

Research Article

Study on storage stability of grapes juice preserved with sodium benzoate, potassium sorbate and potassium metabisulphite

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Abstract

This study was carried out to find the effect of potassium metabisulphite, potassium sorbate and sodium benzoate on the preservation and overall quality of grapes juice. Total seven samples were made with this juice which were named as J₀, J₁, J₂, J₃, J₄, J₅, J₆. They were kept in plastic bottles and stored at room temperature. All samples were analyzed at fifteen days interval physiochemically (pH, total soluble solids, % acidity, ascorbic acid, reducing and non-reducing sugar) and organoleptically (color, flavor, taste and overall acceptability) for a total period of 90 days. Results obtained from statistical analysis ($\alpha < 0.05$) showed that storage interval and preservation had significant effect on physiochemical and organoleptic characteristics. Total soluble solids increased maximum in J₀ (7.46%) and minimum in J₄ (2.79%). Ascorbic acid reduced maximum in J₀ (70.40%) and minimum in J₂ (29.14%). pH reduced maximum in J₀ (17.23%) and minimum in J₄ (4.06%). Acidity increased maximum in J₀ (41.00%) and minimum in J₄ (11.18%). Reducing sugars increased maximum in J₀ (69.51%) and minimum in J₄ (8.81%). Non-reducing sugars decreased maximum in J₄ (83.33 %) and minimum in J₂ (36.22 %). Color score decreased maximum for J₁ (53.30%) and minimum for J₄ (8.00%). Flavor score decreased maximum for J₂ (50 %) and minimum for J₆ (12.43%). Taste score decreased maximum for J₂ (62.66%) and minimum for J₄ (8.00%). Overall acceptability score decreased maximum for J₂ (54.35%) and minimum for J₄ (10.26%). J₄ [(grapes juice + potassium metabisulphite (0.05%) + potassium sorbate(0.05%)] remained very acceptable during storage while J₀ [grapes juice + no preservative] was found very bad. Future study is recommended on microflora assessment, micronutrients assessment, flavonoids and polyphenols extraction which can be added to other food products to prevent cancer in population.

Keywords: Acidity; Ascorbic acid; Organoleptics; pH; Sodium benzoate; Total soluble solids

Introduction

Grapes (*Vitis vinifera*) are belonging to group of berries because of having tiny size and soft structure. They are members of kingdom

plantae and genera *vitis.s* Grapes were actually originated in Turkey. History also have evidences of their presenc in Egypt, Greeks, Europe, North Africa and North

America [1]. Throughout the world grapes are grown in different countries. According to FAO reporting its world wise yield from 75,866 km² was 71% and in the dried farm consumption was recorded 2% of total produced [2]. Grapes juice is ever liking product which is directly use for drinking and sometimes it is converted into other products. It is also fermented to produce wines and vinegar. It consists of 89% water having large concentration of glucose and fructose. The acidity content of grapes juice is high because of the presence of tartaric acid, maleic acid and ascorbic acid. They also give a wide range of antioxidants such as flavonoids, anthocyanins, geraniol, linalool, nerol and tennins. These antioxidants are responsible for preventing different types of cancers in the body [3]. Food graded additives such as benzoate, sorbate etc are added to juices in order to increase their shelf life [4]. In juices benzoate is used up to 0.1% for preservation which is recommended amount in juices but some countries have permission for up to 0.15% to 0.25 %. Sorbic acid such as sorbates are widely used as preservative in juices which act as antimicrobial agent to control microorganisms in food and food products [5]. It is effective if it is used in the range of 0.03-0.05 %. Sorbates are used in the products like jam, jellies while benzoic acid is used in the fruits products such as juices, squashes as they already have acidic pH. It is permitted in the range of 0.01-0.02% which is effective range in these products [6]. Grapes are very important berry fruit but are highly perishable and have very short shelf life [7]. During peak season they are produced in abundance but due to improper storage and handling facilities their losses occur. They are processed through different technical application to different products such as juice, squashes, syrup and jam to make their availability possible at any season of the year. Beverages are liked by consumers in the hot weather. Usually citrus fruits are

used for extracting juices but with the emerging technologies new fruits are also utilized to produce consumer oriented products in every season. To give satisfaction to the taste buds of diabetic patients, different juices are prepared with non-nutritive sweeteners [8]. Keeping in mind the rising demands of the product, nutritional significance and recommendations of health professionals, this study was designed. This study aimed to evaluate the effect of sodium benzoate, potassium sorbate, potassium metabisulphite and storage duration on keeping quality of grapes juice.

Materials and methods

Good quality grapes were purchased from local market of Peshawar and were brought to food processing and analytical Laboratory of The University of Agriculture, Peshawar. After washing cleaning and stemming juice was extracted with the help of electric juicer and was filtered with muslin cloth. Total seven samples were made with concentrations of sodium benzoate, potassium sorbate and potassium metabisulphite, as shown in (Table 1).

Table 1. Sample plan

J ₀	Grapes juice + no preservative
J ₁	Grapes juice + Potassium metabisulphite (0.1%)
J ₂	Grapes juice + Sodium benzoate (0.1%)
J ₃	Grapes juice + potassium sorbate (0.1%)
J ₄	Grapes juice + Potassium metabisulphite (0.05%) + Potassium sorbate (0.05%)
J ₅	Grapes juice + Potassium metabisulphite (0.05%) + Sodium benzoate (0.05%)
J ₆	Grapes juice + potassium sorbate (0.05) + Sodium benzoate (0.05)

All samples were stored in plastic bottles at room temperature. They were analysed physiochemically (pH, total soluble solids,

acidity, ascorbic acid, reducing sugars and non-reducing sugar) and organoleptically (color, flavor, taste and overall acceptability) for total period of 90 days at 15 days interval.

Physiochemical Analysis

All the samples were analyzed physiochemically for pH, total soluble solids, % acidity Ascorbic acid, reducing sugars and non-reducing sugars according to the standard methods of [9].

Organoleptic evaluation

All samples were presented to a panel of ten trained judges and were analyzed for color, flavor, taste and overall acceptability using 9 points hedonic scale as was described by [10].

Statistical Analysis

Data was statistically analyzed by CRD 2 factorial design as recommended by [11] and means were separated by applying least

significant difference (LSD) test at α (<0.05) probability level as defined by [12].

Results and discussion

Ascorbic acid (mg/ 100g) of grapes juice samples

There was a gradual decrease in ascorbic acid content of samples during storage. The average ascorbic acid value was decreased from 25.8 to 12.5 at α value less than 0.05. Maximum average value was observed in J₅ (22.9) and minimum in J₂ (16.4). Highest percent decrease in ascorbic acid content was observed in J₀ (70.40%) and lowest in J₂ (39.27%) as shown in (Table 2). Decrease in ascorbic acid content was also reported by [13] in his work on apple juice samples, by [14] in grape juice samples, by [15] in apple pulp samples, by [16] in apple juice samples, by [17] in kinnow juice samples, and by [18] in mango leather samples.

Table 2. Effect on ascorbic acid content of grapes juice samples

Treatments	Storage intervals (Days)							%Decrease	Average
	Fresh	15	30	45	60	75	90		
J ₀	25.2	22.4	19.0	16.0	13.0	10.0	7.3	70.4	16.4f
J ₁	25.1	23.8	20.1	18.3	14.9	12.2	9.5	62.15	17.7d
J ₂	24.7	22.6	20.5	17.4	15.2	12.0	10.1	59.10	17.5e
J ₃	27.2	25.5	24.2	22.0	20.8	18.6	14.4	47.05	21.8b
J ₄	24.7	22.5	21.5	20.3	19.0	17.2	15.0	39.27	20.0a
J ₅	27.1	25.7	24.5	22.3	20.8	17.2	16.0	40.95	22.9c
J ₆	27.0	25.7	22.5	22.5	21.2	18.5	15.7	41.85	21.8c
Average	25.8d	24.0d	25.3c	19.9b	17.97b	15.1a	12.5a		

pH of grapes juice samples

There was a gradual decrease in pH content of samples. The average pH value was decreased from 4.10 to 3.71 at α value less than 0.05. Maximum average value was observed in J₄ (4.24) and minimum in J₀ (3.76). Highest % decrease in pH content was observed in J₀ (17.23%) and minimum in J₄ (4.06%) as shown in (Table 3). Decrease in pH during storage was also reported by [19] in guava pulp samples, by [20] in strawberry juice samples, by [21] in pineapple leather

samples and by [22] in cashew apple juice samples.

Total soluble solids (° Brix) of grapes juice samples

There was a gradual increase in total soluble solids content of samples. The average value was increased from 18.42 to 19.31 at α value less than 0.05. Maximum average value was observed in J₄ (21.84) and minimum in J₀ (15.04). Highest % increase in total soluble solids content was observed in J₀ (7.46%) and minimum in J₄ (2.79%) as shown in (Table 4). These results are in agreements with the

findings of [23] in mango pulp samples. The same slow increase in total soluble solids content was also shown by [24] in their

spinach orange carrot juice samples and by [25] in lime juice samples.

Table 3. Effect on pH of grapes juice samples

Treatments	Storage intervals (Days)							%Decrease	Average
	Fresh	15	30	45	60	75	90		
J ₀	4.12	4.12	4.07	3.62	3.52	3.49	3.41	17.23	3.76e
J ₁	4.08	4.09	3.84	3.95	3.83	3.81	3.75	8.08	3.90cd
J ₂	4.07	4.12	4.05	3.95	3.89	3.82	3.79	6.87	3.95bc
J ₃	4.11	4.14	4.11	4.03	3.97	3.91	3.82	7.05	4.01b
J ₄	4.18	4.45	4.37	4.28	4.21	4.19	4.01	4.06	4.24a
J ₅	4.04	4.06	4.00	3.90	3.70	3.69	3.63	10.14	3.86cde
J ₆	4.12	4.00	3.95	3.76	3.71	3.65	3.59	12.86	3.82de
Average	4.10a	4.14a	4.05a	3.92b	3.83bc	3.79cd	3.71d	9.51	

Table 4. Effect on total soluble solids of grapes juice samples

Treatments	Storage intervals (Days)							% Increase	Average
	Fresh	15	30	45	60	75	90		
J ₀	14.5	14.5	15.0	15.1	15.2	15.5	15.	7.46	15.07f
J ₁	19.0	19.0	19.5	19.6	19.8	19.8	19.9	4.13	19.51d
J ₂	15.5	15.5	15.6	15.8	16.0	16.2	16.2	4.51	15.82e
J ₃	19.5	19.6	20.0	20.2	20.2	20.5	20.7	6.15	20.1b
J ₄	21.5	21.7	21.7	21.9	21.9	22.1	22.1	2.79	21.84a
J ₅	19.5	19.7	20.0	20.0	20.0	20.1	20.1	3.07	19.91c
J ₆	19.5	19.5	19.5	19.7	20.0	20.2	20.5	5.12	19.84c
Average	18.42d	18.5d	18.75c	18.9b	19.01b	19.2a	19.31a		

Titrateable acidity (%) of grapes juice samples

There was a gradual increase in acidity content of samples. The average value was increased from 1.09 to 1.32 at α value less than 0.05. Maximum average value was observed in J₅ (1.69) and minimum in J₂ (0.92). Highest

% increase in acidity content was observed in sample J₀ (41.00) and minimum in J₄ (11.18) as shown in (Table 5). The same increasing trend in acidity was also reported by [26] in grape juice samples and by [27] in pomegranate syrup sample.

Table 5. Effect on titrateable acidity (%) of grapes juice samples

Treatments	Storage intervals (Days)							%Increase	Average
	Fresh	15	30	45	60	75	90		
J ₀	0.90	1.0	1.71	1.97	1.24	1.31	1.41	41.00	0.98e
J ₁	1.00	1.02	1.06	1.09	1.09	1.11	1.13	13.00	1.07d
J ₂	0.84	0.88	0.90	0.91	0.95	0.98	1.01	20.23	0.92f
J ₃	1.00	1.05	1.10	1.13	1.20	1.23	1.23	23.00	1.13c
J ₄	1.43	1.43	1.51	1.55	1.57	1.57	1.59	11.18	1.52b
J ₅	1.49	1.60	1.65	1.70	1.78	1.82	1.88	26.17	1.69a
J ₆	1.03	1.07	1.11	1.17	1.21	1.23	1.27	23.30	1.15c
Average	1.09e	1.12e	1.71a	1.21d	1.25c	1.29b	1.32b		

Reducing sugar of grapes juice samples.

There was a gradual increase in reducing sugars content of samples. The average value was increased from 11.0 to 13.35 at α value less than 0.05. Maximum average value was observed in J₁ (13.55) and minimum in J₂ (9.90). Highest % increase in reducing sugars

content was observed in J₀ (69.51%) and minimum in J₄ (8.81%) as shown in (Table 6). The same increase in reducing sugars content was reported by [28] in strawberry juice samples and by [29] on dehydrated mango slices

Table 6. Effect on reducing sugar of grapes juice samples

Treatments	Storage intervals (Days)							%Increase	Average
	Fresh	15	30	45	60	75	90		
J ₀	8.20	8.45	12.20	12.50	12.95	13.50	13.90	69.51	11.70c
J ₁	11.90	12.20	12.92	13.21	14.22	14.90	15.50	30.25	13.55a
J ₂	9.00	9.21	9.42	9.80	10.20	10.50	11.00	22.22	9.90d
J ₃	11.11	11.70	12.00	12.52	12.70	12.95	13.50	21.57	12.35bc
J ₄	12.82	12.92	13.20	13.50	13.79	13.80	13.95	8.81	13.40a
J ₅	12.20	12.42	12.62	12.80	12.95	13.20	13.40	9.83	12.80ab
J ₆	11.11	11.42	11.62	11.79	11.86	11.95	12.20	9.81	11.70c
Average	11.00e	11.18de	11.90cd	12.30bc	12.66abc	12.90ab	13.35a		

Non-reducing sugar

There was a gradual decrease in non-reducing sugars content of samples. The average value was decreased from 2.39 to 1.27 at α value less than 0.05. Maximum average value was observed in J₂ (2.96) and minimum in J₀ (0.55). Highest % decrease in

non-reducing sugars content was observed in J₄ (83.33%) and minimum in J₂ (36.22%) as shown in (Table 7). The same decreasing trend in non-reducing sugars content was also shown by [30] in melon cube samples treated with non-caloric sweeteners and by [31] in kinnow juice samples.

Table 7. Effect on non-reducing sugars of grapes juice samples

Treatments	Storage intervals (Days)							Average	%Decrease
	Fresh	15	30	45	60	75	90		
J ₀	1.03	0.93	0.50	0.30	0.12	0.40	0.55	0.547e	46.60
J ₁	3.18	2.60	2.58	2.31	2.24	2.20	2.00	2.44b	37.10
J ₂	3.92	3.15	3.04	3.01	2.61	2.50	2.50	2.96a	36.22
J ₃	1.60	1.48	1.38	1.30	1.10	0.80	0.80	1.20d	50.00
J ₄	1.20	1.15	1.00	0.62	0.57	0.32	0.20	0.72e	83.33
J ₅	1.90	1.80	1.50	1.40	1.30	1.20	1.00	1.44c	47.36
J ₆	3.90	3.40	3.10	3.29	2.59	2.20	1.90	2.91a	51.28
Average	2.39a	2.07b	1.87bc	1.77c	1.50d	1.37de	1.27e		

Colour score of grape juice samples

There was a gradual decrease in color score of grape juice samples. The average score was decreased from 7.54 to 5.45 at α value less than 0.05. Maximum average score was achieved by J₆ (7.60) and minimum by J₀

(5.28). Highest % decrease in color score was observed in J₁ (53.30%) and minimum by J₄ (8.00%) as shown in (Table 8). The same decrease in color score was shown by [32] in post-harvest dried samples and by [33] in lime and orange juice samples.

Table 8. Effect on color score of grapes juice samples

Treatments	Storage Intervals (Days)							Average	% Decrease
	Fresh	15	30	45	60	75	90		
J ₀	7.30	6.5	5.5	5.0	4.5	4.2	4.0	5.28c	45.20
J ₁	7.5	6.8	6.0	5.5	5.0	4.6	3.5	5.55c	53.30
J ₂	7.0	6.5	6.2	5.5	5.0	4.2	3.4	5.40c	51.40
J ₃	7.5	7.2	7.0	7.0	6.6	6.5	6.5	6.90b	13.33
J ₄	7.5	7.2	7.10	7.10	7.00	6.90	6.90	7.10ab	8.00
J ₅	8.0	8.00	7.50	7.50	7.00	7.00	6.90	7.41ab	13.75
J ₆	8.0	8.00	7.90	7.50	7.40	7.40	7.00	7.60a	12.50
Average	7.54a	7.17ab	6.74b	5.65c	5.35c	5.22c	5.45c		

Flavor score of grape juice samples

There was a gradual decrease in flavor score of samples. The average score was decreased from 7.30 to 5.58 at α value less than 0.05. Maximum average score was achieved by J₆ (7.25) and minimum by T₁ (5.52). Highest % decrease in flavor score was observed in J₂ (50 %) and minimum in J₆ (12.43%) as shown in (Table 9). The same decrease in flavor score was observed by [34] in orange juice samples. The work of [35] in different juice samples are also in accordance with our results. The same decrease in flavor score was reported by [36] in mandrine juice samples.

Taste score of grape juice samples

There was a gradual decrease in taste score of grapes juice samples. The average score was decreased from 7.62 to 5.18 at α value less than 0.05. Maximum average score was achieved by J₄ (7.11) and minimum by J₂ (4.78). Highest % decrease in taste score was

observed in J₂ (62.66%) and minimum in J₄ (8.00%) as shown in (Table 10). The same declining trend in taste score were shown by [37] in their study on jack fruit leather samples and by [38] in palmyrah fruit pulp samples.

Overall acceptability score of grape juice samples

There was a gradual decrease in overall acceptability score of samples. The average score was decreased from 7.48 to 5.41 at α value less than 0.05. Maximum average score was achieved by J₆ (7.37) and minimum by J₂ (5.27). Highest % decrease in overall acceptability score was observed in J₂ (54.35%) and minimum in J₄ (10.26%) as shown in (Table 11). The same declining trend in overall acceptability score were shown by [39] in apricot fruit bar samples, by [40] in orange juice stored in glass bottles and by [41] in guava fruit juice samples.

Table 9. Effect on flavor score of grapes juice samples

Treatments	Storage Intervals (Days)							Average	% Decrease
	Fresh	15	30	45	60	75	90		
J ₀	7.00	6.80	6.50	6.20	6.15	6.00	5.70	6.33c	18.57
J ₁	6.90	6.50	6.00	5.40	5.20	4.90	3.80	5.52d	44.92
J ₂	7.00	6.80	6.70	6.00	5.40	4.10	3.50	6.14c	50.00
J ₃	7.20	7.00	6.80	6.50	6.40	6.20	6.10	6.60bc	15.27
J ₄	7.50	7.00	6.90	6.80	6.70	6.50	6.40	6.82ab	14.66
J ₅	7.70	7.20	7.00	6.90	6.90	6.80	6.70	7.02ab	12.98
J ₆	7.80	7.70	7.60	7.00	6.90	6.90	6.90	7.25a	12.43
Average	7.30a	7.00ab	6.78bc	6.40cd	6.23de	5.91ef	5.58f		

Table 10. Effect on taste score of grapes juice samples

Treatments	Storage Intervals (Days)							Average	%Decrease
	Fresh	15	30	45	60	75	90		
J ₀	7.60	6.00	6.00	5.50	4.50	3.50	3.00	5.14c	60.00
J ₁	7.60	7.00	6.50	6.00	5.80	5.40	5.00	6.18b	34.21
J ₂	7.50	6.30	5.40	4.30	4.00	3.20	2.80	4.78c	62.66
J ₃	7.60	7.00	6.50	5.80	5.50	5.40	5.00	6.11b	34.21
J ₄	7.50	7.20	7.20	7.10	7.00	6.90	6.90	7.11a	8.00
J ₅	7.80	7.50	7.00	7.00	6.80	6.70	6.60	7.05a	15.38
J ₆	7.90	7.50	7.30	7.20	7.11	7.00	7.00	7.28a	11.39
Average	7.62a	6.55b	6.55 b	6.12b c	5.81 cd	5.44 d	5.18 d		

Table 11. Effect on overall acceptability score of grapes juice samples

Treatments	Storage Intervals (Days)							Average	%Decrease
	Fresh	15	30	45	60	75	90		
J ₀	7.0	6.23	6.00	5.56	5.05	4.56	4.23	5.58c	41.73
J ₁	7.33	6.76	6.16	5.63	5.33	4.96	4.10	5.75c	44.06
J ₂	7.16	6.53	6.10	5.26	4.80	3.83	3.23	5.27c	54.35
J ₃	7.43	7.06	6.76	6.43	6.16	6.03	5.86	6.53b	21.13
J ₄	7.50	7.13	7.06	7.00	6.90	6.76	6.73	7.01ab	10.26
J ₅	7.83	7.56	7.16	7.13	6.90	6.83	6.76	7.16a	13.66
J ₆	7.90	7.73	7.60	7.23	7.13	7.10	6.96	7.37a	11.89
Average	7.48a	7.02ab	6.69bc	6.32cd	6.03de	5.72ef	5.41f		

Conclusion and recommendations

From this study it was concluded that addition of preservatives strongly affect the products shelf life and consumer acceptability. During this study we found J₄ [(grapes juice + potassium metabisulphite (0.05%) + potassium sorbate (0.05%)] remained very acceptable during storage while J₀ [grapes juice + no preservative] was found very bad. Future study is recommended on microflora assesment, micronutrients assesment and flavonoids and polyphenols extraction and can be added to other food products to prevent cancer in population. Further study is recommended on refrigeration temperature and mixing of more than two fruits is also recommended to make the product more nutritious. Nutritional assessment and packaging effect study is also recommended for future work.

Authors' contributions

Conceived and designed the experiments: M Ayub & JA Nasir, Performed the experiments: S Rani & JA Nasir, Analyzed the data: U Shahni & JA Nasir, Contributed materials/ analysis/ tools: A Zeb, U Shahni & S Rani, Wrote the paper: S Rani & Shahni.

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