Research Article

Effect of chemical preservatives on quality and storage condition of tomato puree

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Abstract

Tomato puree was prepared from tomato fruit of Roma cultivar with different concentration of chemical preservatives, packaged in plastic jars and stored at room temperature ($32 \pm 2^\circ\text{C}$). The stored puree samples were analyzed with 15days intervals for physicochemical composition, sensory attributes and colour breakup. The aim of the research work was to investigate the effect of potassium meta bisulphite and sodium benzoate on tomato puree with addition of citric acid. The colour of TTP3 was very good showed at last analysis by Tintometer (Red: 22.9, Yellow: 7.1, Blue: 1.7). Statistical results revealed that TTP3 (sample treated with 0.05% Potassium meta bisulphite + 0.05% Sodium benzoate) was found best both physicochemically and sensory. The overall acceptability results showed less percent decrease in TTP3 (12.46%) followed by TTP1 (14.91%) and TTP6 (15.32%) respectively. The findings of statistical analysis also shows a significant effect ($P < 0.05$) on treatments and storage of tomato puree.

Keywords: Citric acid; Overall acceptance; Preservatives; Plastic bottles; Tintometer; Tomato puree

Introduction

Tomatoes (*Lycopersicon esculentum*) are propagated and consumed globally both in raw and processed forms with providing an adequate amount of antioxidants in daily diet mainly carotenes and phenolic compounds. Carotenes contain group of phytochemicals promoting good health and protection from diseases. In epidemiological studies, research shows that tomatoes contain antioxidant which has many health benefit properties like avoidance from prostate cancer [1]. Tomato is considered as vegetable by consumption, but according to its botanical aspects tomato is classified as fruit. Watery portion is 93 to

95% contributing as a major constituent whereas the solid content is 5.5 to 9.5% in which 1% of the solid content is seeds and peel. Cultivars, irrigation, environmental and soil conditions are the causes for this wide-range in solid content. The prime acid in tomato is citric acid but other acids are also present in small amount i.e. succinic, oxalic and tartaric acid. In tomatoes antioxidants are also present in appreciable amount which are vitamin C (160 to 240mg/1000g), vitamin A carotenes (6 to 9mg/1000g), lycopene (30 to 200mg/1000g) and phenolic compounds like flavonoids (5 to 50mg/kg). Vitamin E is also present (5 to 20mg/1000g). Minerals present

in tomatoes are iron, zinc, copper and manganese [2].

In Pakistan Swat, Sheikhpura, Rahim Yar Khan, Karachi and Gujranwala are the main districts where this exotic plant grows. December and January is the cultivation period of tomato whereas April to June is its ripening period [3]. In the year (2014-15) the cultivated area for tomato in Pakistan was 60.7 thousand hectares with 570.6 thousand tonnes total production obtained [4]. More than 20% of the tomato produce in Pakistan is wasted before reaching to consumer because of improper marketing, processing and preservation system. At the time of harvesting tomato is available in abundant quantity and sold at low price in market, giving less return to farmer. While in off season its availability is less resulting high price in market. The requirement of tomato processing in urban areas is increasing day by day [5].

Tomato puree is a food product prepared from processing of tomatoes as their main constituent. Concentration of tomato juice was made for puree preparation containing minimum 8.37% total solids. Considering nutritional aspects tomato puree is healthier than other processed tomato products like paste, ketchup and sauce. Normally by cooking and processing the nutritional value of fruits and vegetables decreases but processing of tomato into puree increases the bioavailable lycopene concentration [6, 7].

This research work was carried on Roma which is local cultivar of tomato grown in Pakistan. The total soluble solid content of Roma is 4.9 °brix, acidity is 0.323 percent and ascorbic content is 15.27 per 100g [8]. Keeping in view the above facts and figure, the study was conducted to find out the best possible concentration among different chemical preservatives for tomato puree which was prepared, packed and stored in simple and easy way to reduce post-harvest losses.

Materials and methods

Fresh red tomatoes of optimum quality were brought from vegetable market to Food science and technology department, ARI Tarnab Peshawar. Tomatoes were sorted and washed carefully to remove all types of residual matter. To get more pulp tomatoes were heated before passing to pulper which is called a hot-break method. Electric pulper was used for the separation of skin and coral parts to obtain fine pulp. Then pulp was thickened by heating for 50-60 minutes at 90 to 100°C in stainless steel pot till concentration of required degree brix of tomato puree was achieved and salt was added. Concentrated puree was then divided into seven batches, first batch was not mixed with any chemical preservative (Control) whereas remaining six had chemicals added with different concentrations respectively. Then each of the tomato puree sample was packed in plastic bottles and stored at ambient temperature for 90 days. The treatments were following;

TTP0 = 400g Tomato puree + 0.5% Salt + No preservative (Control).

TTP1 = 400g Tomato puree + 0.5% Salt + 0.1% Potassium meta-bisulphite.

TTP2 = 400g Tomato puree + 0.5% Salt + 0.1% Sodium benzoate.

TTP3 = 400g Tomato puree + 0.5% Salt + 0.05% P.M.S + 0.05% S.B.

TTP4 = 400g Tomato puree + 0.5% Salt + 0.05% P.M.S + 0.05% Citric acid.

TTP5 = 400g Tomato puree + 0.5% Salt + 0.05% S.B + 0.05% Citric acid.

TTP6 = 400g Tomato puree + 0.5% Salt + 0.05% P.M.S + 0.05% S.B + 0.05% Citric acid.

Physicochemical analysis

All the treatments were analysed for total soluble solid, pH, titrable acidity, sugar acid ratio and ascorbic acid by using standard procedures of AOAC 2012 [9].

Colour analysis

The Lovibond Tintometer (model F, UK) was used for colour analysis because of its simplicity and routine used in quality control processes. The sample of tomato puree was

filled in small elongated box and put inside tintometer and then examined by viewing tube. Half the field of view in a viewing tube was occupied by the tomato puree sample, whereas the other half was occupied by light reflected from a white surface that has passed through coloured glasses fixed on racks. The glasses were made in numbered advancements of the subtractive primary colours i.e. red, yellow, blue and white. These numbers were called as Lovibond units. There were three rows for a single colour adjustment, First row ranging from 0 to 1 Lovibond units, Second row ranging from 1 to 10 Lovibond units and third row ranging from 10 to 100 Lovibond units [10].

Sensory analysis

For sensory evaluation nine points hedonic scale (1 to 9) was used. Panel of 10 expert judges were selected to evaluate the aroma, colour, taste, consistency and overall acceptability of tomato puree samples as prescribed by [11].

Statistical analysis

All the results were statistically examined by completely randomized design (CRD) by two factorial adjustment, also applied least significance difference test by using computer software (Statistix 8.1) as given by [12].

Results and discussion

Physicochemical analysis

Total soluble solids

The total soluble solid content of tomato puree preserved with different chemicals shows highest decrease in treatment (TTP0 13.33%) and the lowest decreased was observed in treatment (TTP3 5.38%) during 90 days storage interval (Table 1). The statistical results revealed that treatment and storage has a significant ($P < 0.05$) effect on total soluble solid content of tomato puree. The decrease in total soluble solid content of tomato puree might be due to break down or sedimentation of some solid content. Similar result was produced by [13], who observed decrease in value of TS and TSS during storage due to break down of pectin into other acidic components in tomato puree. According to [14] Puree made by hot break method has also serum sedimentation problem showing decrease in Total soluble solids in storage time period. The result was similar to the findings of [15] who observed decrease in TSS in tomato pulp using chemical preservatives. Decrease in TSS was more in tomato pulp samples stored at higher temperature, possibly due to break down of solid content. The results also agree with [16] who also noted that chemical preservatives in tomato pulp with higher concentration has less decrease in total soluble solid content than low concentration. The research study of [17] also observed decrease in total soluble solids during storage in processed tomato product.

Table 1. Effect of different chemical preservatives on total soluble solids of tomato puree during storage period

Treatments	Storage intervals (days)							Mean
	Initial	15	30	45	60	75	90	
TTP ₀	9.0	8.9	8.8	8.6	8.3	8.1	7.8	8.50e
TTP ₁	9.1	9.0	9.1	8.9	8.8	8.7	8.6	8.89bc
TTP ₂	9.2	9.1	9.0	9.1	8.9	8.8	8.7	8.97ab
TTP ₃	9.3	9.2	9.1	9.2	9.0	8.9	8.8	9.07a
TTP ₄	9.1	9.0	8.9	8.8	8.7	8.5	8.4	8.77cd
TTP ₅	9.0	8.9	8.9	8.8	8.6	8.4	8.2	8.69d
TTP ₆	9.2	9.1	9.0	8.9	8.8	8.7	8.6	8.90b
Mean	9.13a	9.03ab	8.97bc	8.90c	8.73d	8.59e	8.44f	

Mean value having different small letters are significantly dissimilar from one another

pH

The pH of tomato puree preserved with different chemicals shows highest decrease in treatment (TTP0 5.67%) and the lowest decreased was observed in treatment (TTP3 2.71%) during 90 days storage interval (Table 2). The statistical results revealed that treatment and storage has a significant ($P < 0.05$) effect on pH of tomato puree. The decrease in pH of tomato puree possibly due to high ambient temperature and increase in

acidity of the tomato puree samples. The results are also similar with [18] who studied the effect of chemical preservatives on the storage life of tomato juice. He observed that increase of acidity results in decrease of pH. Whereas [19] also reported the decrease in pH in his studied the effect of chemical preservatives on the storage life of tomato paste stored at ambient temperature. He noticed that high temperature is also responsible for decrease in pH.

Table 2. Effect of different chemical preservatives on pH of tomato puree during storage period

Treatments	Storage intervals (days)							(%) Dec	Mean
	Initial	15	30	45	60	75	90		
TTP ₀	4.41	4.38	4.34	4.31	4.28	4.23	4.16	5.67	4.47e
TTP ₁	4.44	4.42	4.41	4.39	4.36	4.34	4.31	2.93	4.38b
TTP ₂	4.49	4.48	4.46	4.44	4.41	4.39	4.36	2.90	4.43a
TTP ₃	4.42	4.41	4.39	4.36	4.34	4.32	4.3	2.71	4.36c
TTP ₄	4.36	4.35	4.33	4.3	4.28	4.25	4.21	3.66	4.30e
TTP ₅	4.37	4.36	4.34	4.32	4.3	4.24	4.2	3.89	4.30e
TTP ₆	4.39	4.38	4.36	4.34	4.31	4.28	4.25	3.19	4.33d
Mean	4.41a	4.40a	4.38b	4.35c	4.33d	4.29e	4.26f		

Mean value having different small letters are significantly dissimilar from one another

Titration acidity

The titration acidity of tomato puree preserved with different chemicals shows highest increase was observed in treatment (TTP0 19.23%) and lowest increase was observed in treatment (TTP3 8.70%) during 90 days storage interval (Table 3). The statistical results revealed that treatment and storage has a significant ($P < 0.05$) effect on titration acidity of tomato puree. The increase in titration acidity might be due to break down of amino acids and conversion into other acids. [2] Also found increase in acidity in his research on tomato processing which is due to break down of some amino acids into components like glutamine and asparagine conversion into glutamic acid and aspartic acid. The result was similar to the findings of [18, 19] they studied the effect of chemical preservatives on the storage life of tomato pulp and paste. Both observe that increase in acidity might be due to decrease in pH and

increase in storage temperature. The findings are similar with [15] who reported the increased in titration acidity in his research effect of chemical preservatives and storage conditions on the nutritional quality of tomato pulp. Acidity was increased higher at ambient temperature (25°C) and lower at freezing temperature (-10°C). It may also be due to oxidation of alcohol and aldehyde during processing and is influenced by storage temperature, higher the temperature greater the increase in acidity.

Sugar acid ratio

The sugar acid ratio of tomato puree preserved with different chemicals shows highest decrease in treatment (TTP0 30.00%) and lowest decrease was observed in treatment (TTP3 13.60%) during 90 days storage interval (Table 4). The statistical results revealed that treatment and storage has a significant ($P < 0.05$) effect on the sugar acid ratio of tomato puree. The decrease in

sugar acid ratio of tomato puree treatments might be due to decrease in total soluble solids content and increase in acidity of the tomato puree. Reduction in sugar-acid ratio is also reported by [20] in preservation of apple

pulp by using chemical preservatives. Drop off in sugar-acid ratio is also observed by [21] in his study on the preservation of mashaday variety of apple.

Table 3. Effect of different chemical preservatives on titrable acidity of tomato puree during storage period

Treatments	Storage intervals (days)							(%) Inc	Mean
	Initial	15	30	45	60	75	90		
TTP ₀	0.42	0.43	0.45	0.46	0.47	0.49	0.52	19.23	0.46b
TTP ₁	0.41	0.42	0.42	0.43	0.44	0.45	0.46	10.87	0.43d
TTP ₂	0.4	0.4	0.41	0.42	0.42	0.43	0.44	9.09	0.42e
TTP ₃	0.42	0.42	0.43	0.44	0.44	0.45	0.46	8.70	0.44d
TTP ₄	0.43	0.44	0.45	0.46	0.47	0.48	0.5	14.00	0.46b
TTP ₅	0.44	0.45	0.46	0.47	0.48	0.5	0.52	15.38	0.47a
TTP ₆	0.43	0.43	0.44	0.45	0.46	0.47	0.49	12.24	0.45c
Mean	0.42e	0.43e	0.44d	0.45c	0.45c	0.47b	0.48a		

Mean value having different small letters are significantly dissimilar from one another

Table 4. Effect of different chemical preservatives on sugar acid ratio of tomato puree during storage period

Treatments	Storage intervals (days)							(%) Dec	Mean
	Initial	15	30	45	60	75	90		
TTP ₀	21.43	20.70	19.56	18.70	17.66	16.53	15.00	30.00	18.51a
TTP ₁	22.20	21.43	21.67	20.70	20.00	19.33	18.70	15.77	20.57b
TTP ₂	23.00	22.75	21.95	21.67	21.19	20.47	19.77	14.03	21.54b
TTP ₃	22.14	21.90	21.16	20.91	20.45	19.78	19.13	13.60	20.78c
TTP ₄	21.16	20.45	19.78	19.13	18.51	17.71	16.80	20.62	19.08d
TTP ₅	20.45	19.78	19.13	18.51	17.92	16.80	15.77	22.91	18.34e
TTP ₆	21.40	21.16	20.45	19.78	19.13	18.51	17.55	17.97	19.71e
Mean	21.68a	21.17b	20.53c	19.91d	19.27e	18.45f	17.53g		

Mean value having different small letters are significantly dissimilar from one another

Ascorbic acid

The Ascorbic acid content of tomato puree preserved with different chemicals shows highest decrease in treatment (TTP₀ 56.36%) and lowest decrease was observed in treatment (TTP₃ 41.21%) during 90 days storage interval (Table 5). The statistical results revealed that treatment and storage has a significant ($P < 0.05$) effect on the ascorbic acid content of tomato puree. The decrease in ascorbic acid content of tomato puree might be due to oxidation at high temperature. The results are similar with [15] who also found decrease in ascorbic acid content of tomato pulp at room temperature (25°C) due to oxidation which is greater at

higher temperature. Ascorbic acid content is also decreased in [22] studied the storage stability of tomato paste packed in polythene tube and plastic bottle. According to [23] that by increasing temperature high losses of ascorbic acid occur.

Colour analysis

The colour analysis of tomato puree preserved with different chemicals shows a significant increase in red, yellow and blue colour during 90 days storage interval (Table 6). In Red colour highest increase was observed in treatment (TTP₀ 20.78%) and lowest increase was observed in treatment (TTP₁ 9.72%). In yellow colour highest increase was observed in treatment (TTP₀

35.48%) and lowest increase was observed in treatment (TTP1 15.07%). In blue colour highest increase was observed in treatment (TTP0 71.43%) and lowest increase was observed in treatment (TTP1 40%). The statistical results revealed that in all colour parameters treatment and storage has a significant ($P < 0.05$) effect on colour of tomato puree. In all of my treatments red colour is dominating over yellow colour and blue colour is also present in small range. According to [24] red colour should predominate on yellow colour and blue colour in excess may lead to scorching of the tomato puree. The results are also similar with [25] who reported that a perfect tomato puree colour would match with following Lovibond units. Red must be 20 or more units, yellow must be 7 or fewer units and blue must be 2 or fewer units. With storage time changes occur in Lovibond colour units.

Sensory analysis

Aroma score

In sensory analysis the Aroma of tomato puree preserved with different chemicals shows highest decrease in treatment (TTP0 41.57%) and lowest decrease was observed in treatment (TTP3 12.79%) during 90 days storage interval (Table 7). The statistical results revealed that treatment and storage has a significant ($P < 0.05$) effect on aroma of tomato puree. The decrease in aroma of tomato puree might be due to escape of some volatile compounds and storage temperature and time. According to [26] 3-Methylbutanol is a volatile component with pungent or earthy aroma mostly responsible for aroma of tomato. Similarly [2] observed that processing completely change the aroma of tomatoes from the fresh tomato due to loss of volatile compounds and new compounds formation. Break down of sugar and carotenoids made compounds that are responsible for cooked odor in tomato products. Dimethyl sulphide mainly responsible for the aroma of heated tomato

products. The results are also similar with [19], in his studied effect of chemical preservatives on the shelf-life of tomato paste stored at ambient temperature. He observed that decrease in aroma of tomato puree may be due to storage time and conditions.

Colour score

In tomato products colour is the most important and appealing sensory attribute for the consumer. In sensory analysis the colour of tomato puree preserved with different chemicals shows highest decrease in treatment (TTP0 49.44%) and lowest decrease was observed in treatment (TTP3 11.36%) during 90 days storage interval (Table 8). The statistical results revealed that treatment and storage has a significant ($P < 0.05$) effect on colour of tomato puree. The decrease in the colour of tomato puree might be due to lycopene which is major pigment for red colour in tomato and different reactions i.e. Millard and Caramelization. The study of [27] also reported that lycopene and beta carotene is highly sensitive to heat and time. According to [28] the presence of oxygen and non-enzymatic browning responsible for colour degradation. [29] observed in his research that lycopene which is responsible for the red colour of tomato is affected by adding salt, sucrose and high heating temperatures.

Consistency score

In sensory analysis the consistency of tomato puree preserved with different chemicals shows highest decrease in treatment (TTP0 29.4%) and lowest decrease was observed in treatment (TTP3 10.5%) during 90 days storage interval (Table 9). The statistical results revealed that treatment and storage has a significant ($P < 0.05$) effect on consistency of tomato puree. The decrease in consistency of tomato puree might be due to high storage time or degradation in total soluble solids content. The results are also similar with [19], in his studied effect of chemical preservatives on the shelf-life of

tomato paste stored at ambient temperature. He observed that decrease in consistency of tomato puree may be due to storage time and conditions. [18] Also reported decrease in

consistency in all samples in his research work on effect of chemical preservatives on the storage life of tomato juice.

Table 5. Effect of different chemical preservatives on ascorbic acid of tomato puree during storage period

Treatments	Storage intervals (days)							(%) Decrease	Mean
	Initial	15	30	45	60	75	90		
TTP ₀	16.5	14.4	11.9	10.2	8.7	8.3	7.2	56.36	11.03d
TTP ₁	16.4	15.6	14.2	12.8	11.3	10.6	9.4	42.68	12.90ab
TTP ₂	16.8	15.7	14.5	13.2	12.1	10.9	9.6	42.86	13.26a
TTP ₃	16.5	15.5	14.3	12.9	11.8	10.5	9.7	41.21	13.03ab
TTP ₄	16.3	15.1	13.9	12.8	11.3	10.7	8.9	45.40	12.71bc
TTP ₅	16.2	14.9	13.5	12.6	10.5	9.8	8.7	46.30	12.31c
TTP ₆	16.1	15.2	13.8	12.7	11.6	10.5	9.4	41.61	12.76bc
Mean	16.40a	15.20b	13.73c	12.46d	11.04e	10.19f	8.99g		

Mean value having different small letters are significantly dissimilar from one another

Table 6. Effect of different chemical preservatives on colour analysis of tomato puree during storage period

Treatments	Colour	Storage intervals (days)							(%) Increase	Mean
		Initial	15	30	45	60	75	90		
TTP ₀	Red	20.2	20.6	21.2	22	22.9	24.1	25.5	20.78	22.36ab
	Yellow	6	6.4	6.9	7.3	7.8	8.4	9.3	35.48	7.44a
	Blue	0.8	1	1.2	1.5	1.8	2.2	2.8	71.43	1.61a
TTP ₁	Red	19.5	19.7	19.9	20.2	20.6	21.1	21.6	9.72	20.37d
	Yellow	6.2	6.3	6.4	6.6	6.8	7	7.3	15.07	6.66de
	Blue	0.6	0.7	0.6	0.7	0.8	0.9	1	40.00	0.76d
TTP ₂	Red	20.5	20.9	21.4	21.9	22.7	24	25.4	19.29	22.40a
	Yellow	6.4	6.7	6.9	7.1	7.4	7.8	8.4	23.81	7.24ab
	Blue	0.9	1.1	1.3	1.6	1.9	2.2	2.7	66.67	1.67a
TTP ₃	Red	20.1	20.3	20.5	21	21.6	22.2	22.9	12.23	21.23c
	Yellow	6	6.1	6.2	6.4	6.6	6.9	7.1	15.49	6.47e
	Blue	0.8	0.9	1	1.2	1.3	1.5	1.7	52.94	1.20bc
TTP ₄	Red	19.8	20	20.3	20.8	21.5	22.4	23.7	16.46	21.21c
	Yellow	6.1	6.2	6.3	6.5	6.7	7	7.4	17.57	6.60de
	Blue	0.7	0.8	0.9	1	1.1	1.2	1.4	50.00	1.01c
TTP ₅	Red	20.3	20.6	21	21.5	22.3	23.2	24.5	17.14	21.91b
	Yellow	6.3	6.5	6.7	6.9	7.2	7.6	8	21.25	7.03bc
	Blue	0.8	0.9	1.1	1.3	1.5	1.8	2.3	65.22	1.39b
TTP ₆	Red	20	20.2	20.4	20.9	21.6	22.5	23.2	13.79	21.26c
	Yellow	6.2	6.3	6.5	6.8	7	7.2	7.4	16.22	6.77cd
	Blue	0.9	1	1.1	1.3	1.5	1.7	2	55.00	1.36b
Mean	Red	20.06f	20.33ef	20.67e	21.19d	21.89c	22.79b	23.83a		
	Yellow	6.17f	6.36ef	6.56de	6.80cd	7.07c	7.41b	7.84a		
	Blue	0.79f	0.91ef	1.03de	1.23cd	1.41c	1.64b	1.99a		

Mean value having different small letters are significantly dissimilar from one another

Table 7. Effect of different chemical preservatives on aroma of tomato puree during storage period

Treatments	Storage intervals (days)							(%) Dec	Mean
	Initial	15	30	45	60	75	90		
TTP0	8.9	8.6	7.9	7.3	6.7	6.1	5.2	41.57	7.24c
TTP1	8.5	8.4	8.3	8.1	7.9	7.6	7.3	14.12	8.01ab
TTP2	8.4	8.3	8.1	7.8	7.5	7.2	6.9	17.86	7.74b
TTP3	8.6	8.5	8.4	8.3	8.1	7.9	7.5	12.79	8.19a
TTP4	8.7	8.6	8.5	8.2	7.8	7.5	7	19.54	8.04ab
TTP5	8.6	8.5	8.3	8	7.5	7.1	6.5	24.42	7.79b
TTP6	8.8	8.7	8.5	8.3	8.1	7.8	7.4	15.91	8.23a
Mean	8.64a	8.51a	8.29ab	8.00bc	7.66cd	7.31d	6.83e		

Mean value having different small letters are significantly dissimilar from one another

Table 8. Effect of different chemical preservatives on colour of tomato puree during storage period

Treatments	Storage intervals (days)							% Dec	Mean
	Initial	15	30	45	60	75	90		
TTP0	8.9	8.2	7.6	6.8	6.1	5.3	4.5	49.44	6.77c
TTP1	8.7	8.5	8.3	8.1	7.9	7.5	7.2	17.24	8.03ab
TTP2	8.4	8.2	8.1	7.8	7.3	6.9	6.3	25.00	7.57b
TTP3	8.8	8.7	8.6	8.5	8.3	8	7.8	11.36	8.39a
TTP4	8.6	8.5	8.3	8.2	8	7.4	7	18.60	8.00ab
TTP5	8.5	8.3	8.1	7.8	7.4	6.9	6.2	27.06	7.60b
TTP6	8.7	8.6	8.5	8.3	8.1	7.9	7.7	11.49	8.26a
Mean	8.66a	8.43a	8.21ab	7.93bc	7.59cd	7.13de	6.67e		

Mean value having different small letters are significantly dissimilar from one another

Table 9. Effect of different chemical preservatives on consistency of tomato puree during storage period

Treatments	Storage intervals (days)							(%)Dec	Mean
	Initial	15	30	45	60	75	90		
TTP ₀	8.5	8.3	7.9	7.4	7	6.6	6	29.4	7.4c
TTP ₁	8.6	8.5	8.4	8.2	8	7.8	7.5	12.8	8.1a
TTP ₂	8.8	8.7	8.5	8.4	8.2	8	7.8	11.4	8.3a
TTP ₃	8.6	8.5	8.4	8.3	8.1	7.9	7.7	10.5	8.2a
TTP ₄	8.3	8.2	8	7.8	7.5	7.2	6.9	16.9	7.7b
TTP ₅	8.4	8.5	8.3	8	7.6	7	6.6	21.4	7.8b
TTP ₆	8.5	8.4	8.2	7.9	7.7	7.4	7.2	15.3	7.9b
Mean	8.53a	8.44ab	8.24b	8.00c	7.73d	7.41e	7.10f		

Mean value having different small letters are significantly dissimilar from one another

Taste score

After colour, taste is the second most important sensory attribute for consumer attraction. In sensory analysis the taste score of tomato puree preserved with different chemicals shows highest decrease in treatment (TTP0 58.82%) and lowest decrease was observed in treatment (TTP3 15.29%) during 90 days storage interval (Table 10). The statistical results revealed

that treatments and storage has a significant ($P < 0.05$) effect on taste of tomato puree. The decrease in taste in tomato puree might be due to increase in acidity and decrease in TSS. [19], reported the decreased in taste of tomato paste due to increase in acidity with the storage time and temperature. Decrease in taste value is due to rise and fall in acid or declining of pH, [30]. According to [31] Cis-3-hexenal is an important compound

responsible for the taste of original tomato which can be loss during processing and storage. Conversion of Cis-3-hexenal to trans-2-hexenal is also be the reason for decrease in taste.

Overall acceptability score

The overall acceptability of tomato puree preserved with different chemicals shows highest decrease in treatment (TTP0 44.83%) and lowest decrease was observed in treatment (TTP3 12.46%) during 90 days storage interval (Table 11). The statistical results revealed that treatments and storage

has a significant ($P < 0.05$) effect on overall acceptability of tomato puree. The decrease in overall acceptability is due to decrease in all other sensory attributes. [32] studied in his research work with the passage of time and presence of temperature responsible in breakdown of quality which results in decline in overall acceptability similar study was found by [33] they preserve apple pulp with the addition of potassium metabisulphite. [19] Also report decline in overall sensory attributes in his findings on effect of chemical preservatives on shelf-life of tomato paste.

Table 10. Effect of different chemical preservatives on taste of tomato puree during storage period

Treatments	Storage intervals (days)							(%)Dec	Mean
	Initial	15	30	45	60	75	90		
TTP ₀	8.5	8	7.4	6.8	5.7	4.6	3.5	58.82	6.36b
TTP ₁	8.4	8.2	8.1	7.9	7.6	7.4	7.1	15.48	7.81a
TTP ₂	8.3	8.1	8	7.8	7.5	7.2	7	15.66	7.70a
TTP ₃	8.5	8.4	8.2	8	7.8	7.5	7.2	15.29	7.94a
TTP ₄	8.8	8.7	8.5	8.3	7.9	7.5	6.9	21.59	8.09a
TTP ₅	8.7	8.6	8.3	8	7.7	7.2	6.7	22.99	7.89a
TTP ₆	8.6	8.5	8.4	8.2	7.8	7.4	7	18.60	7.99a
Mean	8.54a	8.36ab	8.13ab	7.86bc	7.43cd	6.97de	6.49e		

Mean value having different small letters are significantly dissimilar from one another

Table 11. Effect of different chemical preservatives on overall acceptability of tomato puree during storage period

Treatments	Storage intervals (days)							(%) Decrease	Mean
	Initial	15	30	45	60	75	90		
TTP ₀	8.70	8.28	7.70	7.08	6.38	5.65	4.80	44.83	6.94c
TTP ₁	8.55	8.40	8.28	8.08	7.85	7.58	7.28	14.91	8.00ab
TTP ₂	8.48	8.33	8.18	7.95	7.63	7.33	7.00	17.40	7.84ab
TTP ₃	8.63	8.53	8.40	8.28	8.08	7.83	7.55	12.46	8.18a
TTP ₄	8.60	8.50	8.33	8.13	7.80	7.40	6.95	19.19	7.96ab
TTP ₅	8.55	8.48	8.25	7.95	7.55	7.05	6.50	23.98	7.76b
TTP ₆	8.65	8.55	8.40	8.18	7.93	7.63	7.33	15.32	8.09ab
Mean	8.59a	8.44a	8.22ab	7.95bc	7.60c	7.21d	6.77e		

Mean value having different small letters are significantly dissimilar from one another

Conclusions

From the results of this research it was concluded that in physicochemical analysis TTP3 was found best followed by TTP2 and then TTP1, during storage at ambient temperature decrease occur in all treatments in the following analysis: TSS, pH, Sugar Acid Ratio, Ascorbic Acid whereas increase

occur in Titrable Acidity and colour analysis. Whereas in sensory analysis TTP3 is found best followed by TTP1 and then TTP6 in terms of overall acceptance in the following analysis: Aroma, Colour, Consistency and Taste. All the formulations are acceptable but the formulation that is used in TTP3 (0.05% potassium metabisulphite and 0.05% sodium

benzoate) is acclaimed for preservation of tomato puree.

Authors' contributions

Conceived and designed the experiments: N Alam & S Wahab, Performed the experiments: N Alam, Analyzed the data: N Alam & Y Durrani, Contributed materials/analysis/ tools: N Alam & A Khan, Wrote the paper: N Alam.

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