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**RESEARCH ARTICLE :**

# Effect of pretreatments on shelf life and quality characteristics of sun dried tomatoes

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**SUMMARY :** The main objective of the study the effect of pretreatments on shelf life and quality characteristics of sun dried tomatoes. Tomatoes of var. Avinash were sorted and washed with water to remove dirt and soil; and cut into the slices manually with thickness of approximately 1 cm. The Tomato slices were treated in a) Dipping in Sodium benzoate 2 g/100g solution($T_4$) b) Dipping in 2 g/100g sugar solution($T_2$) c) Dipping in 2 g/100g salt solution ($T_3$) in the ratio of 1:1 at room temperature for ½ an hour and d) Tomato slices were considered as control sample($T_1$). The water is drained and the slices were dried under solar drying. Then the slices were packed in 200 gauge polyethylene packs. During storage, the chemical, sensory and microbiological qualities were analyzed. The control samples kept at open drying spoiled within a day itself whereas the pretreated samples had a shelf life of 180 days at ambient temperature (31±2?C and 65±5% RH). Initially the moisture content of the sample was 93±5 g/100g and reduced to 7 to 7.5 g/100g of sample. The other parameters such as pH (4.83), total sugar (6.62 mg/100g) decreased and acidity (0.45g/100g), ascorbic acid (16.50 ± 0.03 mg/100g), lycopene (10.86 ± 0.09 mg/100g) increased in dehydrated sample. It was concluded that2 % sugar pretreated sun dried tomatoes (T2) were best without affecting its nutrients.

**KEY WORDS:**
Pretreatments, Shelf life, Dried tomatoes

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## BACKGROUND AND OBJECTIVES

Tomato is supposed to originate in Mexican region. Tomatoes have been domestically grown in many parts of the world and popularly grown throughout India. Of the world production of 126 million tons (MT), India accounts for only 8.6 MT (Potty, 2009). In Tamil Nadu, tomatoes are cultivated on 70,000 acres of land in the state with an average yield of 1,40,000 tons of tomatoes a day being produced (http://www.andhranews.net, 2009). The varieties cultivated are nadu and plum tomatoes. Tomatoes contain over 80 nutrients beneficial to humans. In the latest years, tomatoes and the obtained products became interesting subjects for researchers, due to their high biological value, antioxidant activity and functional characteristics. At a certain degree, all the products obtained from tomatoes present antioxidant characteristics, determined by the bioactive compounds, like lycopene, ß-carotene, vitamin C, polyphenols

and flavonoids. Sometimes tomatoes were as expensive as apples at Rs.40 to 50 / Kg whereas the high yield of tomatoes has brought down the prices of crop to Rs.7/ basket which lead to heavy loss to the farmers and lead to post harvest losses tomatoes. Rolle (2006) indicated fresh produce losses ranged from 10 to 40% globally, with losses in India at the high end. Chikkasubbanna (2006) reviewed some of the issues and priorities for improving the postharvest sector for vegetable handling. One of the best ways to reduce post harvest losses is converting them in to value added products. Dried tomatoes present a special interest, because some bioactive antioxidants are found in their composition at concentrated state. Lycopene has the highest value, with antioxidant and curative specific features on some diseases, and consequently, the lycopene-rich products may be used for obtaining foods and bioactive food supplements (BFS) (George, 2004).

Tomatoes have also been cut into pieces and sun dried (Gupta and Nath, 1984) and dried by convection (Baloch, Khan, and Baloch, 1997; Collins, Sidhu, and Mullins, 1997; Hawlader, Uddin, Ho, and Teng, 1991; Olorunda, Aworh, and Onucha, 1990; Tripathi and Nath, 1989; Zanoni et. al. 1999) and trials on the drying of whole tomatoes had also been undertaken (Shi, et. al. 1997). Drying of tomatoes had been carried out by hot air at greatly varying temperatures. Hawlader *et al.* (1991) dried tomato slices at temperatures ranging from 40 to 80°C with air velocities between 0.7 and 1.8 m/s. Shi *et al.* (1999) used 95°C, Olorunda *et al.* (1990) used a cabinet dryer at 60–80°C and Zanoni *et al.* (1999) dried tomato halves at 80 and at 110°C. Drying took from a few hours to over 20 h.

According to Heredia *et al.*, (2007) today consumer demand has increased for processed products that keep more of their sensory properties and nutritional value by natural means. Based on these factors, a study was undertaken to standardize the methodology sun dried tomatoes and evaluate the effect of pretreatments and drying methods on quality of dried tomatoes.

## RESOURCES AND METHODS

Tomatoes of var. Avinash were used for the experiments. Tomatoes were sorted and washed with water to remove dirt and soil; further tomatoes were cut into the slices manually with thickness of approximately 1 cm. The Tomato slices were treated as follows: a) Dipping in Sodium benzoate 2 g/100g solution (1:1) at room temperature for ½ an hour b) Dipping in 2 g/100g sugar solution. c) Dipping in 2 g/100g salt solution. The concentrations and time were standardized in preliminary studies. Best combination was selected based on minimum salt absorption and maximum moisture removal. d) Tomato slices were considered as control sample and denoted as follows :

| | |
|---|---|
| $T_1$ | Fresh - control |
| $T_2$ | Pretreated in 2% sugar solution |
| $T_3$ | Pretreated in 2% salt solution |
| $T_4$ | Pretreated in 2% Sodium benzoate solution |

After pretreatment, the water is drained and the slices were spread on aluminium trays for solar drying. The pre-treated samples were placed in trays. The trays were kept inside the solar dryer and a Data logger (Make: Nomad-Omega) was placed inside the dryer so as to record the temperature for every 1h time interval. All the pretreated samples took 36 h for drying to a constant moisture level. When a properly dried tomato is tapped in its center, no tomato pulp should stick to the finger, Parnell *et al.*, (2004).Then packed in 200 gauge polyethylene covers and stored in an airtight containers at ambient temperature. During storage Dehydration ratio, rehydration ratio, moisture, acidity, ascorbic acid, lycopene, sensory evaluation and microbial enumeration were evaluated. The procedures are as follows

### Quality characteristics of dehydrated tomato dehydration ratio (DR) :

Dehydration ratio was calculated as mass of sliced tomato before loading to the drier to mass of dehydrated material at the time of removal from drier (Sebii *et al.*, 2002).

### Estimation of moisture content :

The moisture content was determined according to the AOAC (1984) method. Five (5) g of samples was accurately weighed into dried crucible and placed in a hot air oven at 105±2oC for 4 (four) hours. After drying, the samples were removed from the oven and placed in desiccators to cool for about 30 minutes and then reweighed. The process of evaporation, cooling and weighing process were repeated until constant weight was found.

**Determination of pH :**

The pH of the selected samples was determined by a pH meter (Hanna instruments- ORPP), salinity-sodium tester (ISO-9001 certified company; Woonsocket, RI 02895) with the supplied pH 4.0 buffer solution, distilled water and 50 ml beakers.

**Titrable acidity :**

Titrable acidity was calculated as percentage of citric acid (Ranganna, 2004) by titrating of 10 mL of the tomato juice with a solution of NaOH (0.1N) till pH 8.1.

**Ascorbic acid :**

Ascorbic acid was determined by 2,6 Dichlorophenol - Indophenol Visual Titration Method given in Ranganna (2004).

**Total sugar :**

Total sugar of the sample was analyzed by Shaffer Somogy method described by Ranganna (2004).

**Lycopene :**

Lycopene content of the sample was analyzed by the method Anal. Chem., 21, 1226 (1994).

**Rehydration ratio :**

The rehydration ratio of dried tomato slices was determined as the ratio of rehydrated mass to the initial dehydrated mass, which gives a measure of the ability of dried tomato slices to reabsorb water. A sample of 5 g of the dried tomato slices was placed in a 250 ml beaker containing 150 ml of boiling distilled water. The contents were boiled for 5 min to allow the slices to rehydrate. After rehydration, the free surface water on the tomato slice was removed before assessing the rehydrated mass (Prakash *et al.*, 2004).

**Rehydration ratio = Wr/ WD**

where,

Wr - rehydrated sample mass, g

WD - initial mass of the sample before rehydration, g

**Organoleptic evaluation of dehydrated tomato :**

After the preparation of tomato soup using sun dried tomatoes, 4 samples were selected for organoleptic evaluation according to the method as described by Stone (1985). The Organoleptic evaluations of tomato soup were carried out by semi trained 20 judges. Tomato soup was evaluated organoleptically for color, flavor, texture and overall acceptability. The taste panelists were asked to rate the samples for color, flavor, texture and overall acceptability on 1-9 point hedonic scale, when, 9=like extremely; 8=like very much; 7=like moderately; 6=like slightly; 5=neither like nor dislike; 4=dislike slightly; 3=dislike moderately; 2=dislike very much; 1=dislike extremely.

**Microbiological study :**

Total plate count of the dried product was evaluated using the manual methods of Analysis of foods - Microbiological testing - Lab. Manual 14 (FSSAI, 2012).

**Data analysis :**

The data of physico-chemical analysis and microbiological analysis were subjected to analysis of AGRES software package of Indian Agricultural Statistics Research Institute, New Delhi at 5% significance level. ANOVA under Completely Randomized Design and the mean separation by LSD method was carried out for all the experimental data.

**Fig. A : Fresh tomatoes**

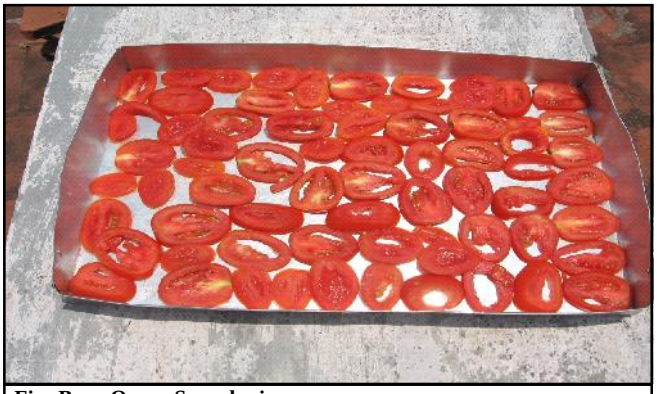

**Fig. B : Open Sun drying**

**Fig. C : Solar drying**

**Fig. D : Sun dried tomatoes**

## OBSERVATIONS AND ANALYSIS

The results of the study revealed that the shelf life of the sun dried were 180 days in all pretreated samples whereas the control samples were deteriorated within a day itself. Moisture content, the water activity and rehydration ratio did not changed significantly ($p<0.05$) during storage for 6 months at 31±2?C and 65±5% RH.

There was an initial moisture content of 80% ± 1 in fresh tomatoes during the initial phase of drying and with the increases of time the final moisture content was reduced to 7-7.5 % for sample treated with 2% sugar, salt and sodium benzoate treated samples until no further changes in their mass were observed. The drying rate was identical and similar to previous study as reported by Hema *et al.* (2007). In the early period of drying, there was a rapid decline in the moisture content for all the pieces of tomatoes. As expected the drying time decreased considerably with an increase in the air temperature.

Generally, the rehydration phenomenon can be explained by physical shrinkage and changes in physiochemical composition during drying at colloidal level (Potter and Hotchkiss, 1995). Also, if proteins are denatured and when they cannot reabsorb water completely leads to lower rehydration of the product. Before consumption of dried foods, they have to be rehydrated by adding water. Various factors that influence the rehydration are drying temperature, soaking time, air displacement, pH and ionic strength (Salunkhe, 1991).The overall variation in the rehydration characteristics of the dried product were influenced by the method of processing, sample constitution, preparation of the sample prior to rehydration and extent of the structural and chemical changes induced during drying as reported by Krokida and Maroulis (2001).But the study conducted by Rajkumar *et al.*, (2007) that thickness had effect on better rehydration ratio.

There was a significant reduction ($P < 0.05$) in ascorbic acid content in all the dried samples. From the data, it is observed that the ascorbic acid was very sensitive to oxidative heat damages as the reduction was significant in both the solar and open sun drying methods.

**Table 1 : Quality parameters of Sun dried tomatoes during storage**

| Treatments | pH | | Dehydration Ratio (DR) | | Rehydration Ratio (RR) | |
|---|---|---|---|---|---|---|
| | 0 day | 180 day | 0 day | 180 day | 0 day | 180 day |
| Fresh | 4.83± 0.08 | - | - | | - | - |
| 2 % Sugar | 4.40±0.07 | 4.02± 0.06 | 13.7±0.02 | 10.2±0.03 | 4.35±0.03 | 3.98±0.02 |
| 2% Salt | 4.25± 0.06 | 4.01±0.07 | 18.0±0.03 | 10.1±0.02 | 4.0±0.02 | 3.02±0.03 |
| 2% Sodium Benzoate | 4.20± 0.03 | 4.06±0.07 | 16.8±0.02 | 09.5±0.02 | 4.51±0.02 | 3.31±0.02 |

*All means are based on triplicate value.

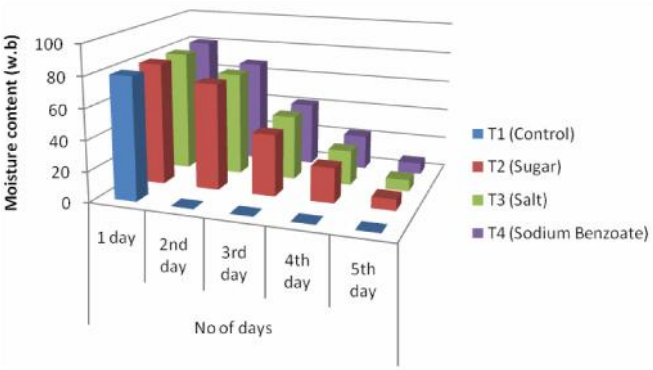


**Fig. 1 : Moisture content of tomatoes**

This is confirmed with the result reported by Giovanelli *et al.* (2002) that the reduction in ascorbic acid content was mainly due to the temperature, exposure to direct sun light and the presence of air. Similarly, Gould (1983) mentioned that the ascorbic acid degradation was mainly due to the temperature at which the tomato products were heated in the presence of air. In a similar line, Gregory (1996) mentioned that the loss of ascorbic acid was primarily due to chemical degradation involving oxidation of ascorbic acid. Also, significant loss of ascorbic acid has been reported in the previous studies using higher temperature and longer drying time. For example, Lavelli *et al.*, (1999) found that about 88% losses in ascorbic acid when tomatoes were dried at 80oC for 7 h to 10% moisture content. Similarly, Zanoni *et al.* (1998) reported that 40 and 80% loss of ascorbic acid when tomatoes were dried at 80 and 110oC, respectively.

Generally tendency of lycopene retention in samples slightly decreased during dehydration process. Conventional air drying decreased lycopene retention greatly in tomato samples, which was attributed to the influence of heat and oxygen. Possible reasons for good retention of lycopene may due to sugar solution keeps oxygen from the tomatoes in osmotic dehydration therefore reducing the oxidation of lycopene. Zanoni *et al.*, (2003) reported that °loss of lycopene during air drying up to 80?C had no effect on the pigment. Also Sharma and Maguer (1996) found that freeze drying and oven drying (25 to 75oC) of tomato pulp solids did not cause any loss in lycopene content. These investigations showed that lycopene is substantially stable at industrial dehydration but air is a critical factor in terms of oxidative damage. The similar results were observed in this study. The temperature involved is around 55?C and in sugar

**Table 2 : Chemical characteristics of sun dried tomatoes during storage**

| Treatments | Total sugar (g/100g) | | Ascorbic acid (mg/100g) | | Lycopene (mg/100g) | | Acidity (g/100g) | |
|---|---|---|---|---|---|---|---|---|
| | 0 day | 180 day | 0 day | 180 day | 0 day | 180 day | 0 day | 180 day |
| Fresh | 6.62 ± 0.41 | - | 16.50 ± 0.03 | - | 10.86±0.09 | - | 0.45 ± 0.02 | - |
| 2 % Sugar | 4.80±0.2 | 4.40±0.2 | 27.43± 0.03 | 22.05± 0.03 | 95±0.8 | 86±0.6 | 4.27±0.02 | 6.28± 0.03 |
| 2% Salt | 4.81±0.3 | 4.25±0.31 | 23.53± 0.03 | 18.04± 0.03 | 90±0.6 | 75±0.8 | 4.21±0.02 | 6.02±0.02 |
| 2% Sodium Benzoate | 4.87±0.2 | 4.20±0.2 | 25.02± 0.03 | 18.03± 0.03 | 90±0.9 | 70±0.7 | 4.86±0.03 | 6.12±0.02 |

*All means are based on triplicate value.

**Table 3 : Colour values of the Sun dried tomatoes**

| Treatments | L* | a* | b* |
|---|---|---|---|
| Fresh | 42.63 | 9.61 | 9.43 |
| 2 % salt | 31.91 | 3.31 | 10.65 |
| 2 %sugar | 39.17 | 5.18 | 12.86 |
| 2 %Sodium Benzoate | 32.91 | 2.15 | 10.80 |

*All means are based on triplicate value.

**Table 4 : Enumeration of microorganisms in sun dried tomatoes during storage**

| Treatments | 0 Day | | 180 days | |
|---|---|---|---|---|
| | Bacteria ($10^{-5}$ cfu/g) | Mould Count ($10^{-2}$ cfu/g) | Bacteria ($10^{-5}$ cfu/g) | Mould Count ($10^{-2}$ cfu/g) |
| Fresh | 10.49 | 4.02 | - | - |
| 2 % Salt | 8.36 | 3.66 | - | 1.62 |
| 2 % Sugar | 8.55 | 3.25 | - | 1.23 |
| 2 % Sodium Benzoate | 7.23 | 3.10 | - | 1.02 |

*Each value represent mean of triplicate.

treated samples; the lycopene retention is slightly high compared to other samples.

The quality of a dried product is also strongly affected by the colour surface, since the consumers like really tomatoes dried with visual appearance that remembers fresh tomato colour. The colour parameters investigated on dried samples showed significant differences ($p< 0.05$) respect to fresh samples, summarized in a decrease of the L* (lightness) and an increase of the h° hue angle). These changes gave to dried tomatoes samples a dark brown shade. It is also reported that during drying the red color of tomato gradually changed to brick - red and then to brown color in open sun drying (Sacilik *et al.*, 2006). Also, Porretta and Sandei (1991) mentioned that higher color change in open sun drying was mainly due to the direct exposure of the tomato slices to solar radiation for a longer period that induced non-enzymatic browning or Maillard reaction.

Microbiological quality is a common criterion used to determine the acceptability and shelf life of dehydrated plant based products. Although some microorganisms are destroyed in the process of drying, this process is not lethal to all microbes. Microbial count of the dehydrated foods depends on handling quality of utensils used during the processing period (Jay, 2000). All packaging materials were capable of maintaining the microbial load below 102 throughout the storage. That may be due to maintenance of water activity below 0.75 in samples packaged in all packaging materials. Earlier researches have suggested that dried foods to be held for several years should be processed to reach the final water activity of 0.60 to 0.75 (Jay, 2000). Moreover all packaging materials except polyvinyl chloride were able to maintain the moisture content between 14-20 %, which the alarm water content suggested for storage stability of dehydrated foods (Jay, 2000).

From the Fig. 2 it was observed that there was no significant different among the pretreatments compared ($T_2$, $T_3$ and $T_4$). The soup prepared from fresh tomatoes ($T_1$) scored high followed by Sugar treated ($T_2$), salt treated ($T_3$) and sodium benzoate treated ($T_4$) in all characteristics. Except taste all the other characteristics there was no significant difference among pretreatments.

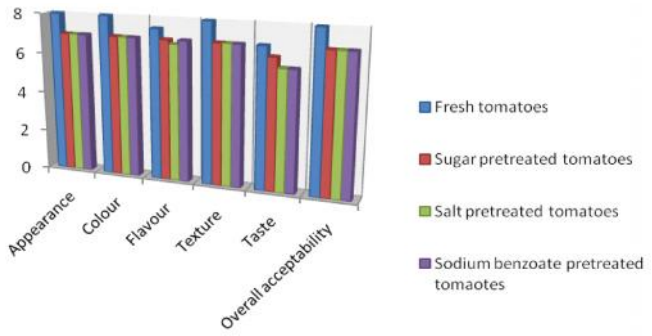


**Fig. 2 : Organoleptic evaluation of tomato soup prepared from fresh and sun dried tomatoes**

## Conclusion :

Plum tomatoes were cut into 1 cm thickness, pretreated with 2% sugar solution and solar dried for 48 hrs was sufficient to obtain a product with good physico-chemical, sensory and microbiological properties. Pouches made from Polyethylene were found to be suitable for storage of sun dried tomato for 6 months at 31±2 oC and 65±5% RH. The chemical characteristics slightly changed during storage period.

Therefore, high quality and aesthetically appealing dried tomatoes can be produced from solar drying. Solar dryers have the advantage of creating higher temperatures and movement of air that increases the rate of drying, therefore reducing the risk of spoilage by micro-organisms. Food is enclosed in the drier keeping contamination (by dust, insects and animals for example) at a minimum. The higher drying rate enables a greater quantity of produce to be dried in a relatively short space of time. Drying by natural means avoids the discoloration that occurs with artificial drying methods caused by high temperatures. However, there are also some drawbacks to solar drying. This process takes longer than oven controlled drying. This drying method is also dependant on weather conditions which include: humidity, insulation intensity and wind speed unlike artificial drying methods where drying conditions can be controlled. Dried tomatoes need to be rehydrated to improve on texture so that their quality matches that of fresh foods.

## REFERENCES

Giovanelli,G., B.Zanoni, V.Lavelli and R.Nani. (2002). Water sorption, drying and antioxidant properties of dried tomato products. Journal of food Engineering, 52: 135-141.

Gould, W.A. (1983). Tomato production, processing and quality evaluation (2nd Eds., pp. xii). Westport, Ct: The AVI Publishing, Inc.

Gregory, J.F. (1996). Vitamins. In. O.R. Fennemma (Eds.) Food Chemistry, New York, Marcel Dekker, Inc pp 531-616.

Hema, P. P.; Sudha. P. and Devibala, B. 2007. Studies on the effect of chemical treatments on dehydrated tomato, J. Food Eng., 54: 141-146.

Jay, J.M. (2000). Preservation of foods by drying, In: Modern Food Microbiology. 6th Edition. An Aspen Publication, Aspen Publishers, Inc., Gaithersburg, Maryland. pp. 363-374.

Krokida, K.M., and Maroulis, Z.B. (2001). Structural properties of dehydrated products during rehydration. International Journal of Food Science and Technology, 36,: 529-538.

Lavelli, C.W.; Hippeli, S.; Peri, C. and Elstner, E. F. 1999. Evaluation of radical scavenenging activity of fresh and air dried tomatoes by three model reactions, J. Agri. and Food Chemistry, 47: 3826-3831.

Potter, N.N. and Hotchkiss, J.H.1995. Food Science. Chapman 7 hall, New York, 608pp.

Porretta, S. and L. Sandai (1991). Determination of 5-Hydroyimethyl, 2- furfural in tomato products: Proposal of a rapid HPLC method and its comparison with the calorimetric method. Food Chemistry, 39, 51-57.

Sacilik, K., Keskin, R. and Elicin, A. K. (2006). Mathematical modelling of solar tunnel drying of thin layer organic tomato. Journal of Food Engineering.73(3): 231-238.

Sharma, S.K., and Maguer, M.L.(1996). Kinetics of lycopene degradation in tomato pulp solids under different processing and storage conditions. Food Res. Intl., 29:309-315.

Stone, C.V. 1985. Sensory Evaluation Prattices. Florida: Academic Press 311p.

Zanoni, B., C. Peri, R. Naniand V. Lavelli (1998).Oxidative heat damage of tomato halves as affected by drying. Food Research International.31 (5): 395- 401.

Zanoni, B., Pagliarini, E., Giovanelli,G., Lavelli, G.(2003). Modelling the effect of thermal sterilization on the quality of tomato puree. J.Food. Engg., 56:203-206.