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Quality Analysis of Refrigerated Strawberry Juice with TSS of 20.5 Treated with Sodium Benzoate and Potassium Sorbate and Citric Acid

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Abstract: *The aim of this research was carried out to investigate the effect of different sugar concentrations and chemical preservatives and storage temperature, i. e. refrigeration temperature (4-10oC) on the physicochemical and sensory attributes of strawberry juice stored for one year. The samples were numbered as, TR28=Strawberry juice (20.5□brix) - no preservatives (control), TR29=Strawberry juice (20.5□brix) with 0.1% sodium benzoate, TR30=Strawberry juice (20.5□brix) with 0.1% potassium sorbate, TR31=Strawberry juice (20.5 brix) with 0.05% sodium benzoate +0.05% potassium sorbate, TR40=Strawberry juice (20.5 brix) - no preservatives (control), TR41=Strawberry juice (20.5 brix) with 0.1% sodium benzoate, TR42=Strawberry juice (20.5 brix) with 0.1% potassium sorbate, TR43=Strawberry juice (20.5 brix) with 0.05% sodium benzoate +0.05% potassium sorbate. A maximum increase was recorded in total soluble solids (TSS) content by TR29, TR30, and TR31 (9.75%), while a minimum increase was recorded in TR43 (7.31%) during storage. A maximum decrease in pH occurred in TR28 (16.94%) followed by TR40 (16.57%), while a minimum decrease was recorded in TR43 (8.14%). A maximum increase in titratable acidity occurred in TR28 (136.19%), followed by TR40 (110.37%), while a minimum increase occurred in TR43 (91.11%). Maximum ascorbic acid decreased in TR28 (84.26%) followed by TR40 (74.39%), while a minimum decrease was observed in TR43 (61.41%) followed by TR41 (62.83%). A maximum increase in reducing sugar content was recorded in TR30 (26.49%), while a minimum increase occurred in TR43 (21.13%). A maximum decrease in non-reducing sugar occurred in TR28 (89.84%) followed by TR40 (88.77%), while a minimum decrease occurred in TR43 (28.88%). A decrease in color was recorded for all samples, but it was in an acceptable range during storage. Flavor deterioration occurred in control samples (TR28 and TR40), while treated samples showed less loss in flavor during storage. Comparatively better consistency was recorded by treated juice. After one year of storage, the samples were acceptable to the consumer on the basis of color, flavor, consistency, and overall acceptability. Among all the treatments, TR28 and TR40 were rejected during storage, while TR43 was found most effective, followed by TR41, and showed better storage stability than other samples.*

Key Words: Strawberry Juice, Benzoate, Sorbate, Sucrose, Refrigeration Temperature

Introduction

Strawberry (Fragaria sp.) is a member of the herbaceous perennial of the "shifts" the family. It is the most important fruit among the berries and has and possesses an important place among small fruit plants (Sharma *et al.*, 2009). It

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is thought that berries are important against several types of cancers (Navindra and P.Seeram. 2008). It is grown in many countries of the world but is grown widely in the United States, Japan, Mexico, Italy, Lebanon (Sharma *et al.*, 2009). Strawberries are also grown widely with a pleasant flavor but smaller in size (Ensminger *et al.* 2007). Gradually grown in Pakistan because of its scope in the future is bright for farmers, and fruits can be traced maximum economic benefit to farmers. There are certain factors that affect the production of strawberries; for example, scientifically grown strawberries give higher production than conventional cultivation (Tonture *et al.*, 2009). The cooling requirements of strawberries are low and can be successfully grown in the tropics and subtropics. They mature in a short period of 30 to 40 days, are non-perishable, and must be consumed early after winning. It cannot reach far away markets in fresh form, so it should be treated carefully during transportation. Strawberries are the first fresh fruit in the market during the spring. Because of the delicious flavor, attractive color, structure, and consumer demand for fruit, it is grown not only in Pakistan but also in other parts of the world. Apart from being consumed fresh, they are also used in the form of treatment such as canned cooked and sweetened, and that is, jam, jelly, and frozen whole berries. Several products are prepared from it, such as purees, jam, juice, wine, etc. (Sharma *et al.* 2009). The fruit is firm, red, and sweet. More than 50% of sucrose in strawberries is glucose. The fruit contains citric acid and often some malic acid. The red color of the fruit is due to the presence of anthocyanin pigment. Volatile esters responsible for many of the fruit flavors are found in it. Nutritionally, strawberries contain low-calorie carbohydrates and is a potential source of vitamin C and fiber. It provides more vitamin C than oranges. The main components of fruit, vitamin C in strawberries is (64.0 mg), water (91.75 g) and protein (0.61 g), fat (0.37 g) and carbohydrate (7.02 g), fiber (2.3 grams), calcium (14.0 mg) and potassium (166.0 mg/160 g), respectively, and vitamin (a) (27). International units, ranging in pH from 3.27 -3.86, helps in achieving stability in the pH range of color from 0.58 to 1.35%, and citric acid and malic and organic acids contribute to excellent flavor. TSS is in the range of 8.0 up to 11.5% and is ideal for juice called for in the market. Soluble solids / acid ratios from 8.52 to 13.79 are a good balance of sweet-tart flavor. In the past decade, there has been a significant increase in the demand for strawberries because the juice has an excellent flavor with an attractive color. However, being the result of a soft tight, slight fluctuation in temperature results in damage and waste of fruit. Due to the lack of other storage facilities to keep the product in the form of raw materials, this study has begun to take advantage of the fruit is very perishable in the form of juice and study the effect of chemical preservatives on the quality of conservation of strawberry juice stored at ambient temperature. Potassium sorbate is important in the preservation of juices during storage (Ayub *et al.* 2010). Sodium benzoate can maintain a good quality of fruit juices during preservation (Ayub *et al.* 2010). It is hoped that these results will help beverage industries to take advantage of this fruit juice to prepare with the shelf stability and the growing demand for consumer goods. This offers high-yield income for farmers and will improve the economy of Pakistan.

Materials and Methods

Fresh mature and sound strawberries were purchased from the local fruit market of Peshawar and were brought to the Food Processing and Analytical Laboratory of the Department of Food Science and Technology, The University of Agriculture Peshawar,

Pakistan, where research work was carried out. The strawberries were washed, followed by sorting, the juice was extracted using a juice extracting machine. The samples were numbered as, T_{R28}=Strawberry juice (20.5°brix) - no preservatives (control), T_{R29}=Strawberry juice (20.5°brix) with 0.1% sodium benzoate, T_{R30}=Strawberry juice (20.5°brix) with 0.1% potassium sorbate, T_{R31}=Strawberry juice (20.5°brix) with 0.05% sodium benzoate +0.05% potassium sorbate, T_{R40}=Strawberry juice (20.5°brix) - no preservatives (control), T_{R41}=Strawberry juice (20.5°brix) with 0.1% sodium benzoate, T_{R42}=Strawberry juice (20.5°brix) with 0.1% potassium sorbate, T_{R43}=Strawberry juice (20.5°brix) with 0.05% sodium benzoate +0.05% potassium sorbate. The juice was filled in a glass bottle, sealed, and stored at refrigeration temperature (4 - 10 C) for a period of one year.

Chemical Analysis

The total soluble solids (TSS) were determined by using an Abbe refractometer at ambient temperature (AOAC, 2000). Inolab digital pH meter was used for pH determination. Acidity was determined by dissolving a known weight of sample in distilled water and titration against 0.01 N NaOH using phenolphthalein as an indicator (Srivastava and Sanjeev, 2003). Ascorbic acid was determined by the direct colorimetric method using 2, 6-dichlorophenol- indophenols as a decolorizing agent by ascorbic acid in sample extract and in slandered ascorbic acid solution (AOAC, 2000). Reducing and non-reducing sucrose was determined by the lane Eynon method (AOAC, 2000).

Sensory Evaluation

A panel of ten judges selected from staff and students of the food science department evaluated the product fortnightly for color, flavor, consistency, and overall acceptability by the method of Larmond (1977) using a scale from 1 to 9, where 1 represented extremely disliked and 9 represent extremely liked.

Statistical Analysis

The data obtained was subjected to statistical analysis using RCBD (Randomized Complete Block Design), and the means were compared by using the LSD (Least Significant Difference) test (Steel and Torrie, 1980). For all the analyses, the alpha error was set at 0.05%.

Results and Discussion

Chemical Analysis

Our results indicated that storage period and the temperature had a significant effect on total soluble solids (TSS) during storage. The mean TSS values of all samples decreased from 20.50 to 19.06 during storage. A minimum increase occurred in T_{R43} (7.31%), while a maximum increase was observed in T_{R29}, T_{R30}, and T_{R31} (9.75%) during storage at refrigeration temperature. A decrease was observed in control samples (T_{R28} and T_{R40}) during storage. These results are in agreement with the results obtained by Zeb *et al.* (2009) during preservation of grape juice stored at room temperature for one month preserved with sodium benzoate and potassium sorbate. Similar results were obtained by Hussain *et al.* (2011) during storage of apple and apricot blended juice storage at refrigeration temperature for three months. An increase in total soluble solids may be due to the breakdown of polysaccharides into monosaccharides and oligosaccharides, while a decrease may be due to the fermentation of sugars into ethyl alcohol, carbon dioxide, and water.

The mean pH values of all samples decreased from 3.58 to 3.16 during storage. During storage, the maximum decrease in pH

content was observed in T_{R28} (16.94%) followed by T_{R40} (16.57%), while a minimum decrease was observed in T_{R43} (8.14%) followed by T_{R42} (9.26%). Similar results were recorded by Mehmood *et al.* (2008) during the study of the effect of pasteurization and chemical preservatives on the quality and shelf stability of apple juice stored at ambient temperature for three months. During storage of apple and apricot blended juices storage, preserved with sodium benzoate at refrigeration temperature for three months by Hussain *et al.* (2011), a decrease in pH was recorded. The decline in pH may be due to the conversion of pectin into pectenic acid, which increases acidity and decreases the pH of the juice.

The mean titratable acidity values of all samples increased from 1.20 to 2.44 during storage. Storage and treatments have a significant effect on the titratable acidity of strawberry juice. A maximum increase was observed in T_{R28} (136.19%) followed by T_{R40} (110.37%), while a minimum increase was observed in T_{R43} (91.11%) followed by T_{R41} and T_{R42} (94.07%). Similarly increase in titratable acidity was observed by Zeb *et al.* (2009) during preservation of grape juice with sodium benzoate and potassium sorbate, stored at room temperature for one month storage period. The results of Ayub and Bilal (2001) are in agreement with our results, who observed an increase in acidity of pomegranate syrup, preserved under different light conditions and different packaging materials at room temperature for the storage period of four months. This increase might be due to acidic compounds formed by degradation or oxidation of reducing sugar and high temperature. An increase in titratable acidity may be due to the breakdown of pectin into pectenic acid or due to the formation of acid by the breakdown of polysaccharides or oxidation of reducing sugars.

Ascorbic acid is sensitive to heat, light, and oxygen, etc. and is the most difficult vitamin to be preserved during storage. As it is the least stable vitamin, it decreases in the product during storage. The mean ascorbic acid values of all samples decreased from 31.95 to 9.72 during storage. A maximum decrease was observed in T_{R28} (84.26%) followed by T_{R40} (74.39%), while a minimum decrease was observed in T_{R43} (61.41%) followed by T_{R41} (62.83%). The results are in agreement with the findings of Zeb *et al.* (2009) during preservation of grape juice with sodium benzoate and potassium sorbate, stored at room temperature for one month storage period, who observed a decrease in the ascorbic acid content of grape juice. The results of Ayub and Bilal (2001) are in agreement with our results, who observed a decrease in the ascorbic acid content of pomegranate syrup, preserved under different light conditions and different packaging materials at room temperature for the storage period of four months. The losses may be due to oxygen present in the product and the headspace of the package.

Sugars are the most important constituent of fruit products and are an essential factor for the flavor of the food product and also act as a natural food preservative. The mean reducing sugars values of all samples increased from 15.85 to 16.52 during storage. Results showed that reducing sugars increased during storage, and a maximum increase was observed in T_{R30} (26.49%) followed by T_{R29} (26.24%) while a minimum increase was observed in T_{R43} (21.13%) followed by T_{R41} (22.08%) while control samples i. e. T_{R28} and T_{R40} showed a decrease during storage. Mehmood *et al.* (2008) observed an increase in reducing sugar of apple juice preserved with chemical preservatives stored at ambient temperature for three months. An increase in reducing sugar of apple and apricot blended juice, preserved with

sodium benzoate at refrigeration temperature for three months and was observed by Hussain *et al.* (2011). This increase in reducing sugar might be due to the conversion of sucrose to reducing sugars (glucose and fructose) primarily due to acids and higher temperatures.

The mean non-reducing sugars values of all samples decreased from 3.74 to 2.01 during storage. A maximum decrease in non-reducing sugar was observed in T_{R28} (89.84%) followed by T_{R40} (88.77%), while a minimum decrease was observed in T_{R43} (28.88%) followed by T_{R41} (29.95%). Mehmood *et al.* (2008) observed a decrease in non-reducing sugar of apple juice preserved with chemical preservatives stored at ambient temperature for three months. An increase in reducing sugar of apple and apricot blended juice, preserved with sodium benzoate at refrigeration temperature for three months, was observed by Hussain *et al.* (2011). This decrease in non-reducing sugar might be due to the conversion of sucrose to glucose and fructose, primarily due to an increase in acidity and high storage temperature and storage period length.

Sensory Analysis

The analysis of our data showed that storage period and treatments had a significant effect on sensory attributes (color, flavor, consistency, and overall acceptability) of the strawberry juice. Loss in color was recorded in all treatments in which maximum loss was recorded in control samples while treated samples retained better color during storage at refrigeration temperature. The off-flavor was produced in control samples which may be due to the fermentation process in which ethyl alcohol, carbon dioxide, and water were produced, while treated samples retained better flavor, which may be due to the combined effect of preservatives, refrigeration temperature, and sugar concentration. Better consistency was recorded by treated samples, especially by those samples which were sweetened with sugar. Data showed that all the samples were acceptable even after one year of storage period. The results are in agreement with the findings of Zeb *et al.* (2009) during preservation of grape juice with sodium benzoate and potassium sorbate, stored at room temperature for one month storage period, who observed a decrease in the color of grape juice. The results of Ayub and Bilal (2001) are in agreement with our results, who observed a decrease in the flavor of pomegranate syrup, preserved under different light conditions and different packaging materials at room temperature for the storage period of four months. These results are in agreement with the findings of Nilugen and Mahendran (2010), who observed a decrease in consistency of ready-to-serve beverages prepared from palmyrah fruit pulp and stored at room temperature for six months.

Conclusion

From this research study, it was concluded that sugar concentration, the combination of preservatives, and storage temperature play a positive role in extending the shelf life of strawberry juice. It was concluded that T_{R28}=Strawberry juice (20.5°brix) - no preservatives (control) and T_{R40}=Strawberry juice (20.5°brix) - no preservatives (control), were rejected while T_{R43}=Strawberry juice (20.5°brix) with 0.05% sodium benzoate +0.05% potassium sorbate maintained better quality followed by T_{R41}=Strawberry juice (20.5°brix) with 0.1% sodium benzoate stored at refrigeration temperature for one year period.

Table 1. Effect of Chemical Preservatives on TSS of Strawberry Juice Stored at Refrigeration Temperature (4-10°C)

Treatment	Storage period in days											
	Initial	20	40	60	80	120	180	240	300	360	% Inc/dec	Mean
	TSS (Total Soluble Solids) in juice											
T_{R28}	20.5	20.5	20.5	19.0	17.5	15.5	13.5	12.0	10.0	9.5	53.65*	15.85 b
T_{R29}	20.5	20.5	20.5	20.5	21.0	21.5	21.5	22.0	22.0	22.5	9.75	21.25 a
T_{R30}	20.5	20.5	20.9	21.0	21.0	21.5	22.0	22.0	22.5	22.5	9.75	21.44 a
T_{R31}	20.5	20.5	21.0	21.5	21.5	21.5	22.0	22.0	22.0	22.5	9.75	21.50 a
T_{R40}	20.5	20.5	19.5	19.0	18.0	15.5	12.5	11.0	10.0	9.0	56.09*	15.55 b
T_{R41}	20.5	20.5	21.0	21.5	21.5	21.5	22.0	22.0	22.3	22.3	8.78	21.51 a
T_{R42}	20.5	20.6	21.0	21.0	21.5	21.5	21.5	22.0	22.0	22.2	8.29	21.38 a
T_{R43}	20.5	21.0	21.0	21.0	21.5	21.5	21.5	22.0	22.0	22.0	7.31	21.40 a
Mean	20.50 a	20.58a	20.67a	20.56a	20.44a	20.00a	19.56a	16.38a	19.10a	19.06a		

Values followed by different letters are significantly (p≤0.05) different from each other.

Table 2. Effect of Chemical Preservatives on pH of Strawberry Juice Stored at Refrigeration Temperature (4-10°C)

Treatment	Storage period in days											
	Initial	20	40	60	80	120	180	240	300	360	% Dec	Mean
	pH value											
T_{R28}	3.60	3.49	3.40	3.37	3.34	3.31	3.27	3.24	3.21	2.99	16.94	3.32 c
T_{R29}	3.60	3.60	3.45	3.41	3.40	3.39	3.34	3.29	3.28	3.20	11.11	3.39 ab
T_{R30}	3.60	3.60	3.52	3.48	3.47	3.39	3.35	3.30	3.27	3.21	10.83	3.41 a
T_{R31}	3.60	3.60	3.50	3.43	3.42	3.37	3.32	3.29	3.27	3.23	10.27	3.40 ab
T_{R40}	3.56	3.44	3.39	3.36	3.31	3.25	3.21	3.19	3.16	2.97	16.57	3.28 d
T_{R41}	3.56	3.53	3.50	3.49	3.45	3.42	3.36	3.32	3.29	3.25	9.55	3.41 a
T_{R42}	3.56	3.51	3.47	3.43	3.39	3.36	3.33	3.30	3.27	3.23	9.26	3.38 b
T_{R43}	3.56	3.53	3.48	3.45	3.43	3.41	3.37	3.33	3.30	3.27	8.14	3.41 ab
mean	3.58 a	3.53 b	3.46 c	3.42 d	3.40 d	3.36 e	3.31 f	3.28 g	3.25 g	3.16 h		

Values followed by different letters are significantly (p≤0.05) different from each other.

Table 3. Effect of Chemical Preservatives on Acidity (%) of Strawberry Juice Stored at Refrigeration Temperature (4-10°C).

Treatment	Storage period in days											
	Initial	20	40	60	80	120	180	240	300	360	% Inc	Mean
	Acidity % content											
T_{R28}	1.05	1.58	1.72	1.86	1.92	1.98	2.10	2.22	2.36	2.48	136.19	1.92 c
T_{R29}	1.05	1.40	1.52	1.62	1.68	1.74	1.86	1.98	2.06	2.14	103.80	1.70 d
T_{R30}	1.05	1.40	1.53	1.64	1.68	1.76	1.88	1.99	2.05	2.16	105.71	1.71 d
T_{R31}	1.05	1.38	1.50	1.62	1.66	1.72	1.84	1.96	2.04	2.12	101.90	1.68 d
T_{R40}	1.35	1.92	2.16	2.32	2.36	2.42	2.54	2.66	2.74	2.84	110.37	2.33 a
T_{R41}	1.35	1.66	1.94	2.11	2.15	2.20	2.32	2.40	2.50	2.62	94.07	2.12 b
T_{R42}	1.35	1.66	1.92	2.08	2.14	2.22	2.34	2.44	2.52	2.62	94.07	2.21 b
T_{R43}	1.35	1.62	1.92	2.08	2.12	2.18	2.30	2.38	2.48	2.58	91.11	2.10 b
Mean	1.20 i	1.57h	1.77 g	1.91 f	1.96 f	2.02 e	2.14 d	2.25 c	2.34 b	2.44 b		

Values followed by different letters are significantly ($p \leq 0.05$) different from each other.

Table 4. Effect of Chemical Preservatives on Ascorbic Acid (%) of Strawberry Juice at Refrigeration Temperature (4-10°C)

Treatment	Storage period in days											
	Initial	20	40	60	80	120	180	240	300	360	% Dec	Mean
	Ascorbic acid content											
T_{R28}	28.60	18.60	14.64	12.04	10.92	9.64	8.32	6.98	5.68	4.50	84.26	11.99c
T_{R29}	28.60	25.00	23.38	21.00	18.22	16.04	13.42	10.32	9.80	8.00	72.02	17.38b
T_{R30}	28.60	24.88	23.30	20.88	18.04	16.00	13.38	10.32	9.78	8.00	72.02	17.32b
T_{R31}	28.60	25.20	23.42	21.32	18.78	16.64	13.98	11.72	10.34	8.50	70.27	17.85b
T_{R40}	35.30	25.72	21.32	19.82	17.34	15.40	13.62	11.32	10.56	9.04	74.39	17.94b
T_{R41}	35.30	31.00	26.78	23.20	20.65	18.98	17.66	15.32	14.78	13.12	62.83	21.68a
T_{R42}	35.30	30.50	26.04	23.06	20.14	18.64	17.32	15.04	14.52	12.98	63.22	21.35a
T_{R43}	35.30	31.55	27.04	23.68	20.98	19.04	17.88	15.64	14.88	13.62	61.41	21.96a
Mean	31.95 a	26.56b	23.24c	20.63d	18.13 e	16.30 f	14.44 g	12.08 h	11.29 h	9.72 oi		

Values followed by different letters are significantly ($p \leq 0.05$) different from each other.

Table 5. Effect of Chemical Preservatives on Reducing Sugar of Strawberry Juice at Refrigeration Temperature (4-10°C)

Treatment	Storage Period in Days											
	Initial	20	40	60	80	120	180	240	300	360	% Inc/de	Mean
	Reducing sugar											
T_{R28}	15.85	15.45	15.02	14.69	13.53	11.98	10.43	9.27	7.73	7.34	53.69*	12.12 b
T_{R29}	15.85	16.82	17.60	18.23	18.73	19.12	19.42	19.65	19.84	20.01	26.24	18.53 a
T_{R30}	15.85	16.84	17.63	18.26	18.77	19.16	19.46	19.68	19.88	20.05	26.49	18.56 a
T_{R31}	15.85	16.72	17.45	18.02	18.54	18.92	19.22	19.46	19.64	19.80	24.92	18.36 a
T_{R40}	15.85	15.48	15.07	14.69	13.91	11.98	9.46	8.50	7.73	6.95	56.15*	11.96 b
T_{R41}	15.85	16.64	17.12	17.56	17.88	18.22	18.56	18.88	19.20	19.35	22.08	17.93 a
T_{R42}	15.85	16.68	17.18	17.64	17.96	18.30	18.64	18.98	19.28	19.46	22.77	18.00 a
T_{R43}	15.85	16.60	17.06	17.50	17.80	18.12	18.44	18.78	19.06	19.20	21.13	17.84 a
Mean	15.85 a	16.40 a	16.77a	17.07a	17.14 a	16.98a	16.70a	16.65a	16.55 a	16.52 a		

Values followed by different letters are significantly ($p \leq 0.05$) different from each other.

Table 6. Effect of Chemical Preservatives on Non-reducing Sugar of Strawberry Juice at Refrigeration Temperature (4-10°C)

Treatment	Storage period in days											
	Initial	20	40	60	80	120	180	240	300	360	% Dec	Mean
	Non-reducing sugar											
T_{R28}	3.74	3.06	2.48	1.92	1.58	1.46	1.22	0.96	0.62	0.38	89.84	1.74 b
T_{R29}	3.74	3.44	3.22	3.04	2.88	2.74	2.66	2.58	2.52	2.48	32.62	2.93 a
T_{R30}	3.74	3.44	3.20	3.00	2.84	2.70	2.62	2.54	2.48	2.44	34.76	2.90 a
T_{R31}	3.74	3.46	3.24	3.06	2.90	2.76	2.68	2.60	2.54	2.50	33.16	2.94 a
T_{R40}	3.74	3.10	2.52	1.94	1.62	1.50	1.24	1.00	0.66	0.42	88.77	1.77 b

T_{R41}	3.74	3.50	3.32	3.16	3.02	2.90	2.80	2.72	2.66	2.62	29.95	3.04 a
T_{R42}	3.74	3.48	3.28	3.12	2.98	2.86	2.76	2.68	2.62	2.58	31.01	3.01 a
T_{R43}	3.74	3.52	3.36	3.20	3.06	2.94	2.84	2.76	2.70	2.66	28.88	3.07 a
Mean	3.74 a	3.37 b	3.07 bc	2.80 cd	2.61 de	2.48 ef	2.35 efg	2.23 fgh	2.10 gh	2.01 h		

Values followed by different letters are significantly ($p \leq 0.05$) different from each other.

Table 7. Effect of Chemical Preservatives on Color of Strawberry Juice Stored at Refrigeration Temperature (4-10°C)

Treatment	Storage period in days											
	Initial	20	40	60	80	120	180	240	300	360	% Dec	Mean
	Color score rate											
T_{R28}	8.00	7.00	6.67	6.67	6.30	6.00	5.67	5.67	5.50	5.50	31.25	6.298 c
T_{R29}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.50	31.25	6.850 a
T_{R30}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.50	5.50	31.25	6.900 a
T_{R31}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.50	5.50	31.25	6.900 a
T_{R40}	8.00	7.00	6.67	6.67	6.30	6.00	5.67	5.67	5.50	5.50	31.25	6.280 c
T_{R41}	8.00	7.50	7.50	7.00	7.00	6.50	6.50	6.00	6.00	6.00	25.00	6.800 ab
T_{R42}	8.00	7.50	7.50	7.00	7.00	6.50	6.50	6.00	6.00	6.00	25.00	6.800 ab
T_{R43}	8.00	6.67	6.67	6.67	6.30	6.67	6.67	6.50	6.00	6.00	25.00	6.615 b
Mean	8.00 o a	7.27 1 b	7.18 9 b	6.87 6 c	6.73 8 cd	6.58 4 d	6.34 1 e	6.16 8 ef	6.00 0 f	5.688 g		

Values followed by different letters are significantly ($p \leq 0.05$) different from each other.

Table 8. Effect of Chemical Preservatives on Flavor of Strawberry Juice Stored at Refrigeration Temperature (4-10°C).

Treatment	Storage period in days											
	Initial	20	40	60	80	120	180	240	300	360	% Dec	Mean
	Flavor score rate											
T_{R24}	8.00	6.67	6.00	5.65	5.00	4.50	3.70	2.67	2.50	2.00	75.00	4.66 b
T_{R25}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.50	31.25	6.85 a
T_{R26}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.50	31.25	6.85 a
T_{R27}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.50	31.25	6.85 a
T_{R36}	8.00	6.67	6.30	6.00	5.30	5.00	4.70	2.00	1.67	1.67	79.12	4.73 b
T_{R37}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.67	29.12	6.86 a
T_{R38}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.67	29.12	6.86 a
T_{R39}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.67	29.12	6.86 a

Mean	8.00 a	7.29 b	7.16 bc	6.70 bcd	6.53 cde	6.43 de	5.92 ef	5.45 fg	5.02 gh	4.64 h	

Values followed by different letters are significantly (p≤0.05) different from each other.

Table 9. Effect of Chemical Preservatives on Consistency of Strawberry Juice Stored at Refrigeration Temperature (4-10°C).

Treatment	Storage Period in Days											
	Initial	20	40	60	80	120	180	240	300	360	% Dec	Mean
	consistency score rate											
T_{R28}	8.00	6.67	6.60	6.30	5.50	5.30	5.00	4.60	4.50	4.00	50.00	5.64 b
T_{R29}	8.00	7.50	7.50	7.00	7.00	6.50	6.50	6.00	5.67	5.25	34.37	6.69 a
T_{R30}	8.00	7.50	7.50	7.00	7.00	6.50	6.50	6.00	5.67	5.25	34.37	6.69 a
T_{R31}	8.00	7.50	7.50	7.00	7.00	6.50	6.50	6.00	5.67	5.25	34.37	6.69 a
T_{R40}	8.00	6.67	6.60	6.30	5.50	5.30	5.00	4.60	4.50	4.00	50.00	5.64 b
T_{R41}	8.00	7.50	7.50	7.00	7.00	6.50	6.50	6.00	6.00	5.67	29.12	6.67 a
T_{R42}	8.00	7.50	7.50	7.00	7.00	6.50	6.50	6.00	6.00	5.50	31.25	6.67 a
T_{R43}	8.00	7.50	7.50	7.00	7.00	6.67	6.50	6.50	6.00	5.67	29.12	6.83 a
Mean	8.00 a	7.29 b	7.27 b	6.82c	6.62 c	6.22 d	6.12 d	5.17 e	5.50 e	5.07 f		

Values followed by different letters are significantly (p≤0.05) different from each other.

Table 10. Effect of Chemical Preservatives on Overall Acceptability of Strawberry Juice at Refrigeration Temperature

Treatment	Storage period in days											
	Initial	20	40	60	80	120	180	240	300	360	% Dec	Mean
	Overall acceptability score rate											
T_{R28}	8.00	7.00	6.67	6.30	6.00	5.67	5.00	5.00	4.50	4.00	50.00	5.51 b
T_{R29}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.50	31.25	6.85 a
T_{R30}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.50	31.25	6.85 a
T_{R31}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.50	31.25	6.85 a
T_{R40}	8.00	7.00	6.67	6.30	6.00	5.67	5.30	5.00	4.50	4.00	50.00	5.84 b

Treatment	Storage period in days											
	Initial	20	40	60	80	120	180	240	300	360	% Dec	Mean
T_{R41}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.00	6.00	5.67	29.12	5.51 a
T_{R42}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.00	5.67	5.67	29.12	6.78 a
T_{R43}	8.00	7.50	7.50	7.00	7.00	7.00	6.50	6.50	6.00	5.67	29.12	6.86 a
Mean	8.00 a	7.37 b	7.29 b	6.82 c	6.75 c	6.66 c	6.16 d	6.00 d	5.58 e	5.18 f		

Values followed by different letters are significantly ($p \leq 0.05$) different from each other.
** = decrease occurred in it.*

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