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EFFECT OF POTASSIUM SORBATE AND SODIUM BENZOATE ON THE QUALITY AND SHELF-LIFE OF STRAWBERRY JAM DURING STORAGE

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ABSTRACT

As well as selection of proper preservative, determining its optimum concentration is of paramount importance for maintaining food quality during storage. The present study evaluated the effect of two preservatives, i.e. potassium sorbate and sodium benzoate on the shelf-life and quality of strawberry jam. These preservatives were applied separately and in combination with different concentrations making up to a total of 7 treatments plus a non-treated control. The experiment was laid out in a randomized complete block design. The effect was studied at 7 storage intervals starting from day 1 to day 90 after jam development. Various parameters such as ascorbic acid content, pH, total soluble solids, sugar acid ratio, amount of reducing and non-reducing sugars, texture and flavor were studied. Significant differences were observed for all the studied parameters. The combined addition of 0.05 % each potassium sorbate and sodium benzoate to the jam proved to be the best combination in terms of extending the shelf-life and improving the quality of strawberry jam during storage.

Keywords: strawberry jam, preservation, potassium sorbate, sodium benzoate, shelf-life.

INTRODUCTION

Strawberry (*Fragaria chiloensis*) belongs to the family Rosaceae. Strawberry is grown in many countries of the world, but is extensively grown in USA, Japan, Mexico, Italy and Lebanon. Now-a-days it is also grown in Pakistan because of its bright scope in future for higher returns to the farmers. This fruit plays an important role in the economy of many countries of the world like Pakistan (Childer, 2009).

It is grown in Pakistan in the specific areas of Punjab and Khyber Pakhtunkhwa. It is cultivated in the month of November. Since strawberry is a newly introduced crop in Pakistan, its average yield per acre is very low as compared to other strawberry producing countries of the world. The reason for this might be the lack of systematic research, poor agronomic practices, and lack of market and economic value of strawberry production among the growers (Mabood, 2000). Kallio *et al*., (2000) studied composition of strawberry jam.

Sodium benzoate is a preservative which is bacteriostatic and fungistatic under acidic conditions. It is used most commonly in acidic foods such as salad dressings, carbonated drinks, jams and fruit juices. It is found in alcohol-based mouthwash and silver polish. It can also be found in cough syrups like Robitussin. Sodium benzoate is declared on a product label as sodium benzoate. Some studies have shown that the preservative Potassium metabisulphate should be added up to 0.062-0.125%. This amount can lower the percent reduction of ascorbic acid in fruit jam (Krebs *et al*., 2006). This study realizes the importance of adding preservatives to the jam and determines the optimum concentration of the two important food preservatives i.e Potassium sorbate and Sodium benzoate.

MATERIALS AND METHODS

Jam preparation

Three types of strawberry jams were prepared. Strawberry jam was filled in clear sterilized glass bottles sealed with plastic caps and labelled. The jam was made by 1:2 (sugar: juice).

Treatment with preservatives

Strawberry jam samples were treated with potassium sorbate and sodium benzoate accordingly:

T0 = No preservatives (control)
T1 = 0.1% potassium sorbate
T2 = 0.1% sodium benzoate
T3 = 0.05% potassium sorbate + 0.05% sodium benzoate
T4 = 0.025% potassium sorbate + 0.025% sodium benzoate
T5 = 0.075% potassium sorbate + 0.075% sodium benzoate
T6 = 0.866% potassium sorbate + 0.866% sodium benzoate
T7 = 0.95% potassium sorbate + 0.95% sodium benzoate

Physicochemical analysis

- Ascorbic acid content was determined by titrimatric method as reported in AOAC (1984).
- Total soluble solids were determined by the method of AOAC (1984) using hand refractometer at room temperature.
- pH was determined by the digital pH meter.
- Sugar and acid ratio was determined by the following formula:
  Sugar/Acid = TSS/%Acidity
- Sugars (reducing and non reducing) were determined by Lane Eynon method as reported in AOAC (1984).

Statistical analysis

The data regarding different parameters were statistically analyzed using the statistical software SPSS

and means were separated by LSD test as recommended by Steel and Torrie (1980).

RESULTS AND DISCUSSIONS

Ascorbic acid

The data regarding ascorbic acid of strawberry jam is presented in Table-1. The data indicates that different treatments of potassium sorbate and sodium benzoate significantly affected ascorbic acid of strawberry jam which was gradually decreased during storage. Maximum ascorbic acid (4.30) was observed in T6, while minimum ascorbic acid (3.10) was recorded in T3. Significant difference ($P<0.05$) in ascorbic acid of strawberry jam was observed during storage period. Maximum ascorbic acid (3.86) was noted during first day of storage, followed by 15th day (3.85), whereas the minimum ascorbic acid (3.56) was recorded at 90th day of storage. Statistical analysis of the data showed a decreasing trend of ascorbic acid among treatments during storage. Ascorbic acid decreased from the maximum of 3.86 to the minimum of 3.56 during storage. High temperature during storage depressed the firmness of strawberry jam indicating low ascorbic acid (vitamin C). These results are in agreement with the findings of Riaz *et al*., (2000), who reported decreased ascorbic acid content, non-reducing sugars and pH during storage. Tiwari *et al*., (2009), also reported significant reduction in ascorbic acid of strawberry jams during storage.

Total acidity

The data pertaining to total acidity in strawberry jam is presented in Table-2. The total acidity was significantly affected by different treatments of potassium sorbate and sodium benzoate during storage. Maximum total acidity (0.49%) was recorded in T1 stored at room temperature. Whereas, total acidity was minimum (0.33%) in T3. Total acidity was maximum (0.47%) at 1st day, followed by 15th day with 0.45% acidity. The minimum total acidity (0.38%) was recorded at 90th day of storage interval. The decreasing range of total acidity in strawberry jam was recorded among different treatments during storage. Total acidity in treated samples decreased from the maximum of 0.49% to the minimum of 0.33%. During storage period, the total acidity decreased from the maximum of 0.47% to the minimum of 0.38%. Decreasing trend in total acidity may be due to optimum level of potassium sorbate and sodium benzoate during storage period. These results are in line with the findings of Tiwari *et al*., (2009) reported significant reduction in acidity of strawberry jams during storage.

pH

The data concerning pH of strawberry jam is indicated in Table-3. Mean values of the data showed that pH of strawberry jam was significantly affected by different treatments of potassium sorbate and sodium benzoate during storage. Highest pH (3.74%) was recorded in T7. Whereas, pH was minimum (2.83%) in T3. The pH in stored jam was maximum (3.10%) at 1st day interval, followed by 15th day with pH of 3.08%. Minimum pH (2.98%) was noted in jam stored at 90th day interval. Decreasing trend for pH was observed among treatments during storage period. The pH declined from the maximum of 3.74% in T7 to the minimum of 2.83% in T3. The storage period decreased pH value of strawberry jam from 3.10 to 2.98%. The reason for decreasing tendency of pH may be due to affecting the firmness of jam by treatments and storage period indicating poor pH value. These results are in agreement with the findings of Riaz *et al*., (2000) who reported decreased ascorbic acid content, non-reducing sugars and pH during storage.

Total soluble solids

The data regarding total soluble solids in strawberry jam is given in Table-4. The analyzed samples of jam showed that total soluble solids were significantly affected by different treatments of potassium sorbate and sodium benzoate during storage. Highest total soluble solids (70.9) were recorded in T7, while minimum total soluble solids (66.2) were noted in T3. Total soluble solids was maximum (70.0) at 60^{th} day interval, followed by 75th day with total soluble solids of 69.4. Minimum total soluble solids (67.6) were noted at 1st day storage interval. Total soluble solids increased from the minimum of 66.2 in T3 to the maximum of 70.9 in T7. The total soluble solids are capable for organoleptic evaluation as colour, flavour of strawberry. The increasing range from 67.6 at 1^{st} day to 70.0 at 60^{th} day and decreasing trend from 70.0 at 60^{th} day to 68.2 at 90^{th} day was recorded during storage. The boosting range of total soluble solids may be due to treatments and prolong storage life of strawberry. These results are in agreement with the findings of Riaz *et al*., (2000) who reported increased total soluble solids during storage. Rathore *et al*., (2007) also reported a significant ($P<0.05$) effect of storage on Dusheri variety of mango and an increasing trend of average total soluble solids from 10 to 25.27%.

Sugar acid ratio

The data concerning sugar acid ratio in strawberry jam is presented in Table-5. The analyzed samples showed that sugar acid ratio was significantly affected by different treatments of potassium sorbate and sodium benzoate during storage. Maximum sugar acid ratio (12.30) was recorded in T6, while minimum sugar acid ratio (11.27) was noted in T3. The maximum sugar acid ratio (11.90) was recorded at 90^{th} day interval, followed by 75^{th} day interval with sugar acid ratio of 11.87. The minimum sugar acid ratio (11.77) was noted at 1st day of storage interval. An increasing trend of sugar acid ratio was observed among the treatments during storage period. Sugar acid ratio increased from the minimum of 11.27 in T3 to the maximum of 12.30 in T6, while this increase was from the minimum of 11.77 at 1st day to the maximum of 11.90 at 90th day of storage interval. The increase in sugar acid ratio may be due to suppress the quality of strawberry jam during storage.

Table-1. Effect of different treatments on ascorbic acid (Vitamin C) mg/100 g of strawberry jam stored at room temperature for 90 days.

Treatments	**Intervals** (Days)			**% decrease**		**Mean**			
	1st	**15th**	**30th**	**45th**	**60th**	**75th**	**90th**		
T0	3.40	3.38	3.35	3.28	3.23	3.15	3.10	8.82	3.27 c
T1	3.40	3.35	3.31	3.26	3.22	3.14	3.08	9.41	3.25 c
T2	3.30	3.36	3.30	3.24	3.20	3.13	3.05	7.58	3.23 c
T3	3.20	3.18	3.12	3.10	3.07	3.02	3.00	6.25	3.10 d
T4	4.40	4.32	4.29	4.25	4.20	4.10	4.05	7.95	4.23 b
T5	4.30	4.28	4.23	4.20	4.18	4.10	4.08	5.12	4.20 b
T6	4.50	4.47	4.43	4.25	4.20	4.15	4.18	8.89	4.30 a
T7	4.40	4.45	4.40	4.18	4.15	4.09	4.00	9.08	4.24 b
Mean	3.86 a	3.85 ab	3.80 b	3.72 c	3.68 c	3.61 d	3.56 e	-	-

Mean values followed by different letters are significantly (P<0.05) different from each other.
LSD value for storage period = 1.080
LSD value for treatments = 0.048

Table-2. Effect of different treatments on acidity (%) of strawberry jam stored at room temperature for 90 days.

Treatments	**Intervals** (Days)			**% decrease**		**Mean**			
	1st	**15th**	**30th**	**45th**	**60th**	**75th**	**90th**		
T0	0.52	0.50	0.47	0.45	0.44	0.43	0.38	26.92	0.46 c
T1	0.57	0.55	0.52	0.50	0.46	0.44	0.41	28.07	0.49 a
T2	0.49	0.47	0.46	0.44	0.42	0.41	0.40	18.37	0.44 d
T3	0.37	0.36	0.33	0.33	0.32	0.31	0.30	18.92	0.33 h
T4	0.41	0.40	0.40	0.38	0.37	0.35	0.33	19.51	0.38 g
T5	0.43	0.42	0.41	0.40	0.39	0.39	0.37	13.95	0.40 f
T6	0.46	0.46	0.44	0.43	0.42	0.41	0.41	10.87	0.43 e
T7	0.48	0.47	0.48	0.47	0.46	0.45	0.43	10.42	0.46 b
Mean	0.47 a	0.45 b	0.44 c	0.42 d	0.41 e	0.40 f	0.38 g	-	-

Mean values followed by different letters are significantly (P<0.05) different from each other.
LSD value for storage period = 0.001
LSD value for treatments = 0.001

Table-3. Effect of different treatments on pH (%) of strawberry jam stored at room temperature for 90 days.

Treatments	**Intervals** (Days)			**% decrease**		**Mean**			
	1st	**15th**	**30th**	**45th**	**60th**	**75th**	**90th**		
T0	2.94	2.92	2.91	2.90	2.91	2.89	2.88	2.04	2.91 c
T1	2.89	2.88	2.86	2.86	2.85	2.83	2.80	3.11	2.85 d
T2	2.90	2.89	2.87	2.86	2.85	2.85	2.79	3.79	2.86 d
T3	2.87	2.85	2.84	2.84	2.82	2.81	2.78	3.14	2.83 d
T4	2.96	2.96	2.94	2.85	2.92	2.91	2.90	2.03	2.92 c
T5	2.88	2.87	2.85	2.84	2.84	2.81	2.80	2.78	2.84 d
T6	3.53	3.48	3.45	3.36	3.37	3.28	3.21	9.06	3.38 b
T7	3.85	3.81	3.76	3.74	3.70	3.68	3.45	5.19	3.74 a
Mean	3.10 a	3.08 ab	3.06 bc	3.03 cd	3.03 cd	3.01 de	2.98 e	-	-

Mean values followed by different letters are significantly (P<0.05) different from each other.
LSD value for storage period = 0.032
LSD value for treatments = 0.034

Table-4. Effect of different treatments on total soluble solids of strawberry jam stored at room temperature for 90 days.

Treatments	**Intervals** (Days)			**% increase**		**Mean**			
	1st	**15th**	**30th**	**45th**	**60th**	**75th**	**90th**		
T0	66.4	66.9	67.0	67.5	68.4	68.2	67.5	3.01	67.4 e
T1	67.5	67.8	68.2	68.7	69.6	68.8	68.0	3.11	68.4 d
T2	66.6	68.5	68.9	69.6	70.2	69.9	70.0	5.09	69.1 c
T3	65.2	65.8	66.2	66.8	67.4	67.0	65.0	3.37	66.2 f
T4	67.1	67.6	68.1	68.6	69.7	69.0	66.8	3.87	68.1 d
T5	68.5	69.0	69.6	70.2	71.5	70.5	67.3	4.38	69.5 c
T6	69.4	69.5	70.3	70.8	71.5	70.7	69.4	3.02	70.2 b
T7	69.8	70.2	70.8	71.3	71.6	70.1	71.5	2.58	70.9 a
Mean	67.6 d	68.2 c	68.6 c	69.2 b	70.0 a	69.4 b	68.2 c	-	-

Mean values followed by different letters are significantly (P<0.05) different from each other.
LSD value for storage period = 0.53
LSD value for treatments = 0.56

Table-5. Effect of different treatments on sugar acid ratio of strawberry jam stored at room temperature for 90 days.

Treatments	**Intervals** (Days)			**% increase**		**Mean**			
	1st	**15th**	**30th**	**45th**	**60th**	**75th**	**90th**		
T0	12.10	12.11	12.14	12.13	12.15	12.16	12.18	0.66	12.14 c
T1	11.13	11.14	11.17	11.16	11.18	11.25	11.27	1.26	11.19 g
T2	12.00	12.05	12.14	12.14	12.17	12.16	12.20	1.67	12.12 c
T3	11.22	11.23	11.26	11.30	11.18	11.32	11.35	1.16	11.27 f
T4	11.75	11.78	11.72	11.80	11.81	11.84	11.92	1.45	11.80 d
T5	11.52	11.56	11.57	11.60	11.58	11.62	11.64	1.04	11.58 e
T6	12.27	12.30	12.31	12.29	12.30	12.31	12.35	0.65	12.30 a
T7	12.16	12.18	12.24	12.22	12.26	12.30	12.32	1.32	12.24 b
Mean	11.77 e	11.79 de	11.82 cd	11.83 c	11.87 b	11.90 a		-	-

Mean values followed by different letters are significantly ($P<0.05$) different from each other.
LSD value for storage period = 0.032
LSD value for treatments = 0.034

CONCLUSION AND RECOMMENDATIONS

On the basis of the results obtained, it is concluded that total soluble solids, sugar acid ratio and reducing sugar were increased in strawberry jam treated with 0.05% potassium sorbate + 0.05% sodium benzoate (T3) during storage period kept at 23°C temperature. During the storage period, ascorbic acid, total acidity, pH and non-reducing sugar were gradually decreased during 90 days storage period. Sensory evaluation (colour, flavour and texture) was slightly decreased during storage period. T3 (0.05% potassium sorbate + 0.05% sodium benzoate) was found most acceptable by presenting best results during storage period.

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