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Effect of Different Antimicrobial Agents on Preservation of Watermelon Pulpy Juice

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Abstract: This research was conducted to study the effect of chemical preservatives such as sodium benzoate, potassium sorbate and potassium metabisulphite individually and in combination on preservation of watermelon pulpy juice, stored (in 250ml plastic bottles) at ambient temperature for the period of three months. The treatments were W_0 (watermelon pulpy juice without preservative), W_1 (0.1% sodium benzoate + 0.1% citric acid), W_2 (0.1% potassium sorbate + 0.1% citric acid), W_3 (0.05% sodium benzoate+0.05% potassium sorbate + 0.1% citric acid), W_4 (0.05% sodium benzoate+0.05%potassium meta-bisulphite + 0.1% citric acid) and W_5 (0.05% potassium sorbate+0.05% potassium meta-bisulphite + 0.1% citric acid). The juice was analyzed physicochemically for parameters such as ascorbic acid, pH, TSS, % acidity, sugar acid ratio , reducing sugar, non-reducing sugar and organoleptically evaluated for color, flavor and overall acceptability. Ascorbic acid decreased from 37.03 to 20.61 mg/100g, pH decreased from 4.77 to 4.32, TSS increased from 14.00 to 15.61° brix, titratable acidity increased from 0.19% to 0.27%, sugar acid ratio decreased from 74.06% to 58.36%, reducing sugar increased from 5.11% to 6.05%, non-reducing sugar decreased from 2.22% to 1.78%, mean score for color decreased from 8.08 to 5.58, flavor decreased from 7.75 to 4.08, and overall acceptability decreased from 7.90 to 3.96 during storage. Sample W_5 and W_4 were comparatively found the best during three months storage, statistical analysis indicated that treatments and storage period had a significant ($P<0.05$) effects on physico-chemical and sensory properties of watermelon pulpy juice.

Key words: Watermelon · Pulp juice · Preservatives

INTRODUCTION

Watermelon (*Citrullus lanatus)* belongs to the family Cucurbitaceae is a monoecious spreading annual vine with large pinnately lobed leave and it is grown for the large juicy sweet fruits. Fruits may be oblong or spherical in shape with a thick but fragile rind and can exceed 10-12 kg in weight. It consists of fleshy center usually deep red to pink, but sometimes orange, yellow and even green if not ripe. It has green, yellow and sometimes white smooth exterior rind [1]. Watermelon should be green in colour, tan or brown skins indicate over-ripeness. The soluble solid concentration should be at least 10%. Per fruit of water melon contain 93ml water, 0.5g protein, 0.1g fat, 5g carbohydrate, 0.4g fiber, 8mg calcium, 9mg phosphorus, 0.3mg iron, 250ug beta-carotene, 0.04mg thiamine, 0.05 mg riboflavin and 0.1mg niacin; it also provides 22 calories energy to the body [2]. The total production of watermelon in Pakistan from 2010-2011 was 150 989 ton [3]. Watermelon is a rich natural source of lycopene, a carotenoid of great interest because of its antioxidant capacity and potential health benefits. Watermelon is a source of lycopene in its fresh to frozen form. It was noted that no difference exist in the plasma lycopene concentration of the child who utilized fresh-frozen watermelon juice [4].

Juices are considered beneficent to human health because of sugars, vitamins, and minerals. Soft drinks filling at low temperature result in high water activity and microbial growth. It can be prevented by decreasing pH,

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increasing sugar content and by chemical preservatives [5]. Preservatives which are mostly used in soft drinks industry are sorbic acid and sorbates. Sorbic acid prevents yeasts and moulds growth and even some bacteria at low pH. The microbial growth is inhibited by the interaction of conjugated double bound in the aliphatic chain which can not metabolize by yeasts and moulds [6]. There are different methods to preserve the watermelon pulpy juice; chemical preservation is one of them. Shelf life of food products is extended by chemical preservatives. Only food graded preservatives are used in amount recommended by different agencies. There are different chemical preservatives used in preservation of food. Some of them are; sodium benzoate, potassium sorbate, sorbic acid, potassium metabisulphite and sulphur dioxide etc. Different factors are consider before selection of chemical preservatives, these are; nature of food, property of food, effect of chemical, microbial load, condition of handling and storage. Selection of chemical preservatives must be according to laws. Keeping in view the above various aspects of previous research carried out for various fruit juices preservation, this project was designed to study the effect of different antimicrobial agents on the preservation of watermelon pulpy juice.

MATERIALS AND METHODS

This research was conducted in the Department of Food Science and Technology Faculty of Nutrition Sciences, The University of Agriculture, Peshawar. The watermelon was purchased from the local market of Peshawar. Watermelon was cut in big pieces and seeds were separated. Pulp portion was grinded and were added sodium benzoate, potassium sorbate and potassium meta-bisulphite. These preservatives were used individually as well as in combination. Sucrose (4g/86ml) was added to increase total soluble solids up to 14%. Each sample was stored in 250ml transparent plastic bottle and stored at ambient temperature. The product was analyzed at 15 days interval for a total period of 90 days. Total soluble solids, pH, % acidity, ascorbic acid, sugar acid ratio, total sugar, reducing sugar, non reducing sugar were determined by ascribed method of AOAC [7]. Organoleptic evaluation of watermelon pulpy juice was carried out by panel of judges according to recommended method of Larmond [8]. Judges compared the samples by assigning score ranges from 1-9, where 1 and 9 represent extremely dislike and extremely like respectively. All the data was analyzed statistically by using complete randomized design (CRD) and means were separated by LSD test as described by Steel and Torrie [9].

RESULTS AND DISCUSSION

The watermelon pulpy juice sample was analyzed for physico-chemical and organoleptic properties (ascorbic acid, pH, TSS, % acidity, sugar acid ratio, reducing sugars, non-reducing sugars, color, flavor and overall acceptability).

Ascorbic Acid: Mean value of ascorbic acid significantly ($p<0.05$) decreased from 37.03mg/100g to 20.61 mg/100g during storage. For treatments, the maximum mean value of ascorbic acid was recorded in sample W_5 (32.24) followed by W_4(30.05) mg/100g, while the minimum mean value was observed in sample W_0(23.16) followed by W_3 (28.32) mg/100g. The maximum decrease was recorded in sample W_0 (60.62%) followed by W_2 (49.34%) and the minimum decrease was observed in sample W_5 (31.81%) followed by W_4(38.32%) (Table 1). Ascorbic acid content of watermelon pulpy juice was significantly ($p<0.05$) affected by treatments and storage period. Negi and Roy [10] investigated that addition of potassium metabisulphite minimize the losses of ascorbic acid content during storage period. Findings of Kinh [11] matched with this result, who recorded a decrease in ascorbic acid content in apple pulp. High temperature and light during storage causes loss in ascorbic acid. Same result was reported by Mehmood [12] reported that during storage ascorbic acid content was decreased. Zeb [13] conducted research on grape juice and observed that during storage under ambient temperature ascorbic acid content was decreased.

The pH: Mean pH significantly ($p<0.05$) decreased from 4.77 to 4.32 during storage. For treatments, the maximum mean value of pH was recorded in sample W_0 (5.30) followed by W_5(4.47), while the minimum mean value was observed in sample W_2(4.26) followed by W_3 (4.35). The maximum decrease was recorded in sample W_0 (13.83%) followed by W_2 (10.44%), while the minimum decrease was observed in sample W_5 (6.66%) followed by W_4 (7.14%) (Table-2). The pH value of watermelon pulpy juice was significantly ($p<0.05$) affected by treatments and storage period. These results are in agreement with those obtained by Cecilia and Maia [17] who, reported a decrease was observed in pH of apple juice having high pulp content during storage. The reeducation in pH may be due to the breakdown of pectin and formation of free acid [14]. During processing and storage pH was decreased, as the same results were obtained by Zeb [13]. During storage of watermelon pulpy juice, there was

Table 1: Effect of different antimicrobial agents and storage period at ambient temperature on ascorbic acid (mg/100g) of watermelon pulpy juice.

	Storage period (Days)								
Treatments	Initial	15	30	45	60	75	90	% Decrease	Mean
W_0	35.20	31.27	26.08	22.04	18.10	15.63	13.86	60.62	23.16e
W_1	37.32	34.91	31.10	28.44	25.02	23.20	21.49	42.41	28.78bc
W_2	36.07	32.25	29.15	26.41	23.22	20.42	18.27	49.34	26.54d
W_3	37.21	34.14	31.07	28.18	25.06	22.18	20.43	45.09	28.32c
W_4	38.17	35.05	32.38	29.05	27.16	25.03	23.54	38.32	30.05b
W_5	38.25	36.42	34.19	32.47	30.06	28.25	26.08	31.81	32.24a
Means	37.03a	34.00b	30.66c	27.76d	24.77e	22.45f	20.61g		

LSD value for storage interval = 1.5012

LSD value for treatments = 1.3898

Figures with different small letters are statistically different ($p<0.05$).

Table 2: Effect of different antimicrobial agents and storage period at ambient temperature on pH of watermelon pulpy juice.

	Storage period (Days)								
Treatments	Initial	15	30	45	60	75	90	%Decrease	Mean
W_0	5.71	5.58	5.41	5.29	5.17	5.06	4.92	13.83	5.30a
W_1	4.61	4.55	4.49	4.41	4.36	4.29	4.24	8.02	4.42bc
W_2	4.50	4.43	4.32	4.25	4.18	4.11	4.03	10.44	4.26d
W_3	4.58	4.50	4.43	4.35	4.26	4.19	4.15	9.38	4.35c
W_4	4.62	4.51	4.47	4.43	4.38	4.34	4.29	7.14	4.43b
W_5	4.64	4.58	4.52	4.46	4.42	4.37	4.34	6.66	4.47b
Means	4.77a	4.69b	4.60c	4.53cd	4.46de	4.39ef	4.32f		

LSD value for storage interval = 0.0767

LSD value for treatments = 0.0710

Figures with different small letters are statistically different ($p<0.05$).

Table 3: Effect of different antimicrobial agents and storage period at ambient temperature on TSS of watermelon pulpy juice.

	Storage period (Days)								
Treatments	Initial	15	30	45	60	75	90	% Increase	Mean
W_0	14.0	14.1	14.4	14.8	15.2	15.7	16.1	15.00	14.90a
W_1	14.0	14.4	14.7	14.9	15.1	15.3	15.5	10.71	14.84a
W_2	14.0	14.3	14.6	14.9	15.3	15.5	15.8	12.85	14.91a
W_3	14.0	14.2	14.4	14.7	15.1	15.4	15.6	11.42	14.77ab
W_4	14.0	14.4	14.6	14.8	15.0	15.2	15.4	10.00	14.77ab
W_5	14.0	14.2	14.4	14.6	14.8	15.0	15.3	9.28	14.61b
Means	14.00g	14.26f	14.51e	14.78d	15.08c	15.35b	15.61a		

LSD value for storage interval = 0.1768

LSD value for treatments = 0.1637

Figures with different small letters are statistically different ($p<0.05$).

a proportional increase in acidity as the pH decreased. The degradation of reducing sugar and pectin forms an acidic compound which might causes increase in acidity.

Total Soluble Solids (TSS): Mean value of TSS significantly ($p<0.05$) increased from 14.00 to 15.61° brix during storage. For treatments, the maximum mean value of TSS was recorded in sample W_2 (14.91° brix) followed by W_0 (14.90° brix) and the minimum mean value was observed in sample W_5 (14.61° brix) followed by W_3 andW_4(14.77° brix). The maximum increase was recorded in sample W_0 (15.00%) followed by W_2 (12.85%) and minimum increase was observed in sample W_5 (9.28%) followed by W_4 (10.00%) (Table-3). Increase in temperature and inversion of sucrose into glucose and fructose might be result in increase in total soluble solids. TSS of watermelon pulpy juice was significantly ($p<0.05$) affected by treatments and storage period. At room temperature a significant increase occur in TSS of watermelon pulpy juice, these results were reported to be in favor with the work of Zeb [13]. Muhammad [15] reported that at room temperature the chemical, physical

Table 4: Effect of different antimicrobial agents and storage period at ambient temperature on % acidity of watermelon pulpy juice.

	Storage interval (Days)								
Treatments	Initial	15	30	45	60	75	90	% Increase	Mean
W_0	0.12	0.14	0.15	0.16	0.17	0.18	0.19	58.33	0.15f
W_1	0.21	0.23	0.25	0.26	0.27	0.28	0.29	38.09	0.25c
W_2	0.23	0.25	0.27	0.29	0.31	0.32	0.33	43.47	0.28a
W_3	0.22	0.24	0.26	0.28	0.29	0.30	0.31	40.90	0.27b
W_4	0.21	0.23	0.24	0.25	0.26	0.27	0.28	33.33	0.24d
W_5	0.20	0.21	0.22	0.23	0.24	0.25	0.26	30.00	0.23e
Mean	0.19g	0.21f	0.23e	0.24d	0.25c	0.26b	0.27a		

LSD value for storage interval = 0.0425

LSD value for treatments = 0.0391

Figures with different small letters are statistically different ($p<0.05$).

Table 5: Effect of different antimicrobial agents and storage period at ambient temperature on sugar acid ratio of watermelon pulpy juice.

	Storage period (Days)								
Treatments	Initial	15	30	45	60	75	90	% Decrease	Mean
W_0	116.6	100.7	96.00	92.50	89.41	87.22	84.73	27.33	95.30a
W_1	66.66	62.60	58.80	57.30	55.92	54.64	53.44	19.83	58.48c
W_2	60.86	57.20	54.07	51.37	49.35	48.43	47.87	21.34	52.7d
W_3	63.63	59.16	55.38	52.50	52.06	51.33	50.32	20.91	54.91d
W_4	66.66	62.60	60.83	59.20	57.69	56.29	55.00	17.49	59.75c
W_5	70.00	67.61	65.45	63.47	61.66	60.00	58.84	15.94	63.86b
Means	74.06a	68.31b	65.08c	62.72cd	61.01de	59.65de	58.36e		

LSD value for storage interval = 0.8351

LSD value for treatments = 0.9427

Figures with different small letters are statistically different ($p<0.05$).

and sensory evaluation of citrus squash affected by the florescent. By storing squash for five months, a significant increase was observed in TSS. During storage, an increase in total soluble solids of fruit juices was observed by several other researchers as well. Sattar and Rehman [16] observed the effect of canning and storage of kinnow juice, during storage gradual increase occurs in total soluble solids.

Titratable Acidity: Mean value of % acidity significantly ($p<0.05$) increased from 0.19 to 0.27 during storage. For treatments, the maximum mean value of %acidity was recorded in sample W_2 (0.28) followed by W_3 (0.27), while the minimum mean value was observed in sample W_0 (0.15) followed by W_5 (0.23). The maximum increase was recorded in sample W_0(58.33%) followed by W_2 (43.47%) and the minimum increase was observed in sample W_5 (30.00%) followed by W_4(33.33%) (Table 4). Titratable acidity of watermelon pulpy juice was significantly ($p<0.05$) affected by treatments and storage period. Similar results obtained from study of Mehmood [12] stated that during storage and processing of fruit juices pH was decreased and acidity was increased. Cecilia and Maia [17] reported that titratable acidity was increased in pulp apple juice. High storage temperature is responsible for increasing in acidity, oxidation or degradation of reducing sugar or pectic body's breakdown into pectinic acid causes the formation of acidic compounds.

Sugar Acid Ratio: Mean value of sugar acid ratio significantly ($p<0.05$) decreased from 74.06 to 58.36 during storage. For treatments, the maximum mean value of sugar acid ratio was recorded in sample W_0 (95.30) followed by W_5 (63.86) and the minimum mean value was observed in sample W_2 (52.73) followed by W_3 (54.91). The maximum decrease was recorded in sample W_0 (27.33%) followed by W_2 (21.34%) and the minimum decrease was observed in sample W_5 (15.94%) followed by W_4 (17.49%) (Table 5). Sugar acid ratio of watermelon pulpy juice was significantly ($p<0.05$) affected by treatments and storage period. These results are in agreement with those obtained by Chyau [18], they found that during the ripening of guava fruit, the contents of total pectin, total sugar, reducing sugar and acidity dropped obviously from the mature to the ripe stage but the sugar acid ratio increased inversely.

Table 6: Effect of different antimicrobial agents and storage period at ambient temperature on % reducing sugars of watermelon pulpy juice

	Storage period (Days)								
Treatments	Initial	15	30	45	60	75	90	% Increase	Mean
W_0	5.02	5.19	5.27	5.44	5.65	5.78	6.12	21.91	5.49d
W_1	5.11	5.35	5.42	5.58	5.76	5.90	6.08	18.98	5.60b
W_2	5.09	5.31	5.42	5.51	5.73	5.92	6.10	19.84	5.58bc
W_3	5.07	5.24	5.31	5.49	5.67	5.89	6.04	19.13	5.53cd
W_4	5.13	5.49	5.57	5.69	5.82	5.94	6.01	17.15	5.66a
W_5	5.16	5.38	5.48	5.62	5.83	5.96	6.00	16.27	5.63ab
Means	5.11g	5.32f	5.41e	5.55d	5.74c	5.89b	6.05a		

LSD value for storage interval = 0.0656

LSD value for treatments = 0.0607

Figures with different small letters are statistically different ($p<0.05$).

Table 7: Effect of different antimicrobial agents and storage period at ambient temperature on % non-reducing sugars of watermelon pulpy juice

	Storage period (Days)								
Treatments	Initial	15	30	45	60	75	90	% Decrease	Mean
W_0	2.40	2.30	2.21	2.13	2.01	1.92	1.85	22.91	2.11a
W_1	2.02	1.96	1.89	1.82	1.75	1.69	1.64	18.81	1.82e
W_2	2.35	2.29	2.20	2.11	2.04	1.95	1.87	20.42	2.11a
W_3	2.11	2.06	1.97	1.89	1.82	1.76	1.69	19.90	1.90d
W_4	2.29	2.22	2.16	2.07	1.98	1.91	1.87	18.34	2.07b
W_5	2.19	2.11	2.02	1.95	1.88	1.84	1.81	17.35	1.97c
Means	2.22a	2.15b	2.07c	1.99d	1.91e	1.84f	1.78g		

LSD value for storage interval = 0.0304

LSD value for treatments = 0.0282

Figures with different small letters are statistically different ($p<0.05$).

Reducing Sugars: Mean value of reducing sugar significantly ($p<0.05$) increased from 5.11 to 6.05% during storage. For treatments, the maximum mean value of reducing sugar was recorded in sampleW_4 (5.66) followed by W_5 (5.63) and the minimum mean value was observed in sample W_0 (5.49) followed byW3 (5.53). The maximum increase was recorded in sample W_0 (21.91%) followed by W_2 (19.84%) and the minimum increase was observed in sample W_5 (16.27%) followed by W_4 (17.15%) (Table 6). Reducing sugar of watermelon pulpy juice was significantly ($p<0.05$) affected by treatments and storage period. These results match with the study of Mehmood [12] reported that in packed orange apple reducing sugar was increased which may be due to conversion of non reducing sugars to reducing sugars. In a related study Kinh [11] who stated that during storage reducing sugar was increased in apple pulp. The raise in reducing sugar may be due to the inversion of sucrose to reducing sugar because of acids and high temperature during preservation at high temperature and acid the sucrose invert to reducing sugar cause to increase the value of reducing sugar (glucose + fructose) Hashmi [19].

Non-reducing Sugars: Mean value of non-reducing sugar significantly ($p<0.05$) decreased from 2.22 to 1.78% during storage. For treatments, the maximum mean value of non-reducing sugar was recorded in sample W_0 and W_2 (2.11) followed by W_4 (2.07) and the minimum mean value was observed in sample W_1 (1.82) followed by W_3 (1.90). The maximum decrease was recorded in sample W_0 (22.91%) followed by W_2 (20.42%) and the minimum decrease was observed in sample W_5 (17.35%) followed by W_4 (18.34%) (Table 7). Non-reducing sugar of watermelon pulpy juice was significantly ($p<0.05$) affected by treatments and storage period. These results are in agreement with the findings of Kinh [11], who reported that during storage reducing sugar increased in apple pulp. Hashmi [19] observed that reduction in non-reducing may be inverted to reducing sugar. In a similar study Mehmood [12] stated that during preservation and storage of grape juice at ambient temperature high value of reducing sugars and minimum value of non reducing sugar was observed.

Organoleptic Evaluation: Samples of watermelon pulpy juice were evaluated for color, flavor and overall acceptability by the recommended method of Larmond

Table 8: Effect of different antimicrobial agents and storage period at ambient temperature on color of watermelon pulpy juice

	Storage period (Days)								
	Score Rate at 9 Point Hedonic Scale								
Treatments	Initial	15	30	45	60	75	90	% Decrease	Mean
W_0	8.5	6.9	6.5	5.2	4.5	3.9	3.4	60.00	5.55d
W_1	8.5	7.6	7.2	6.8	6.5	6.2	6.0	29.41	6.97b
W_2	8.5	7.3	6.7	6.0	5.8	5.0	4.5	47.05	6.25c
W_3	8.5	7.4	6.8	6.0	5.9	5.5	4.9	42.35	6.42bc
W_4	8.5	8.2	8.0	7.8	7.6	7.5	7.4	12.94	7.85a
W_5	8.5	8.2	8.0	7.8	7.6	7.4	7.3	14.11	7.82a
Mean	8.50a	7.60b	7.20bc	6.60cd	6.31de	5.91ef	5.58f		

LSD value for storage interval = 0.6677

LSD value for treatments = 0.6182

Figures with different small letters are statistically different ($p<0.05$).

Table 9: Effect of different antimicrobial agents and storage period at ambient temperature on flavor of watermelon pulpy juice

	Storage period (Days)								
	Score Rate at 9 Point Hedonic Scale								
Treatments	Initial	15	30	45	60	75	90	% Decrease	Mean
W_0	8.5	5.0	4.2	3.3	2.4	1.0	1.0	88.23	3.62c
W_1	8.6	7.0	6.5	6.0	5.5	5.0	4.5	47.67	6.15b
W_2	8.6	6.8	6.0	5.3	4.4	3.5	3.0	65.11	5.37b
W_3	8.6	6.9	6.3	5.8	4.9	4.2	3.5	59.30	5.74b
W_4	8.6	7.6	7.2	6.8	6.5	6.2	5.9	31.39	6.97a
W_5	8.6	7.8	7.6	7.4	7.2	7.0	6.8	20.93	7.48a
Mean	8.58a	6.85b	6.30bc	5.76cd	5.15de	4.48ef	4.11f		

LSD value for storage interval = 0.8783

LSD value for treatments = 0.8132

Figures with different small letters are statistically different ($p<0.05$).

[8]. Panel of 10 judges were assign to score them between 9-1. Extremely like and dislike was represented by 9 and 1, respectively.

Color: Mean score for color was significantly ($p<0.05$) decreased from 8.50 to 5.58 during storage. For treatments,the maximum mean value was recorded in sample W_4 (7.85) followed by W_5 (7.82), while the minimum mean value was observed in sample W_0 (5.55) followed by W_2 (6.25). The maximum decrease was recorded in sample W_0(60.00%) followed by W_2 (47.05%) and minimum decrease was observed in sample W_5 (14.11%) followed by W_4 (12.94%) (Table 8). Color of watermelon pulpy juice was significantly ($p<0.05$) affected by treatments and storage period. Similar results were obtained by Brenndor [20], who reported that browning of fruits and vegetables reduces by the use of SO_2. The reduction in color scores might be due to Millard reaction accelerated during storage. In fruit juices and syrup precipitation occur due to high temperature. Zeb [13] analyzed the reduction in color stored at room temperature. The change in color during storage was due to browning reaction between amino acid and reducing sugars, speed up by high temperature. During storage at high temperature browning reaction between reducing sugar and amino acid accelerated which is responsible to change the color.

Flavor: Mean score for flavor was significantly ($p<0.05$) decreased from 8.58 to 4.11 during storage. For treatments, the maximum mean value was recorded in sample W_5 (7.48) followed by W_4 (6.97), while the minimum mean value was observed in sample W_0 (3.62) followed by W_2 (5.37). The maximum decrease was recorded in sample W_0 (88.23%) followed by W_2 (65.11%) and the minimum decrease was observed in sample W_5 (20.93%) followed by W_4(31.39%) (Table 9). Flavor of watermelon pulpy juice was significantly ($p<0.05$) affected by treatments and storage period. This result is in agreement with the findings of Kinh [11], who reported that during storage

Table 10: Effect of different antimicrobial agents and storage period at ambient temperature on overall acceptability of watermelon pulpy juice

	Storage period (Days)								
	Score Rate at 9 Point Hedonic Scale								
Treatments	Initial	15	30	45	60	75	90	% Decrease	Mean
W_0	8.4	5.5	4.0	3.0	1.0	1.0	1.0	88.09	3.41d
W_1	8.5	7.3	6.7	6.2	5.7	5.1	4.4	48.23	6.27bc
W_2	8.5	7.0	6.3	5.6	4.5	3.4	2.6	69.41	5.41c
W_3	8.5	7.2	6.4	5.8	4.9	4.3	3.5	58.82	5.80c
W_4	8.5	7.6	7.0	6.6	6.4	6.2	6.0	29.41	6.90ab
W_5	8.5	7.8	7.5	7.2	7.0	6.8	6.7	21.17	7.35a
Mean	8.48a	7.06b	6.31bc	5.73cd	4.91de	4.46e	4.03e		

LSD value for storage interval = 0.9862

LSD value for treatments = 0.9130

Figures with different small letters are statistically different ($p<0.05$).

apple pulp maintained better flavor when preserved with chemical preservatives.The flavor loss is due to the furfural production and losses of ascorbic acid content which causes loss of flavor as explained by Shimoda and Osajima [21]. In orange juice accumulation of furfural level was useful indicator for the development of off flavor during storage.

Overall Acceptability: Mean score for overall acceptability was significantly ($p<0.05$) decreased from 8.48 to 4.03 during storage. For treatments, the maximum mean value was recorded in sample W_5 (7.35) followed by W_4 (6.90), while the minimum mean value was observed in sample W_0 (3.41) followed by W_2 (5.41). The maximum decrease was recorded in sample W_0(88.09%) followed by W_2 (69.41%) and the minimum decrease was observed in sample W_5(21.17%) followed by W_4(29.41%) (Table 10). Overall acceptability of watermelon pulpy juice was significantly ($p<0.05$) affected by treatments and storage period. Similar results were obtained by Rosario [22],who reported that progressive degradation occurred in overall acceptability by increasing temperature and storage duration. The loss of overall acceptability was due to the loss of ascorbic acid and furfural production as analyzed by Shimoda and Osajima[21] reported that the degradation of ascorbic acid and furfural production causes the loss of overall acceptability. During storage furfural level was accumulated in orange juice which was useful sign for overall acceptability.

CONCLUSION

In this research work watermelon pulpy juice was preserved with chemical preservatives as sodium benzoate, potassium sorbate and potassium metabisulphite, stored in 250ml plastic bottles at ambient temperature for three months. The parameters studied were ascorbic acid, pH, TSS, %acidity, sugar acid ratio, reducing sugar, non-reducing sugar and organoleptic evaluation (color, flavor and overall acceptability). Sample W_5 (0.05% potassium sorbate+0.05% potassium meta-bisulphite + 0.1% citric acid) and W_4 (0.05% sodium benzoate+0.05% potassium meta-bisulphite + 0.1% citric acid) were found the best, while W_0 (watermelon pulpy juice without preservative) showed poor results below the scale of sensory acceptability.

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