International Journal of Advance Research in Science and Engineering
Volume No.06, Special Issue No.(01), Nov 2017
www.ijarse.com
IJARSE
ISSN: 2319-8354

Influence of Pre-treatments, Packaging material and Storage on the Lycopene content, Ascorbic acid and Phenols of the dried tomato slices (Variety Punjab Chuhra)

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ABSTRACT

The study was carried out to investigate the effect of different chemical pretreatments (2% ethyl oleate + 4% potassium carbonate (1 min) + 2% sodium metabisulfite (2 min). Packaging material (Low Density Polyethylene and Polyester) and Storage on the lycopene content, Ascorbic acid and Phenols of the dried tomato slices (variety Punjab Chuhra). The effects of pretreatments, packaging material and storage and their interactions were found statistically significant ($p<0.05$).

Keywords: Polyester, Polyethylene, Pretreatments, Punjab Chuhra, Storage,

I. INTRODUCTION

Tomato (*Lycopersicon esculantum* L.*)* is one of the most widely consumed fresh vegetables in the world. Tomatoes are rich source of lycopene (60-90 mg kg-1), polyphenols (10-50 mg kg-1) and small quantities of vitamin E (5-20 mg kg-1) and also a nutritionally recognized vegetable for their vitamin C content, with an average tomato supplying about 40% of the adult United States Recommended Daily Allowances (RDA) of 60 mg (Charanjeet *et al.*, 2004).

The preservation of fruits and vegetables by dehydration offers a unique challenge. Due to the structural configuration of these products, the removal of moisture must be accomplished in a manner that will be least detrimental to the product quality. Tomato (*Lycopersicum esculantum* L.) has a limited shelf life at ambient conditions and is highly perishable. It creates glut during production season and becomes scanty during off-season. Over the past few years, consumers have increasingly demanded food products providing both good sensorial quality and specific nutritional properties. Thus, there exists a need to develop suitable technology for processing and preservation of this valuable product in a way that will not only check losses but also generate additional revenue for the country.

Tomato as other fruits and vegetables can be dried using various methods and the quality of dehydrated tomato depends on many parameters such as tomato variety, total soluble solid content of the fresh product, size of the

tomato segments and air temperature. Processing of tomatoes using sun drying with cut pieces, drying of whole tomatoes, spray drying and convection drying using solar or mechanical systems has been used for many years (Baloch *et al.*, 2006).

Traditional sun-drying is a slow process compared with other drying methods and quality losses may result from high moisture content, colour degradation by browning, microbial growth (Lewicki *et al.*, 2002). Presently, there are few published studies comparing the single or mixed effects of calcium chloride and sodium metabisulfite dipping treatments on quality parameters of cabinet-dried tomatoes. Hence, the objective of this study was to evaluate the effects of different pre-treatments, packaging material and storage on the lycopene content, ascorbic acid and phenols of dried tomato (variety Punjab Chuhra).

II. MATERIALS AND METHODS

One variety of fresh tomato (Punjab Chuhra) was selected for the present study. Fruits were sorted and washed with water to remove dirt and soil and finally they were cut into slices of 15mm thickness. Following pretreatments were applied to tomatoes before drying:

T_0 Control: Non- pretreated samples were used as control samples.

T_2: Whole tomatoes were dipped in 2% ethyl oleate + 4% potassium carbonate solution for one minute and then 2% sodium metabisulfite dipping solution was applied to sliced tomato slices for 2 minutes.

2.1 Lycopene content (mg/100g):

The fresh and dried tomato (5-10gm) was extracted repeatedly with acetone in a pestle and mortar until the residue is colourless. Acetone extract was transferred to a separating funnel containing 10-15 ml of petroleum ether and mix gently and the carotenoid pigments were transferred into the petroleum ether by diluting the acetone (lower phase) with water or water containing 5% $Na_2 SO_4$. The lower phase was then transferred to another separating funnel and the petroleum ether extract containing the carotenoid pigments to an amber coloured bottle. The extraction of the acetone was repeated similarly with petroleum ether until it turns colourless and acetone phase was discarded. Small quantity of anhydrous $Na_2 SO_4$ was added to petroleum ether extract and then transferred to a 50 ml volumetric flask and diluted to mark with petroleum ether.

Calculations were made by the formula

$$\text{Lycopene content (mg/100 g sample)} = \frac{3.1206 \times A \times D \times 100}{1 \times W \times 1000}$$

Where, A = absorbance at 503 nm; D = dilution of extract to 100 ml;
W = weight of sample taken.

2.2 Ascorbic Acid (mg/100g)

Ascorbic acid was estimated by the method as described by Rangana (1986) using 2, 6-dichlorophenol indophenol dye. Dye factor was calculated by titrating 5 ml standard ascorbic acid plus 5 ml (3%) metaphosphoric acid against 2, 6-dichlorophenol indophenol till pink colour appeared and volume used was noted.

$$\text{Dye factor} = \frac{0.5}{\text{Titre value}}$$

Ascorbic acid was estimated by taking 5g of sample, volume made upto 100 ml with (3%) metaphosphoric acid and filtered. Then aliquot of 10 ml was taken in a titration flask and titrated against 2, 6-dichlorophenol indophenol till light pink colour appeared (which persisted for 15 seconds). Vitamin C was calculated using the following formula:

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Titre value x dye factor x volume made up}}{\text{ml of filtrate taken for x weight of sample estimation}} \times 100$$

P2.3 henols (mg/100g)

Total phenol content of sample was determined by spectrophotometric method given by Thimmaiah (1999). 500mg of sample was grinded with a pestle and mortar and ten times volume of 80% ethanol was added to it. The homogenate was centrifuged at 10,000 rpm for 20 mints and the supernatant was saved. The residue was re-extracted five times with the 80% ethanol, centrifuged and the supernatant was pooled. The supernatant was evaporated to dryness and the residue was dissolved in a known volume of distilled water (5ml) 0.2 ml of aliquot was pipette out into test tubes and 3ml volume was made up with water . 0.5 ml folincio calteu reagent was added to each tube. After 3 minutes 2 ml of 20 % sodium carbonate solution was added and mixed thoroughly. The tubes were placed for exactly one minute in boiling water followed by cooling. The absorbance was then measured at 650nm using spectrophotometer (DOUBLE BEAM UV-VIS spectrophotometer, UV5704SS) against a reagent blank. A standard curve was prepared using different concentrations of catechol. From standard curve the concentration of phenols in the test sample was found and expressed as mg phenols per 100g catechol.

III. RESULTS AND DISCUSSION

3.1 Lycopene (mg/100g)

As can be seen in Table I, the maximum lycopene content 83.89 mg/100g was recorded in the sample treated with 2% ethyl oleate + 4% potassium carbonate (1 min) + 2% sodium metabisulfite (2 min) followed by control (T_0) with a lycopene content of 82.04 mg/100g. During storage of 180 days there was

significant decrease in lycopene content from 92.04 to 73.82 mg/100g in dried tomato samples. In PE pouches maximum average lycopene content of 85.22 mg/100g was recorded in dried tomato samples during 180 days of storage, followed by 80.72 mg/100g in LDPE pouches.

With advancement of storage period there was a gradual decrease in lycopene content of the dried tomato samples irrespective of pretreatments and packaging materials. The overall mean lycopene content in treated sample was 83.89 mg/100g followed by control with 82.04 mg/100g lycopene content. The highest storage mean lycopene content 92.04 mg/100g was recorded at 0 day of storage in dried tomato slices which decreased to 73.82 mg/100g at 180 days of storage. The maximum lycopene content of 85.22 mg/100g was recorded in PE pouches followed by LDPE pouches with the lycopene content of 80.72 mg/100g.

In general, dried tomatoes have poor lycopene stability unless carefully processed and promptly placed in sealed packages and kept in proper storage conditions. The main cause of lycopene degradation during processing and storage are isomerization and oxidation. The lycopene content in dried tomato slices was influenced by pre treatments and storage conditions including packaging material during storage period. Both the samples (control and treated) showed progressive loss of lycopene throughout the storage period, but with a different rate of degradation and colour changes. Pre treated samples showed a good retention of lycopene as compared to control samples as sodium metabisulfite has a significant protective on lycopene.

The lycopene content showed a gradual decrease during 180 days of storage as the lycopene gets isomerised and oxidized. Lycopene loss was more in samples stored in LDPE pouches as compared to PE pouches due to less permeability regarding to light and oxygen in PE pouches leading to less oxidation and subsequently less degradation in the lycopene content (Shi *et al*., 2008). Similar results were obtained by (Olorunda et al., 2000 and Okanlawon *et al*., 2002).

3.2 Ascorbic Acid

Ascorbic acid is degraded by higher temperatures and the degradation product (L dehydroascorbic acid, DHAA) could participate in Strecker degradation with amino acid, producing a browning pigment. Not only does the high temperature of drying air affect the loss of ascorbic acid, but a long period of drying time can also introduce a significant loss of ascorbic acid (Mallappa *et al.* 2015 ; Kwanhathai *et al.* 2012).

As can be seen in Table II, during storage of 180 days there was significant decrease in ascorbic acid (mg/100g db) of the dried tomato samples due to pre treatments, packaging material and storage. The highest storage mean ascorbic acid content 11.99 mg/100g was recorded at 0 day of storage in dried tomato slices which decreased to 10.57 mg/100g at 180 days of storage. The maximum ascorbic acid content 11.31 mg/100g was recorded in control samples followed by ascorbic acid content of 11.18 in treated samples. Highest ascorbic acid of 11.56 mg/100g was recorded in dried tomato slices stored in PE pouches as compared to 10.93 mg/100g in LDPE pouches.

The permeability of the packaging material to oxygen had a detrimental effect on the retention of ascorbic acid as LDPE pouches being more permeable to atmospheric oxygen leads to oxidation thus reducing the ascorbic

acid content (Howard *et al.*, 2000). Similar results have been reported by Pura *et al.* (2001), Ou *et al.* (2002), Marin *et al.* (2004), Sidonia *et al.* (2005) and Suna *et al.* (2006).

3.3 Phenols (mg/100g)

The maximum phenol content 14.18 mg/100g was recorded in the sample treated with 2% ethyl oleate + 4% potassium carbonate (1 min) + 2% sodium metabisulfite (2 min) followed by control (T_0) with the phenol content of 12.62 mg/100g. During storage of 180 days there was significant decrease in phenol content from 13.90 to 13.06 mg/100g in dried tomato samples. In PE pouches maximum average phenol content of 13.58 mg/100g was recorded in dried tomato samples during 180 days of storage, followed by 13.22 mg/100g in LDPE pouches (Table III).

With advancement of storage period there was a gradual decrease in phenol content of the dried tomato samples irrespective of pretreatments and packaging materials. The overall mean lycopene content in treated sample was 14.18 mg/100g followed by control with 12.62 mg/100g lycopene content. The highest storage mean phenol content 13.90 mg/100g was recorded at 0 day of storage in dried tomato slices which decreased to 13.06 mg/100g at 180 days of storage. The maximum phenol content of 13.58 mg/100g was recorded in PE pouches followed by LDPE pouches with the lycopene content of 13.22 mg/100g.

The phenol content in control samples was higher as compared to treated samples which may be due to the protective nature of sodium metabisulfite. During storage the phenol content gets decreased due to the activity of enzymes like phenyl alanine amino lyase and polyphenol oxidase. Maximum retention of phenol was seen in samples stored in PE pouches as compared to samples stored in LDPE pouches due to less permeability of oxygen in PE pouches which otherwise will lead to the oxidation of the phenolics compounds (Stewart *et al*., 2000). Similar observations were recorded by (Kerchofs 2003 and Odekunle et al., 2006)

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