/100g and 10.20-14.50 mg/100g respectively. Similar result was also observed by Singh and Roy (1984).

Reducing sugar

The reducing sugar content of the formulated treatments slightly increased during storage periods (Table 3). The initial reducing sugar content of T_1, T_2, T_3 and T_4 was observed 4.01%, 4.21%, 4.46% and 4.79% respectively and T_5, T_6, T_7 and T_8 were found 4.03%, 4.41%, 4.47% and 4.76% respectively. It was observed that for all the treatments, the reducing sugar slightly increased due to hydrolysis of sugar with citric acid during storage periods. Ewaidah (1972) reported that the reducing sugar increased due to the hydrolysis of sucrose present in fruit beverage.

Non-reducing sugar

Table 3 showed that the initial non-reducing sugar of the formulated beverages T_1, T_2, T_3 and T_4 were observed 6.78%, 6.80%, 7.01% and 7.31% and the T_5, T_6, T_7 and T_8 were found 6.80%, 6.83%, 7.02% and 7.22% respectively. After 6 months of storage the non-reducing sugar in the T_1, T_2, T_3 and T_4 were observed 6.10%, 6.03%, 6.15% and 6.66% while in that of T_5, T_6, T_7 and T_8 it was found 6.02%, 6.92%, 6.12% and 6.70% respectively. It was observed that for all the treatments, the non-reducing sugar increased slightly. This may be due to conversion of some reducing sugar to non-reducing sugar through the process of glucogenesis. The observations were similar to Ewaidah (1972).

Total sugar

A negligible changes in total sugar content in the prepared beverage through 6 months storage periods was observed at room temperature 28-32^{0}C (Table 3). It was observed that the initial total sugar range found in all treatments 10.79-12.10%. After 1, 2, 3, 4, 5 and 6 months of storage periods, the TSS ranges were increased slightly and found 10.81.-12.10%, 10.83-12.02%, 10.85-12.05%, 10.86-12.07%, 10.92%-12.30% and 10.95-12.33% respectively. This might be due to variation in percent pulp content and conversion of sugar.

Table 3. The effect of storage on the composition of mixed juice

Treatment	Storage period (months)															
	0				1				2				3			
	Vit-C (mg/ 100g)	Reduc-ing sugar (%)	Non-reduc-ing sugar (%)	Total sugar (%)	Vit-C (mg/ 100g)	Reduc-ing sugar (%)	Non-reduc-ing sugar (%)	Total sugar (%)	Vit-C (mg/ 100g)	Reduc-ing sugar (%)	Non-Reduc-ing sugar (%)	Total sugar (%)	Vit-C (mg/ 100g)	Reduc-ing sugar (%)	Non-Reduc-ing sugar (%)	Total sugar (%)
T_1	19.27	4.01	6.78	10.79	18.52	4.01	6.78	10.81	17.14	4.02	6.76	10.83	16.59	4.03	6.75	10.85
T_2	20.34	4.21	6.80	11.01	19.81	4.21	6.80	11.01	18.64	4.22	6.76	10.98	17.82	4.24	6.75	10.99
T_3	22.36	4.46	7.01	11.47	21.53	4.46	7.01	11.47	19.61	4.47	6.98	11.42	18.23	4.48	6.78	11.44
T_4	23.36	4.79	7.31	12.10	22.11	4.79	7.31	12.10	20.11	4.81	7.21	12.02	19.29	4.84	7.01	12.05
T_5	20.85	4.03	6.80	10.83	19.12	4.03	6.80	10.83	18.12	4.04	6.78	10.85	14.47	4.06	6.76	10.86
T_6	21.16	4.41	6.83	11.24	20.14	4.41	6.83	11.24	19.43	4.42	6.82	11.24	16.08	4.45	6.81	11.26
T_7	23.98	4.47	7.02	11.49	22.78	4.47	7.02	11.49	20.56	4.48	7.01	11.52	17.37	4.00	6.98	11.52
T_8	23.63	4.76	7.22	11.98	21.10	4.76	7.22	11.99	20.41	4.78	7.19	12.01	18.41	4.68	7.17	12.03

Table 3. (contd.) The effect of storage on the composition of mixed juice

Treatment	Storage period (months)											
	4				5				6			
	Vit-C (mg/ 100g)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Vit-C (mg/ 100g)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Vit-C (mg/ 100g)	Reducin g sugar (%)	Non-reducing sugar (%)	Total sugar (%)
T_1	15.62	4.06	6.73	10.86	13.92	4.26	6.17	10.95	11.40	4.80	6.10	11.05
T_2	16.98	4.28	6.71	10.99	15.12	4.53	6.44	11.02	14.30	4.66	6.03	11.20
T_3	16.46	4.51	6.75	11.46	15.58	4.69	6.96	11.71	14.28	4.76	6.15	11.72
T_4	18.47	4.87	6.98	12.07	16.53	4.88	7.38	12.30	14.50	4.88	6.66	12.33
T_5	12.10	4.08	6.74	10.88	11.90	4.50	6.02	10.92	10.20	4.61	6.02	10.95
T_6	14.41	4.46	6.80	11.26	13.35	4.74	7.21	11.32	11.19	4.80	6.92	11.56
T_7	15.15	4.33	6.94	11.57	13.46	4.68	6.30	11.57	11.21	4.78	6.12	11.62
T_8	17.55	4.86	7.15	12.03	15.47	4.88	7.15	12.10	14.33	4.88	6.70	12.18

Storage studies

Eight samples of mixed juice were stored at ambient temperature (28-32^{0}C). The colour, flavour, turbidity, TSS, acidity and microbial load (Standard plate count) in the mixed juice and cloud formation in mixed juice were observed during the storage period of 6 months (Table 4). Colour was no change up to 3 months and then slight change to changed colour and flavour was fresh up to 4 months and then changed slightly. The addition of acid and dilution of juice improved the transparency. There was no change in color, flavor, turbidity and gas formation up to 6 months in T_8. No gas formation during storage was observed in the mixed juice, which indicated that the heat processing was adequate (Table 5). In microbiological study immediately after preparation of juice the total no. of viable count was not uniform. It also showed that the total colony count increased slightly with the increase of storage periods. The initial microbial loads of all treatments were found 2.53, 2.64, 2.71, 2.80, 2.75, 2.42, 2.65 and 2.47 cfu/g, respectively. After six months, it was increased slightly in all treatments. The microbial load was also very low and far below the safely level (Zurowietz, 1978).

Table 4. Microbial load count at storage period

Treatment	Microbial load (log cfu/g)						
	Initial	1st month	2nd month	3rd month	4th month	5th month	6th month
T_1	2.53	2.78	2.91	3.05	3.13	3.19	3.27
T_2	2.64	2.85	2.98	3.12	3.31	3.42	3.55
T_3	2.71	2.86	3.01	2.95	3.10	3.14	3.21
T_4	2.80	2.82	2.85	2.90	2.93	2.97	3.03
T_5	2.75	2.81	2.85	2.89	2.90	2.97	3.10
T_6	2.42	2.56	2.69	2.72	2.75	2.82	2.98
T_7	2.65	2.71	2.76	2.79	2.85	2.95	2.98
T_8	2.47	2.55	2.62	2.67	2.76	2.87	3.12

Table 5. Change of physical appearance during storage period

Treat-ment	Storage period (months)															
	0				1				2				3			
	Color	Flavor	Turbidity	Gas formation	Color	Flavor	Turbidity	Gas formation	Color	Flavor	Turbidity	Gas formation	Color	Flavor	Turbidity	Gas formation
T_1	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil
T_2	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil
T_3	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil
T_4	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil
T_5	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil
T_6	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil
T_7	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil
T_8	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil

Table 5. (contd.) Change of physical appearance during storage period

Treat-ment	Storage period (months)											
	4				5				6			
	Color	Flavor	Turbi-dity	Gas formation	Color	Flavor	Turbi-dity	Gas formation	Color	Flavor	Turbi-dity	Gas formation
T_1	No change	Good	Clear	Nil	No change	Good	Clear	Nil	Slightly changed	Slightly changed	Cloudy	Nil
T_2	No change	Good	Clear	Nil	No change	Good	Clear	Nil	Slightly changed	Slightly changed	Cloudy	Nil
T_3	No change	Good	Clear	Nil	No change	Good	Clear	Nil	Slightly changed	Slightly changed	Cloudy	Nil
T_4	No change	Good	Clear	Nil	No change	Good	Clear	Nil	Slightly changed	Slightly changed	Cloudy	Nil
T_5	No change	Good	Clear	Nil	No change	Good	Clear	Nil	Slightly changed	Slightly changed	Cloudy	Nil
T_6	No change	Good	Clear	Nil	No change	Good	Clear	Nil	Slightly changed	Slightly changed	Cloudy	Nil
T_7	No change	Good	Clear	Nil	No change	Good	Clear	Nil	Slightly changed	Good	Slightly cloudy	Nil
T_8	No change	Good	Clear	Nil	No change	Good	Clear	Nil	No change	Good	Clear	Nil

Sensory evaluation of mixed juice

The prepared mixed juices were subjected to sensory evaluation for color, flavor, sweetness, sourness, consistency, thickness and overall acceptability. After 6 month of storage, the samples were evaluated by a taste-testing panel of 15 judges. The mean score for color, flavor, sweetness, sourness, stickiness, thickness and overall acceptability of nine treatments were shown in (Table 6). A two-way analysis of variance was conducted for all the attributes. The DMRT test revealed that the colour of the samples T_8 was most preferred and significantly better than other treatments. Sample T_2, T_4 and T_5 had shown least colour acceptability than other treatments. The color deterioration was occurred might be due to the little exposure of light in the juice. Similar result also found by Joslyn and Tressler (1961) which strongly support the findings.

Table 6. Mean sensory score of mixed juice for different sample

Treatment	Sensory attributes						
	Colour	Flavour	Sweetness	Sourness	Stickiness	Thickness	Overall acceptability
T_1	6.33^{bc}	5.07^{c}	5.27^{e}	2.53^{b}	3.86^{b}	5.26^{b}	5.73^{de}
T_2	5.80^{c}	5.73^{b}	6.00^{d}	2.67^{b}	3.33^{cd}	4.60^{c}	6.00^{cde}
T_3	7.00^{ab}	5.80^{b}	6.53^{bcd}	2.67^{b}	3.00^{d}	3.80^{d}	6.47^{abc}
T_4	5.93^{c}	6.53^{a}	7.00^{ab}	2.80^{ab}	2.46^{e}	2.80^{e}	6.53^{abc}
T_5	5.93^{c}	5.07^{c}	4.87^{e}	2.60^{b}	4.86^{a}	6.13^{a}	5.53^{e}
T_6	6.13^{c}	5.53^{bc}	6.33^{cd}	2.67^{b}	3.73^{bc}	5.06^{b}	6.33^{bcd}
T_7	7.07^{ab}	7.13^{a}	6.73^{bc}	3.13^{a}	3.46^{bc}	4.53^{c}	6.87^{ab}
T_8	7.13^{a}	7.07^{a}	7.47^{a}	2.93^{ab}	3.46^{bc}	4.40^{c}	7.07^{a}
LSD	0.670	0.606	0.538	0.372	0.429	0.505	0.624

Hedonic scale : 9= Like extremely, 8= Like very much, 7= Like moderately, 6= Like slightly, 5= Neither like nor dislike, 4= Dislike slightly, 3= Dislike moderately, 2= Dislike very much &1= Dislike extremely.

Flavour of the T_7 was most preferred and significantly different than other samples. The flavour of the T_8 and T_4 significantly was better than the T_3, T_2 and T_6. There was significant difference in flavour acceptability and the T_1 and T_5 had shown least flavour acceptability among the treatments. Sweetness of the T_8 was most preferred than other treatments. Among the treatments T_4 had shown least sweetness than other treatments. Sourness of the T_7 was highest and significantly different than other the treatments. Among the treatment T_1 had shown lowest sourness than other treatments. Consistency of the T_5 was most preferred than other treatments. Among the treatment T_1 had shown least consistency than other treatments. Thickness of the T_5 was most preferred than other treatments. Among the treatments T_6 and T_1 had shown least thickness than other treatments. Overall acceptability of the T_8 was most preferred than other treatments (T_8 contained 13% mixed pulp+12.38%sugar+0.25%citric acid+0.5%CMC+0.06%KMS). The T_5 & T_1 had shown lowest overall acceptability when compared with other treatments.

Minimizing the expected settling of mixed juices

Eight formulations were conducted for the study of settling problem and were observed in the mixed juice during storage period at the bottom of the glass bottles with lug cap. Coloured oil ring appeared at the neck of the glass bottles in T_1, T_2 and T_5. All these indicated the inadequate quality control of the juices but not the spoilage of the product. Formulations T_1, T_2, T_5 and T_6 showed maximum sedimentation and the T_8 showed minimum sedimentation. The amount of CMC influenced the stabilization of fruit juices. By using 12% and 13% mixed pulp with 0.5% CMC and 13% mixed pulp with 1.5% gum (acacia), the lower sedimentation of the mixed pulp observed in bottles. This is due to the thickening effect of the CMC in fruit juices. For prevention of sedimentation, CMC is better thickening agent than gum.

Martin Glicksman (1969) reported that the CMC as bodying agent is necessary to impart the syruping texture that is normally supplied by the high sugar concentration. Although the gum has essentially the caloric value as sucrose it imparts a desirable body and viscosity to fruit beverages and at much lower concentration than sucrose.

Certain physical changes were observed in the treatments during storage. Although ring formation was found in glass bottles T_1, T_2, T_3 and T_5. The treatments were not deteriorated. Ring formation may occur due to improper or inadequate blended or microbiological activity. These results were similar to Jacob (1959).

CONCLUSION

Mixed juices containing 13 % pulp, 0.5 % CMC, 0.25 % citric acid, 0.06 % KMS and 12.38 % sugar (T_8) was the most acceptable formulation of all treatments. This study will help to prepare mixed juices with effective way and also to maintain the edible quality up to six months of storage at room temperature (28-32^{0}C). Potassium meta bisulphate (KMS) was most effective for prevention of spoilage against microbial growth in bottled mixed juices and carboxy methylcellulose (CMC)

was the best thickening agent to decrease the sedimentation of all the samples. So, this technology is very helpful for dissemination in food processing industries and consumers will be easily taken this mixed juice all the year round.

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