World Journal of Agricultural Sciences 7 (2): 136-142, 2011
ISSN 1817-3047

Evaluation of Apple and Apricot Blend Juice Preserved with Sodium Benzoate at Refrigeration Temperature

[1]Imtiaz Hussain, [2]Alam Zeb and [2]Muhammad Ayub

[1]Department of Food Science and Technology Faculty of Agriculture
Rawalakot Azad Jammu and Kashmir, Pakistan
[2]Department of Food Science and Technology, NWFP Agricultural University Peshawar, Pakistan

Abstrac: This study was carried out to investigate the effect sodium benzoate on apple and apricot blend juice. The samples were; apple juice (T_1), apricot juice (T_2), 75% apple and 25% apricot juice (T_3), 50% apple and 50% apricot (T_4), 25% apple and 75% apricot juice (T_5). From (T_6) to (T_{10}) above concentrations were repeated with 0.01% sodium benzoate as preservative. The samples were stored at 4°C for three months and stored juice samples were analyzed for parameters like ascorbic acid, acidity and pH, total soluble solids, reducing and non reducing sugars, overall acceptability and microbial study after the intervals of 15 days for the period of three months. The results showed that ascorbic acid content was decreased during storage The minimum ascorbic acid content was decreased in T_8 (44.61%), while maximum in T_5 (78.26%). Acidity was increased in all treatments maximum acidity increase was recorded for T_1 (46.87%) and minimum for T_8 (31.25%). pH value decreased during storage. Where the maximum decreased was recorded for T_3 (25.02%) and minimum for T_8 (7.92%). The total soluble solids (TSS) (° brix) increased in juice sample maximum in T_1 (6.97%) and minimum in T_7 (4.76%). Reducing sugars was increased during storage of juices samples, the maximum value regarding reducing sugars was recorded for T_2 (8.82%) and minimum for T_6 (8.02). Non-reducing sugars decreased was observed during storage maximum value observed for T_5 (33.92%) and minimum for T_7 (17.00%).Results regarding overall acceptability showed that maximum mean score observed for T_8 and T_{10} were found most acceptable in maintaining the sensory characteristics compared to others during storage. Minimum microbial load were observed in T_8 and maximum in T_1 to T_5 (uncountable). Among all the treatments T_8 and T_{10} were most effective in maintaining the sensory and nutritional quality during storage.

Key words: Juice · Apple · apricot · Blend · Storage · Sodium benzoate · Sensory evaluation

INTRODUCTION

Juices are a good source of sugars, vitamins and minerals; all valuable components to human health. The current food trend toward healthier diets makes juice consumption an important natural food alternative and improves the availability of its nutritive compounds. The composition of a fruit juice depends on the variety, origin and growing conditions of the fruit, its quality and the processing and storage procedures Fruit and vegetable juices could play an important role in enhancing human health. Preservation is aimed at achieving the self life prolongation of foods. Present tendencies are based on the employment of certain methods which ensure qualitatively products, less preserved, with no additives, with nutritional value, but also safe from the microbiological point of view [1, 2].

Soft drinks bottled at low temperatures have high values of the water activity, which allow microbial growth; the pH, the sugar content and the addition of preservatives prevent the microorganism's growth in soft drinks [3]. The sorbic acid and the sorbates are the preservatives mostly used in the soft drinks industry. The sorbic acid acts efficiently against the yeasts and moulds growth and of some bacteria, acting at a low pH, but however continues to be efficient at a pH of 6.5. The microorganisms growth inhibition is achieved through the interaction of the system of the two conjugated double

Corresponding Author: Imtiaz Hussain Department of Food Science and Technology Faculty of Agriculture
Rawalakot Azad Jammu and Kashmir Pakistan, E-mail: imti_hussain2005@yahoo.com.

bound in the aliphatic chain with cellular dehydrogenises which most of the yeasts and moulds cannot metabolize [4]. In fruit beverages preservation, the sodium salt of the benzoic acid is frequently used, as it is more soluble than the free acid; however, the acid formed from the salt dissolved in solution, is responsible for the antimicrobial activity, which is optimum at a pH value ranging from 2.5 to 4. [5]. Benzoic acid (C_6H_5COOH) and its more water-soluble sodium salt (C_7H5NaO_2) are used widely to delay yeast spoilage of acidic foods and beverages. In the United States, benzoic acid and sodium benzoate are Generally Recognized as Safe (GRAS) and their use in foods is permitted up to a maximum level of 0.1% [6]. In Europe, benzoic acid (E210) and sodium benzoate (E211) are permitted food preservatives with maximum levels allowed depending on the food in which they are used [7]. The Acceptable Daily Intake (ADI) for benzoic acid has been set by the FAO/WHO at 5 mg kg) 1 body weight [8]. Benzoic acid has a long history of safe use. It occurs naturally in blueberries, cranberries, coffee beans, tea, cinnamon, cloves and other foods at levels of 10-1000 mg kg)1 [9.10]. Even so, some consumers regard the deliberate addition of benzoates to foods as a form of adulteration. Allergic reactions (e.g. asthma and skin rashes) following ingestion of foods preserved with benzoate in susceptible individuals have helped to fuel the increasingly vociferous public demand for the reduced use of chemical food preservatives [11, 12]. Reductions in the permitted levels of use for many traditional preservatives are considered to be the likely outcome of the legislation reviews that are in progress in many countries. The quality and shelf life of fruit juice depend upon a range of internal parameters related to the product and several external factors, packaging being one of them [13]. Blending increase the taste and flovar of fruit juices [14] reported that blend of apple and grape juices were highly acceptable in quality and retained acceptable flovr and colour during storage at 24°C for 12 months.

Blending could lead to the production of delightful and delicious beverages with improved organoleptic quality and a high nutritive value. In this study, chemical and organoleptic assessment of blended juice with various proportions of apple and apricot juice was carried out to determine the most acceptable blend organoleptic properties and studied shelf life of such a blend. Considering the antimicrobial activity of Sodium benzoate this study was carried out to determine the microbial, organoleptic and nutritional quality changes of blend juice during storage.

MATERIALS AND METHODS

Fresh mature and sound apple and apricot were purchased from the local fruit market of Rawalakot..The fruits were washed followed by sorting, peeling and destoning the juices were extracted using juice extracting machine from Oster company model number 3165 and filled in glass bottles for the storage study. The treatments were made as (T_1) 100% apple juice (control), (T_2) 100% Apricot juice (control),(T_3) 50% apple+ 50% apricot juice (T_4) 75% apple + 25% apricot juice (T_5) 25%apple + 75% apricot juice (T_6) 100% Apple juice and 0.1% sodium benzoate (T_7) 100% apricot juice and 0.1% sodium benzoate (T_8) 50%apple+50% apricot juice and sodium benzoate (T_9) 75%apple+25% apricot juice and sodium benzoate (T_{10}) 25%apple+75% apricot juice and sodium benzoate. The juice was treated as in the flow diagram (Fig. 1), sealed and stored at refrigeration temperature (4°C) for a period of three months.

Chemical Analysis: Ascorbic acid was determined by the direct colorimetric method using 2, 6- dichlorophenol-indophenols as decolorizing agent by ascorbic acid in sample extract and in standard ascorbic acid solution [15]. Acidity was determined by dissolving a known weight of sample in distilled water and titration against 0.01 N NaOH using phenolphthalein as indicator [16]. Inolab digital pH meter was used for pH determination. Reducing and non-reducing sucrose was determined by lane Eynon method [15]. The total soluble solids (TSS) were determined by using Abbe refractometer at room temperature [15].

Sensory Evaluation: A panel of ten judges selected from staff and students of food science department evaluated the product fortnightly for color, flavor and overall acceptability by the method of Larmond [17] using a scale from 1 to 9, where 1 represented extremely disliked and 9 represent extremely liked.

Microbial Evaluation (Total Fungal Count): Total Fungal Counts (TFC/ml) was determined by standard dilution plate method using nutrient agar medium [15].

Statistical Analysis: The data obtained was subjected to statistical analysis using RCBD (Randomized Complete Block Design) and the means were compared by using LSD (Least Significant Difference) test [18] For all the analyses, the alpha error was set at 0.05%.

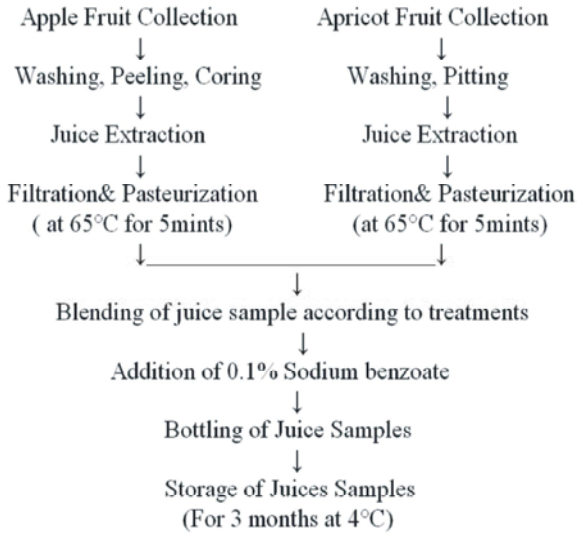

Fig. 1: Flow diagram of apple apricot blend juice stored at 4°C

RESULTS AND DISCUSSION

The results of present study indicated that storage period and temperature had significant effect on ascorbic acid content of different samples. There was a gradual decrease in ascorbic acid of apple and apricot juice. Results show that minimum percent decrease in ascorbic acid content was recorded in sample T_8(44.61%) and maximum T_5 (78.26%) and maximum mean value recorded for T_7 (5.67) and minimum for T_1(3.64) (Table 1). Ascorbic acid is the most difficult vitamin to be preserved during pasteurization. As it is the least stable vitamin, it decreases in the product during storage. In a similar study viberg *et al*. [19] reported a decrease in ascorbic acid during they recorded that ascorbic acid in strawberry pulp were affected after treatment involving freezing, heating and accelerated storage. These results are in agreement with the findings of Nunes *et al*. [20] who recorded a change in Chandler variety of strawberries stored at 4°C. Acidity of samples (T_1 to T_{10}) ranged from 0.30 to 0.36, which were gradually increased to 0.48 to 0.64 during 3 months of storage. The mean values increased from 0.39 to 0.51. Maximum mean values were recorded in sample T_2 (0.51) followed by T_1 and T_{10} (0.48), while minimum mean values were observed in sample T_7(0.39) and followed by T_8 (0.40). During storage maximum increase was observed in sample T_1 (46.87%), while minimum increase was observed in T_7 (31.25%) (Table 2). The findings of this study suggest that storage periods and treatments had a significant effect on acid content of juice during storage. These results are in agreement with the findings of Nunes *et al*. [20] who reported an increase in acidity of strawberry during storage. This increase might be due to the break down of pectin in to pectenic acid. The results are confirmed by the findings of Rai *et al*. [21]. The data showed that different treatment and storage intervals had a significant effect on pH of all samples. The mean pH values of all samples decreased from 4.30 to 2.90 during storage. Maximum decrease was recorded in T_3 (25.02%), while minimum in T_8 (7.92%) (Table 3). the acidity is considered one of the physio-chemical properties, which affects both organoleptic and keeping qualities of a product [22]. Decrease in pH-values and increase in total titratable acidity during the cold storage period may be due to activity of some acid-producing bacteria such as *Alicyclobacillus acidoterrestris* [23].

The analysis of our data showed that different treatments and storage intervals had a significant effect on TSS of apple and apricot juice. Maximum mean values were recorded in T_2 (10.29) followed by T_8 (10.26), while minimum mean values were recorded T_1 (8.24). Our results indicated a gradual increase in TSS of all samples. Maximum increase was observed in T_1 (6.67%) and minimum in T_7 (4.76%) (Table 4). Sugars are the most important constituent of fruit product and are essential factor for the flavor of the food product and also act as a natural food preservative. Results showed that reducing sugars increased in all samples during three months of storage. The maximum% increased was observed for T_2 (8.82%) and minimum for T_1 (2.71%).The treatments and storage intervals had a significant effect on reducing sucrose of the juice. The Maximum mean scores recorded for T_{10} (6.96) and minimum for T_2 (6.47) (Table 5). These results are in agreement with Ruiz-Nieto *et al*. [24] who showed an increase in glucose and fructose contents in strawberry fruits. The non reducing sugars decreased in all samples the maximum decreased was recorded for T_5 (33.92%) and minimum for T_7 (17.00%).The maximum mean value recorded for T_1 (2.68) and minimum for T_3 (1.08) (Table 6). The storage and treatments had significant effect on the non reducing sucrose of the juice stored at refrigeration temperature. These results are confirmed [24] who suggested that sucrose content of the fruit convert to glucose and fructose during the storage, results in the change in sucrose contents of juices.

Table 1: Effect of sodium benzoate on ascorbic acid (%) of apricot and apple juice stored at 4°C

	Storage Intervals (Days)								
	Initial	15	30	45	60	75	90	Mean	% Dec.
T_1	5.6	5.0	4.2	3.5	2.8	2.6	1.8	3.64d	67.85
T_2	7.6	7.0	6.0	4.8	4.0	3.1	2.0	4.92b	73.68
T_3	6.5	5.8	5.0	4.2	3.4	2.6	1.7	4.17cd	73.84
T_4	6.8	6.0	5.1	4.3	3.4	2.4	1.6	4.22c	76.47
T_5	6.9	6.0	5.1	4.2	3.3	2.4	1.5	4.20c	78.26
T_6	5.6	5.0	4.5	4.0	3.6	3.2	2.8	4.10cd	50.0
T_7	7.5	7.0	6.4	5.8	5.1	4.4	3.5	5.67a	53.33
T_8	6.5	6.0	5.6	5.1	4.5	4.0	3.6	5.04b	44.61
T_9	6.8	6.3	5.4	5.0	4.5	3.9	3.4	5.02b	50.00
T_{10}	6.9	6.2	5.7	5.2	4.4	3.8	3.2	5.05b	53.62
Mean	6.670bc	6.030cd	5.30ab	4.61de	3.90cd	3.24abc	2.51ef		

The values in column and row followed by different small letters are significantly (P<0.05) different

Table 2: Effect of sodium benzoate on acidity of apricot and apple juice stored at 4°C

	Storage Intervals (Days)								
Treatments	Initial	15	30	45	60	75	90	Mean	% Inc.
T_1	0.34	0.38	0.42	0.48	0.52	0.58	0.64	0.48bc	46.87
T_2	0.36	0.40	0.45	0.55	0.58	0.63	0.65	0.51a	46.61
T_3	0.32	0.36	0.37	0.41	0.45	0.50	0.58	0.42efgh	44.82
T_4	0.30	0.34	0.38	0.43	0.48	0.52	0.56	0.43efg	46.42
T_5	0.32	0.34	0.38	0.41	0.47	0.52	0.54	0.42efgh	46.73
T_6	0.33	0.36	0.39	0.42	o.45	0.48	0.50	0.41fghi	34.00
T_7	0.30	0.34	0.37	0.40	o.43	0.46	0.48	0.39hi	37.00
T_8	0.33	0.35	0.38	0.40	0.43	0.45	0.48	0.40ghi	31.25
T_9	0.36	0.39	0.43	0.45	0.48	0.51	0.55	0.45bcde	34.54
T_{10}	0.34	0.48	0.38	0.43	0.48	0.50	0.56	0.48b	43.33
Mean	0.329ab	0.373cd	0.393ef	0.487dc	0.492de	0.508bc	0.549ab		

The values in column and row followed by different small letters are significantly (P<0.05) different

Table 3: Effect of sodium benzoate on pH of apricot and apple juice stored at 4°C

	Storage Intervals (Days)								
Treatments	Initial	15	30	45	60	75	90	Mean	% Dec.
T_1	4.30	4.24	4.23	4.15	4.00	3.8	3.30	4.00ab	23.25
T_2	3.80	3.72	3.61	3.5	3.30	3.00	2.90	3.40I	23.68
T_3	4.00	3.94	3.93	3.8	3.50	3.33	3.00	3.64efgh	25.02
T_4	3.85	3.81	3.80	3.7	3.50	3.00	2.90	3.50hI	23.37
T_5	3.95	3.92	3.98	3.8	3.40	3.20	3.00	3.60fgh	24.00
T_6	4.20	4.10	4.06	4.00	3.90	3.80	3.60	3.94abc	14.28
T_7	3.83	3.78	3.74	3.70	3.60	3.40	3.30	3.62fgh	13.83
T_8	3.91	3.87	3.83	3.80	3.76	3.70	3.60	3.78cdef	7.92
T_9	3.84	3.80	3.75	3.70	3.65	3.40	3.30	3.63efgh	14.06
T_{10}	3.92	3.88	3.83	3.77	3.70	3.60	3.50	3.74def	10.71
Mean	3.96bc	3.906cd	3.876ab	3.792dc	3.631ef	3.423de	2.94cd		

The values in column and row followed by different small letters are significantly (P<0.05) different

Table 4: Effect of sodium benzoate on TSS of apricot and apple juice stored at 4°C

	Storage Intervals (Days)								
Treatments	Initial	15	30	45	60	75	90	Mean	% Incr.
T_1	8.00	8.00	8.10	8.20	8.30	8.50	8.60	8.24d	6.97
T_2	10.00	10.00	10.10	10.30	10.40	10.50	10.70	10.29a	6.54
T_3	9.00	9.00	9.10	9.20	9.30	9.40	9.50	9.21b	6.26
T_4	9.00	9.00	9.10	9.20	9.30	9.40	9..60	9.22b	6.25
T_5	9.00	9.00	9.10	9.20	9.30	9.40	9..50	9.21b	5.25
T_6	8.00	8.00	8.10	8.20	8.30	8.40	8.50	8.55c	6.25
T_7	10.00	10.00	10.10	10.20	10.30	10.40	10.50	8.21d	4.76
T_8	9.00	9.00	9.10	9.20	9.30	9.40	9.50	10.26a	5.25
T_9	9.00	9.00	9.10	9.20	9.30	9.40	9.50	9.21b	5.26
T_{10}	9.00	9.00	9.10	9.30	9.40	9.50	9.60	9.21b	6.25
Mean	9.10ab	9.13cd	9.17bc	9.22cde	9.32ef	9.43dc	9.55abc		

The values in column and row followed by different small letters are significantly (P<0.05) different

Table 5: Effect of sodium benzoate on reducing sugars (%) of apricot and apple juice stored at 4°C

	Storage Intervals (Days)								
Treatments	Initial	15	30	45	60	75	90	Mean	% Inc.
T_1	6.80	6.86	6.86	6.9	6.94	6.97	6.99	6.90abcd	2.71
T_2	6.2	6.3	6.4	6.45	6.5	6.7	6.8	6.47g	8.82
T_3	6.6	6.7	6.75	6.8	6.9	6.95	6.99	6.81de	5.00
T_4	6.4	6.5	6.6	6.7	6.8	6.9	6.98	6.69f	8.30
T_5	6.7	6.8	6.85	6.9	6.99	7.00	7.1	6.90abcd	5.63
T_6	6.81	6.85	6.90	6.95	6.98	6.99	7.1	6.88abcd	4.08
T_7	6.30	6.39	6.47	6.56	6.64	6.71	6.82	6.55g	7.62
T_8	6.50	6.60	6.70	6.75	6.83	6.89	6.96	6.74ef	6.60
T_9	6.70	6.80	6.85	6.90	6.95	6.90	7.00	6.87cd	4.28
T_{10}	6.75	6.85	6.90	6.95	6.97	7.10	7.20	6.96abc	6.25
Mean	6.576cd	6.665ab	6.728bc	6.786dc	6.850ab	6.911ef	6.994dc		

The values in column and row followed by different small letters are significantly (P<0.05) differ

Table 6: Effect of sodium benzoate on non-reducing (%) sugars of apricot and apple juice stored at 4°C

	Storage Intervals (Days)								
Treatments	Initial	15	30	45	60	75	90	Mean	% Dec.
T_1	2.90	2.80	2.75	2.70	2.60	2.55	2.1	2.68ab	27.58
T_2	2.00	1.90	1.80	1.75	1.64	1.54	1.44	1.77b	28.00
T_3	2.50	2.30	2.10	2.00	1.95	1.90	1.85	1.08b	26.00
T_4	2.60	2.30	2.20	2.00	1.95	1.91	1.85	2.10ab	30.00
T_5	2.80	2.50	2.40	2.30	2.00	1.96	1.85	2.25ab	33.92
T_6	2.80	2.50	2.40	2.35	2.32	2.26	2.21	2.41ab	21.42
T_7	2.30	2.10	2.00	1.97	1.94	1.92	1.90	2.01b	17.00
T_8	2.60	2.50	2.30	2.10	1.99	1.96	1.92	2.22ab	26.15
T_9	2.90	2.70	2.60	2.50	2.45	2.40	2.36	2.55bc	18.62
T_{10}	2.70	2.40	2.30	2.25	2.21	2,18	2.15	2.31ab	20.37
Mean	2.61ab	2.40bc	2.285cd	2.192de	2.105ef	2.058bc	1.963cd		

The values in column and row followed by different small letters are significantly (P<0.05) different

Table 7: Effect of sodium benzoate on overall acceptability of apricot and apple juice stored at 4°C

	Storage Intervals (Days)								
Treatments	Initial	15	30	45	60	75	90	Mean	% Decr.
T_1	7.78	6.5	5.5	4.5	3.00	2.00	1	4.32fg	87.14
T_2	6.3	5.3	4.3	3.5	3.00	2.5	1.5	3.77g	76.19
T_3	7.4	6.4	5.4	4.4	3.6	3.00	2.00	3.60efg	72.97
T_4	7.60	6.6	5.6	4.6	3.5	3.1	2.1	5.15bcde	72.36
T_5	7.6	6.3	5.2	4.2	3.2	2.2	1.5	4.31fg	80.26
T_6	7.7	7.2	6.8	6.4	6.00	5.50	5.00	6.37a	35.06
T_7	6.30	6.00	5.70	5.40	5.10	5.05	5.00	6.62abcd	49.20
T_8	7.5	7.00	6.5	6.00	5.5	5.00	4.80	6.00ab	46.66
T_9	7.6	7.2	6.8	6.5	6.00	5.50	5.00	6.35a	35.52
T_{10}	7.4	6.9	6.5	6.1	5.6	4.9	4.5	6.98ab	39.18
Mean	7.318bc	6.540ab	5.830cd	5.160bc	4.450de	3.825cde	3.240ef		

The values in column and row followed by different small letters are significantly (P<0.05) different

Table 8: Effect of sodium benzoate on growth of microganisms of apricot and apple juice stored at 4°C

	Storage Intervals (Days)								
Treatments	Initial	15	30	45	60	75	90	Mean	% Incr.
T_1	14	22	80	96	-----	-----	------		
T_2	13	24	70	83	-----	------	------		
T_3	12	18	72	85	-------	-------	----		
T_4	11	17	70	81					
T_5	12	19	72	85	-----	------	------		
T_6	08	13	70	118	211	293	318	148	97.5
T_7	09	14	78	121	212	290	318	148.5	97.16
T_8	06	12	77	122	211	296	320	147.42	98.13
T_9	05	12	70	122	216	287	316	148.86	98.14
T_{10}	04	11	88	124	218	290	321	185.8	98.75
Mean									

The values in column and row followed by different small letters are significantly (P<0.05) different

Sensory Analysis: The analysis of our data showed that storage period and treatments had a significant on overall acceptability (obtained from color, flavor and odor) of the apple and apricot blend juices. The mean score of ten judges decrease from 7.78 to 1.00. Maximum mean score of judges was recorded in T_{10} (6.98) followed by T_7 (6.62), while minimum mean score of judges was recorded in T_3 (3.60) followed by T_2 (3.77). Maximum decrease was observed in sample T_1 (87.14%) followed by T_5 (80.26%), while minimum increase was observed in T_6 (35.06%) followed by T_9 (35.52%), (Table 7). The findings of this study showed that the product overall acceptability during storage. These results are confirmed The loss of flavour and taste may be due to the degradation of ascorbic acid and furfural production [25, 26].

Microbial Evaluation: Maximum number of colonies recorded in T_1 to T_5 (uncountable during 30 days), while minimum mean growth of microorganism was observed in T_8 (147.42) T_6 (148) cfu/1 ml (Table 8) who reported the increase number of colonies during storage [27, 28].

CONCLUSION

From the present study it was concluded that blend juices of apple and apricot with 0.1% sodium benzoate were found most acceptable sensory evaluation and microbial safety and retention of most of the nutrients during 3 months storage at 4°C.Further revealed that% apple +%apricot juice (T_8) and% apple and% apricot (T_{10}) juice blend can be successfully prepared and remain acceptable for three months at4°C storage.

REFERENNCES

1. Gould, G.W., 2000. British Medical Bulletin, 26: 84-96.
2. Ranken, M.D., R.C. Kill and C.G.J. Baker, 2005. Food Industries Manual 24th Edition Springer, Verlag.
3. Stiles, B.A., S. Duffy and D.W. Schaffner, 2001. Food Microbiol., 18: 521-529.
4. Varnam, A.H. and J.P. Sutherland, 1999. Food Products Series. Technology, Chemistry and Microbiology, vol. 2: Aspen Publication.
5. Akpan U.G. and A.S. Kovo, 2005. Leonardo J. Sci., 7: 17- 22.
6. Anon, 1988. Code of Federal Regulations, Title 21, Section 184.1021 and 184, 1733. United States: US Food and Drug Administration.
7. Anon., 1995. EC Directive 95/2/EC. Food additives other than colours and sweeteners. Official J. the European Communities, 61: 1-40.
8. JECFA, 1983. 27th Report of the Joint FAO/WHO Expert Committee on Food Additives. WHO Technical Report Series no. 696. Geneva: World Health Organization.
9. Chipley, J.R., 1993. Sodium benzoate and benzoic acid. In Antimicrobials in Foods 2nd ed. Davidson, P.M. and Branen, 11-48.
10. Merck, 1983. The Merck Index 10th edn. Rahway, New Jersey: Merck, Inc.
11. Petrus, M., S. Bonaz and E. Causse, 1996. Asthma induced by benzoate containing foods and antiallergic drugs. Archives de Pediatrie. 3: 984-987.
12. BIBRA International, 1999. Toxicity Profile: Benzoic Acid and its Common Salts. Information and Advisory Service, Carshalton, Surrey, UK: 11.
13. Mannheim, C.H., J. Miltz and A. Letzter, 1987. Interaction between polyethylene laminated cartons and aseptically packed citrus juices. J. Food Sci., 52: 737-740.
14. Sistrunk, W.A and J.R. Morris, 1985. Quality acceptable of two cultivars of muscadine grapes mixed with other juices, J. Am. Soc. Hort. Sci., 110: 325-332.
15. AOAC, 2004. Of.cial methods of Analysis of the Association of Official Analytical Chemists, 20th ed: 1058-1059.
16. Srivastava, R.P. and K. Sanjeev, 2003. Fruit and Vegetable Preservation Principles and Practices: Important Methods for Analysis of Fruits and Vegetables and Their Products. Third Revised and Enlarge Edition. International Book Distribution Co., Lucknow, India: 363.
17. Larmond, E., 1977. Method for sensory evaluation of food. Canada Dept. of Agriculture, Publ., 1286: 36-37.
18. Steel, R.G.D. and J.H. Torrie, 1980. Principle and Procedures of Statistics. McGraw Hill Book Co. NY, U.S.A, 2nd ed.: 195-238.
19. Viberg, U., C. Alklint, B. Akesson, G. Onning, I. Sjoholm, J.T. Kumpulainen and J.T. Salonen, 1999. The effect of processing on total antioxidatant capacity in strawberries. Proceedings of the Second International Conference on Natural Antioxidants and Anticarcionogens in Nutrition, Health and Disease.
20. Nunes, M.C.N., M.B. Morais, J.K. Brecht and S.A. Sargent, 1995. Quality of strawberries after storage in controlled atmospheres at above optimum storage temperatures. Proceedings of the Florida State Horticultural Soci. Pub., 108: 273-278.
21. Riaz, R.A., A. Ali and M. Saleem, 1988. Studies on the preparation and storage stability of comminuted kinow fruit beverage bees. Pak. J. Sci. Ind. Res., 32: 574-578.
22. El Sheikha, A.F., 2004. Technological, chemical and microbiological studies on some packed foods. M.Sc. Faculty of Agriculture, Minufiya University, Egypt.
23. Kang, D.H., R.H. Dougherty and B. Swanson, 2003. Controlling *Alicyclobacillus acidoterrestris* in fruit juices by high pressure and high temperature. Nutr. Rep. Food Sci. Hum. Nutr, 311-316.
24. Ruiz-Nieto A., A.J.M. Lopez, M.R. Lopez, M.J. Lopez, J.J. Medina, H.A.T. Scheer, F. Lieten and J. Dijkstra, 1997. Analysis of sucrose's from strawberry cultivars of commercial interest-contents evolution. Proceedings of The Third International Strawberry Symposium, Veldhoven, Netherlands, 29 Vol. 2. Acta Hort., 439: 663-667.
25. Shimoda, M. and Y. Osajima, 1981. Studies on off-flavour formed during storage of Satsuma mandarin juice. J. Agric. Chem. Soc. Of Japan, 55: 319-24.
26. Perez, A.G. and C. Sanz, 2001. Effect of high oxygen and high carbon- dioxide atmospheres on strawberry flavour and other quality traits. J. Agric. Food Chem., 49: 2921-30.
27. Nkama, I., M.H. Badau, E.K. Collins, W. Mian, J.O. Igene and C.A. Negbenegor, 1994. Some dried spices and condiments sold in Maiduguri, Nigeria. J. Food Sci. Technol-India; 31: 420-22.
28. Badau, M.H., A.M. Adeniran and I. Nkama, 2001. Fungi associated with various fresh meats sold in Maiduguri market, Nigeria. Sci. Forum: J. Pure. Appl. Sci., 4: 255-62.