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Research Paper

Study of the shelf-life and nutritional characteristics of tomato puree during ambient storage condition

DHRUV KUMAR SINGH, CHANDRA PRAKASH **AND** VISHAL KUMAR

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See end of the paper for authors' affiliations

Correspondence to **:**
DHRUV KUMAR SINGH
Department of Agronomy, N.D. University of Agriculture andTechnology, Kumarganj, FAIZABAD (U.P.) INDIA
Email: dhruv.apfe@gmail.com

ABSTRACT : The evaluation of shelf-life and nutritional value of tomato puree was carried out in this experiment. The microbial and chemical analysis of tomato puree were done at the interval of 15, 30 and 45 days. The sensory evaluation was also carried out in this experiment. The control sample had no preservative in it and it lost its nutritional value with in 15 days. The sample which had sugar and salt as preservative had good sensory evaluation but its life was up to 30 days. The sample which had acetic acid in it had both shelf-life and nutritional value was very good. The sample which had citric acid as preservative had shown even better results. Its shelf-life and nutritional value was almost same as sample which had acetic acid as preservative but it scored over in sensory evaluation.

KEY WORDS : Tomato, Shelf-life, Storage, Puree

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Tomato (*Lycopersicon esculentum*) is cultivated indifferent countries for its edible red fruit. Lycopene is photochemical nutrient element found in many fruits and vegetables, but excessively found in tomato that imparts natural red colour (Holden *et al.*, 1999 and Gertner *et al.*, 1997) reported that lycopene is the predominant carotenoidin tomatoes. Supplementation of tomato products, containing lycopene, has been shown to lower biomarkers of oxidative stress and carcinogenesis (Basu and Imrhan, 2006). Many factors affect the lycopene concentration in raw tomatoes, such as genetics, soil, and plant nutrition, handling, maturity and seasonal variations. The green raw tomato turns into red when it ripens, as the cisform of lycopene present in tomato gradually changesinto transform of lycopene with the maturity (Xianquan *et al.*, 2005).

Tomatoes and related tomato products are the major source of lycopene compounds. They are also considered an important source of other carotenoids in human diet. Lycopene in fresh tomato fruits occurs essentially in the all *trans*-configuration. Lycopene is not converted to retinol *in vivo*. Bio-availability of lycopene in processed tomato products is higher than in unprocessed fresh tomatoes (Shi. Maguer, 2000). Lycopene has recently received attention for its potential role in preventing prostate cancer and cardio-vascular diseases in humans (Arab and Steck, 2000 and Heber and Lu, 2002). It is a natural antioxidant due to its ability to act as a free radical scavenger. It has the highest singlet oxygen quenching rate of all carotenoids in biological systems (Di Mascio *et al.*, 1989 and Tinker *et al.*,1994). Lycopene concentration in fresh tomatoes may vary from 5 to 50 mg/kg, depending on the cultivar, ripening stage, and temperature during crop growth (Hadley *et al.*, 2002 and Scott and Hart, 1995).

Many undesirable quality changes could occur in the dried products during drying and storage (Maskan, 2000 and 2001). The colour of tomato is an important quality index concerning consumer acceptance (Dermesonlouoglou *et al.*, 2007; D'Sousa *et al.*, 2008). Lycopene is the main colouring agent for the red colour of the tomatoes (D'Sousa *et al.*, 2008; Lavelli and Scarafoni, 2011). Lycopene oxidation is reported to be the most important reason for the colour loss during storage of tomatoes (Demirbüker, 2001, Nguyen and Schwartz 1999).

■ RESEARCH METHODS

Based upon the reported literature, the experimental plan was devised. Tomatos were cleaned, washed, peeled and blanched. Then pulp extraction machine was used for the extraction of tomato pulp. After extraction, the tomato pulp was sterilized by autoclaving at 120^0 for 15 min and packed in glass bottle and aluminum pouch. The physico-chemical and microbiological qualities were evaluated just after preparation of tomato pulp and at the interval of 0 days up to 45 days during storage at room temperature. Experimental variables/parameters and their levels and descriptions are given in Table A.

Total soluble solid:

TSS (°Brix) of tomato puree was measured by refractrometer of range of 0-32 °Brix, using the method recommended by Srivastav and Kumar (2009). A brief description is given below. A drop of sample was placed on the prism and the observation was taken in front of sunlight. The visible scale showed a dark line indication measuring TSS in degree °Brix.

Acidity:

The acidity of tomato puree was estimated a method described by Srivastav and Kumar (1994). 5 ml sample was placed in 100 ml distilled water, placed for heating for some period and a shake well and filtrate. Filtrate volume of aliquot was taken and was titrated with 0.1N NaOH using phenolphthalein as indicator. The endpoint was denoted by the appearance of pink colour. The titration was repeated thrice and the average value was recorded.

$$\% \text{ Acidity} = \frac{\text{Titre x 0.1 x 0.064 x 100}}{\text{Wt. of sample taken x 1000}}$$

pH:

pH is the measurement of the logarithm of inverse of hydrogen ion concentration in the solution.

$$pH = -\log (H^+)$$

where,

(H+) = hydrogen ion concentration (g\lit).

The electronic pH meter (make: Systronic µ pH system-361) was calibrated using 7 pH and 4 pH standard buffer solutions. Then electrode was dipped in the test solution and the temperature knob was adjusted to temperature of test solution. The function selector switch was set to pH and reading of digital display was allowed to stabilize.

Evaluation of overall acceptability:

A hedonic rating test method was used for the evaluation of overall acceptability as recommend by Pandey (2005). A panel consisting of member of different ages and different eating habits was constituted to evaluate the quality through properly-planned experiment. The panelists were selected from the staff and students of the department. Samples were served to the panelist and they were asked to rate the acceptability of the product through the sense of organs. Overall acceptability based as the average data of colour, texture, flavour and taste of the products as evaluated by the panelist. The hedonic rating scale ranged from extremely like (09) to extremely dislike (01). A test performa was also prepared and given to panelist before evaluation recommended by Pandey (2005).

Rating (s)	Score
Like extremely	09
Like very much	08
Like moderately	07
Like slightly	06
Neither like nor dislike	05
Dislike slightly	04
Dislike moderately	03
Dislike very much	02
Dislike extremely	01

Table A : Details of variables/parameters, there levels and descriptions

Sr. No.	Variables/parameters	Level	Descriptions	Quality parameters
1.	Tomato variety	1	Local fully ripe	Physico-chemical parameters
2.	Packaging	1	Glass bottle	Ascorbic acid
3.	Total soluble solid	2	10^0 and 12^0 B	pH
4.	Sample weight	1	100 g	Microbial parameter (yeast mould count)
5.	Storage condition	1	Ambient temperature	Sensory evaluation
				Colour and appearance
				Taste
				Flavour
				Overall acceptability
6.	Preservatives	3	10%	Sugar and salt
				Acetic acid
				Citric acid

■ RESEARCH FINDINGS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Microbial growth in tomato puree of various samples during storage:

For control sample microbial activity started after 15 days and after 30 days the microbial activity was 2 x 10^5 cfu/ml. And after 45 days, the microbial activity was even more *i.e.* 2.5 x 10^5 cfu/ml (Fig. 1). In the treatment preservatives were added. The 5g of sugar and 5g of salts were added. On first day it was seen that microbial activity was zero. After 15 days there was a slight increase in the microbial activity and the result was 1 cfu/ml. Later on, after 30 and 45 days, there was slight increase in microbial activity and that was 1.5cfu/ml and 2 cfu/ml, respectivlely (Fig. 2). In treatment the acetic acid was used and results were much better than the control sample and treatment 1. The microbial activity was very less. After 15 and 30 days, the microbial activity was only 1 cfu/ml (Fig. 3). In treatment 3 the citric acid was used and results were much better than treatment 1 and treatment 2 and the microbial activity was very less. The microbial activity after 15 days was zero and after 30 and 45 days the activity was very less. It was only 1x 10^5 cfu/ml (Fig. 3).

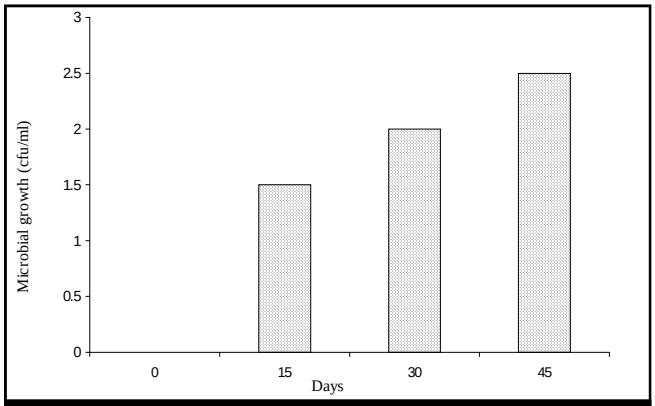

Fig. 1: Microbial growth in tomato puree of control sample

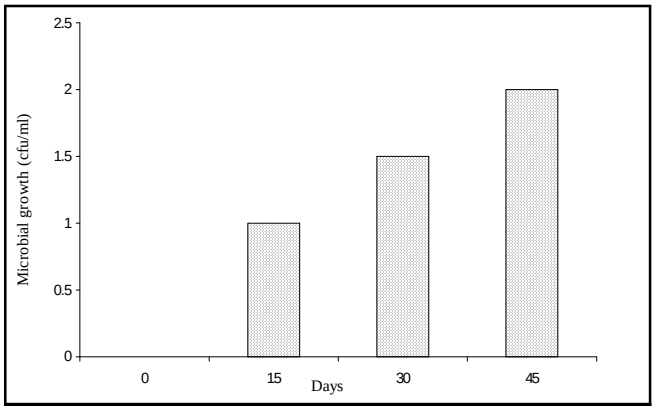

Fig. 2: Microbial growth in tomato puree with sugar and salt as preservative

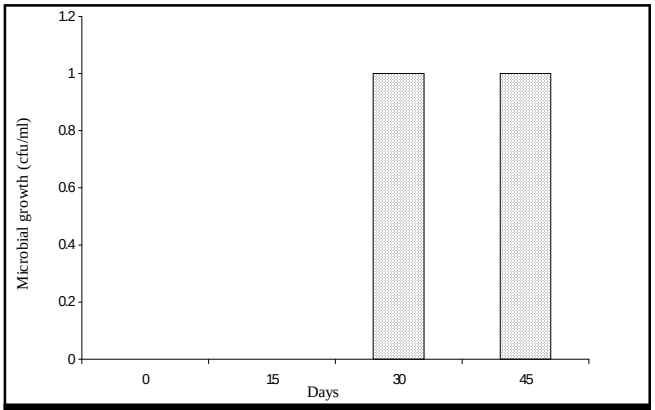

Fig. 3: Microbial growth in tomato puree of various samples during storage

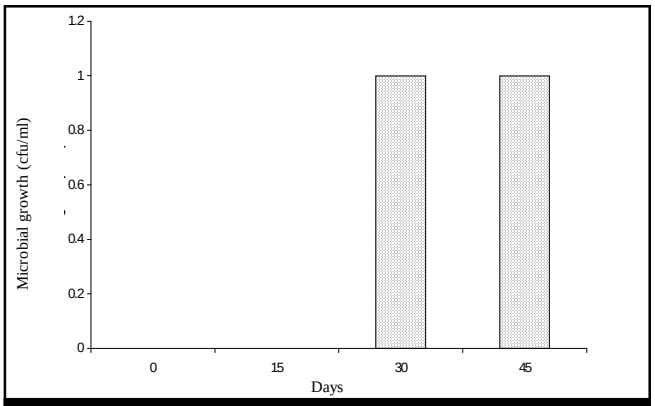

Fig. 4: Microbial growth in tomato puree with citric acid as preservative

Chemical changes in tomato puree of various samples during storage:

Changes in T.S.S. of tomato puree:

In the chemical analysis of tomato puree, the T.S.S. was found out to be 10 ^{0}brix and it was constant for whole 45 days. There was no change in brix. For treatment1, the chemical analysis was done and T.S.S was found to be 10 ^{0}brix and it was constant for whole 45 days. For treatment 2 during chemical analysis the T.S.S. was 12 ^{0} brix and it was constant for whole 45 days. Chemical analysis of treatment 3 was done and T.S.S. was found to be 12 ^{0} brix and it was constant for whole 45 days.

Changes in pH of tomato puree:

The pH of control sample was 4.28 at first day and then it started increasing after 15 days. It was 4.39 and after 30 days it was 4.42 and at last it was 4.63. The pH of treatment1 was 4.60 at first day and then it increased to 4.68 after 30 days of interval. The pH after 45 days was 4.73. The pH was increasing as number of days were increasing which shows that quality is

decreasing. The pH initially was 4.61 and then it started increasing. It was 4.66 after 15 days and 4.71 after 30 days. But after 45 days it further increased to 4.75. The pH of sample was 4.51 at first day and then increased to 4.63 after 30 days and 45 days it further reduced 4.69 and 4.71 (Fig. 4).

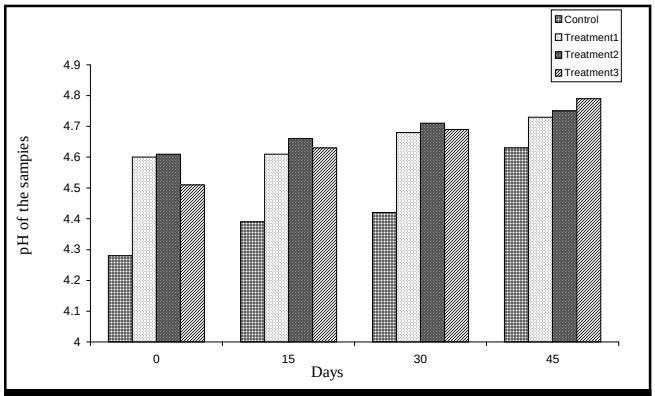

Fig. 5: Comparision of PH of tomato puree

Changes in vitamin C of tomato puree:

The vitamin C of samples was 23.70 mg at first day and then it started decreasing. It was 23.62 mg for 30 days and after 45 days it reduced to 23.59 mg.. The vitamin C of treatment1 was 25.63 mg at first day and then it reduces to 25.51 mg after 15 days. After 30 days it was 25.42 mg and then further reduced to 25.36 mg after 45 days. The vitamin C was decreasing as days were increasing. At first it was 26.81 mg and then it reduced to 26.75 mg after 15 days. After 30 and 45 days it further reduced to 26.71 mg and 26.68 mg (Fig. 5).

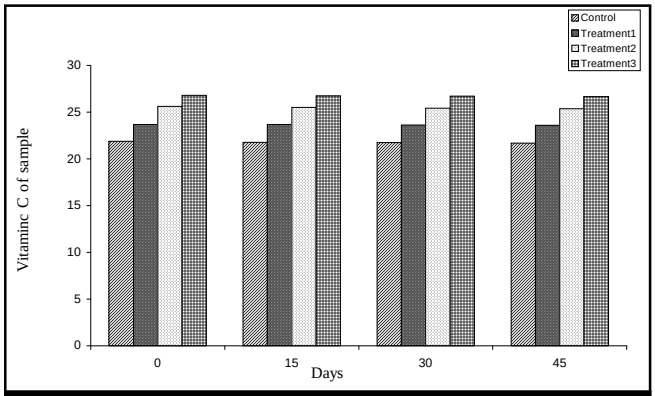

Fig. 6: Comparision of vitamin C of tomato puree

Effect of different treatments on sensory evaluation of tomato puree during storage:

The treatment T_0 in which no preservative was used showed poor result and its score was 7 whereas T_3 in which uses ascorbic acid was used had 8 score. The treatment T_2 had better score than treatment T_1 (Fig. 6). The score of taste was almost same for all the four treatments. It was closed to 8. But after 15 days the score of treatments T_3 was better than all other three. It was 7.67 after 45 days and T_2 and T_3 treatments showed satisfactory results. The score of T_0 and T_1 were 6.67 and 7.50 (Fig. 7). The scores of flavour was 8.67 at first day and also all other treatments had score close to 8.00 but after 15 days there was variation in score, T_0 had 5.33 score, T_1 had 6.33, T_2 had 7.33 and T_3 had 8.00. This showed there was a change in flavour for all treatments (Fig. 8). The over all acceptability score at first day was 8.3 and for T_3 was 9.00 and after that it decreased as day progressed.

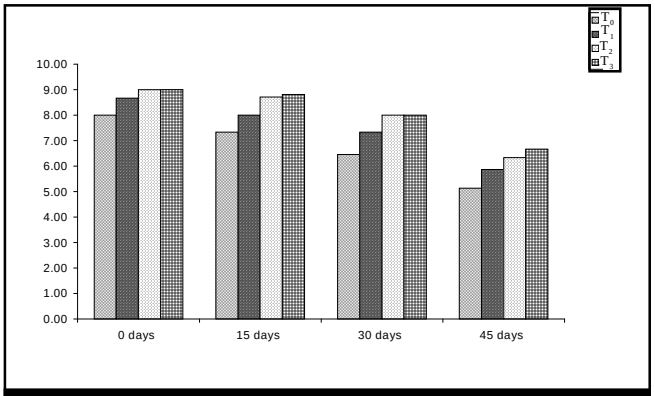

Fig. 7: Comparision of colour of tomato puree

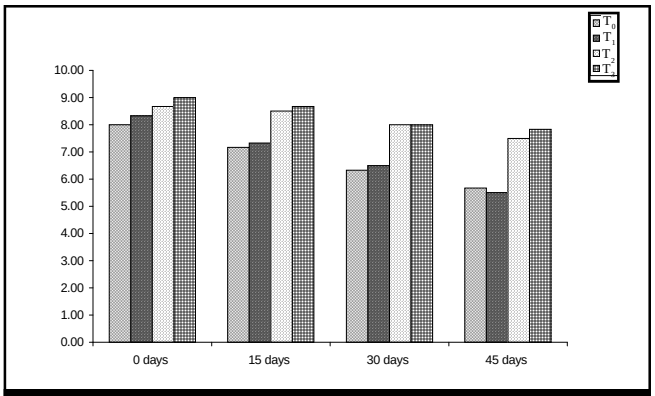

Fig. 8: Comparision of taste of tomato puree

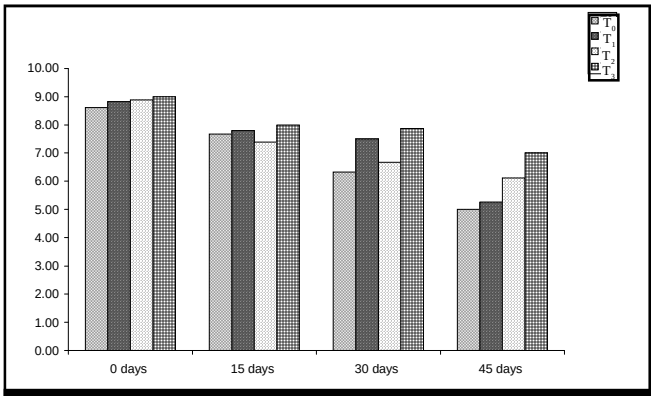

Fig. 9: Comparision of flavour of tomato puree

After 45 days T_3 had over all acceptability much better than other treatments. The score was 7.17. The score of treatment T_1 was 7 which was closed to T_3 while other treatments had got lower score below 7 (Fig. 10).

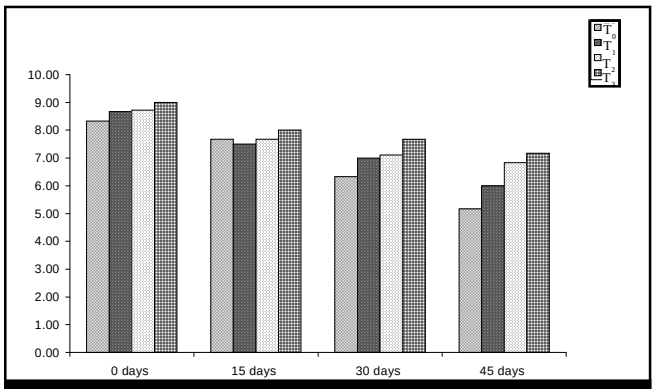

Fig. 10 : Comparision of overallacceptabitiy of tomato puree

Conclusion:

The control sample lost its colour, flavour and taste after 15 days. The microbial activity started after 15 days and was 1.5 x 10^5 cfu/ml.The sample in which sugar and salt were added as preservatives retained its colour, taste and flavour up to 15 days. The microbial activity after 15 days was 1 x 10^5 cfu/ml. It was safe microbiologically up to 15 days.The sample in which acetic acid was used as preservative showed good result microbiologically after 30 days. The result was 1 x 10^5 cfu/ml. The colour, taste and flavour were retained up to 30 days.The microbial and chemical analysis of sample in which citric acid was used as preservative was much better than other samples. For sample in which citric acid was used as preservative, the microbial result after 30 days was 1 x 10^5 cfu/ml which was the same as sample in which acetic acid was as preservative but during sensory evaluation the colour, flavour and taste of citric acid sample showed much better results than acetic acid sample.

Authors' affiliations:
CHANDRA PRAKASH, Department of Agricultural Engineering, Marathwada Institute of Technology, BULANDSHAHR (U.P.) INDIA

VISHAL KUMAR, Department of Post Harvest Engineering and Technology, Sardar Vallabhbhai Patel University of Agricultural and Technology, MEERUT (U.P.) INDIA

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