Contents available at http://epubs.icar.org.in,www.kiran.nic.in; ISSN: 0970-6429

Indian Journal of Hill Farming

June 2015, Volume 28, Issue 1, Page 77-80

Extension of Shelf Life of Tomato Using $KMnO_4$ as Ethylene Absorbent

[1] A. Nath • Bandita Bagchi • V. K. Verma • H. Rymbai • A. K. Jha • Bidyut C. Deka

Division of Horticulture, ICAR Research Complex for NEH Region, Umiam, Meghalaya, India PIN-793103.

ARTICLE INFO

Article history:
Received 13 July 2015
Received Revised 11 August 2015
Accepted 12 August 2015

Key words:
Tomato,
Shelf life,
Ethylene absorbent,
$KMnO_4$,
Polypropylene

ABSTRACT

Ethylene absorbents can increase the shelf life of fruits and vegetables since they scavenge away ethylene hormone, responsible for fruit ripening. Such a technique is used in increasing the shelf life of ripe tomato. Ripe tomatoes, after washing and removal of surface moisture were packed in polypropylene (200 gauge) packets with 0.002% perforation and without perforation. Chalks treated with different concentrations of $KMnO_4$ (1500 ppm-2500ppm) were kept inside the polypropylene packets, along with the tomatoes. Tomatoes packed in perforated (0.002%) polypropylene (200 gauge) packets with 2500 ppm $KMnO_4$ treated chalks had the shelf life of 28 days in cold storage (04±5°C and 85% RH) and 14 days in room temperature storage (24±5°C and 70% RH). Analysis of the samples were carried out and it was found that $KMnO_4$ (2500ppm) + perforation showed minimum decay percentage, and slow rate of changed in TSS, colour 'a' value and lycopene content, while maximum value was recorded for fruit firmness, acidity, ascorbic acid by the treatment.

1. Introduction

Tomato (*Solanum esculentum* L.) is one of the most importance vegetables, which has high demand in the market. In India, this crop occupies about 0.87 m ha of the area with production of 16.5 million MT, of which 68, 183.7 MT were exported with annual export earnings of 11,480.6 lakhs Rupees (NHB, 2011). It is being used as an extender in Indian dishes, as well as used to make a number of value added products like tomato sauce, ketchup, puree, etc. Tomato is rich in lycopene content (1.82-11.19 mg/g) (Markovic et al. 2000), Ascorbic acid (8 - 120 mg/100g) and Organic acid (0.4%) of fresh fruits (Cantwell 2000). These bioactive compounds, especially lycopene and ascorbic acid are a good natural antioxidant, particularly effective at quenching the destructive potential of singlet oxygen (Rymbai et al. 2011). Intake of this antioxidants has been linked to lower incidence of prostate cancer, cholesterol, atherosclerosis, coronary heart disease and protect the skin against harmful UV rays (O'Hare et al. 2004; Rymbai et al. 2011).

However, tomato being the climacteric fruit, marked increase of respiration rate and ethylene production during ripening process occurs, which reduce it shelf life at ambient temperature. Extending its shelf life is very important for utilizing the fruit to its fullest extent. Numerous attempts have been made in this aspect. Potassium permanganate was found to extend the shelf-life of climacteric fruit (Nwufo et al. 1994). Bhagwan et al. (2000) had reported the extension of shelf life of tomato by post-harvest antioxidant application such as ascorbic acid, sodium benzoate and benzyladenine. The technique of modified atmosphere packaging has also been used for its shelf life extension as reported by Isabel et al. (2008). Ethylene absorbents like monocyclopropene (MCP) could also be used to increase the storage life of the whole fruit. In the present investigation different concentrations of $KMnO_4$, as ethylene absorbents with (or without) polypropylene as packing material were used to conduct a study on the shelf life extension of ripe tomatoes.

Corresponding author: rymbaihort@gmail.com

2. Materials and methods

Plant material

Fully ripe tomatoes (Hybrid: Avinash-2) were collected from the Experimental field, Division of Horticulture, ICAR-RC for NEH Region, Umiam, Meghalaya (India) in the month of May, 2010. The tomatoes were washed properly and surface moisture was removed with tissue papers.

Treatments

These tomatoes were then packed in individual polypropylene (200 gauge) bags with 0.002% perforations or without perforations. To use $KMnO_4$ as ethylene absorbent in the bags, initially $KMnO_4$ solutions of different concentrations (1500-2500 ppm) were made and pieces of chalks were dipped in for 2 hours. The chalks were dried in oven at 100°C for 1 hour. These chalks were then put into each bag of tomatoes and sealed. The packets were kept at room temperature (24±5^{0}C and 70% RH) and cold storage (04±2^{0}C and 85% RH).

Observations

The treated tomatoes were evaluated at 7 days interval for various quality parameters, *viz*., total soluble solids, ascorbic acid, acidity and lycopene. Decay loss percentage, changes in colour and texture of the tomatoes during the storage period was also evaluated.

Analysis

Total Soluble Solids (TSS) content was determined using digital refractometer (Erma refractometer) and reading was expressed in degree brix (°B). Titratable acidity (TA) was determined according to the method described by Ranganna (1994). Ascorbic acid was estimated by using 2, 6 dichlorophenol indophenol dye visual titration method (Ranganna 1994). Lycopene content was estimated as per the method suggested by Ranganna (1994). The texture of the tomatoes were studied using a Stable Micro System TA-XT2 texture analyzer (Texture Technologies Corp. UK) and colour by using Hunter L, a, b colour measuring system (Colour Quest XE model) and estimated as Hunter value L, a and b where ‘ a ’ (‘ + ’ value indicated redness and ‘−’ value indicated greenness), ‘ b ’ (‘ + ’ value indicated yellowness and ‘−’ value indicated blueness) and ‘ L ’ (varies from 0 to 100 where ‘ 100 ’ indicated white and ‘ 0 ’ indicated black) Texture Analyzer assessed the samples on the basis of the force required for deformation of the tissues of the tomatoes (Ranganna 1993). The replicated data of all the observations were analyzed by using of Complete Randomized Design (CRD) with the help of statistical OP-STAT software.

3. Results and Discussion

Decay loss

By texture analysis, it was found that slow softening of the tissues of tomatoes occurred during the storage period (Table 1). The maximum shelf life extension was found in case of perforated (0.002%) polypropylene (PP) bags with 2500 ppm $KMnO_4$. This treatment had the decay loss of 0 % for 28 days in cold storage (CS) and 14 days in room temperature storage (RT). The minimum decay loss might be due to reduction in ethylene evolution, leading to slow the rate of softening of the fruits (Pangaribuan et al. 2003).

Fruit firmness

The maximum fruit firmness was recorded with the treatment $KMnO_4$ (2500ppm) + perforated polypropylene bag in the entire storage interval, *i.e*., at 14 (2.52 kg) and at 28 days (2.43 kg) under room and cold storage condition respectively (Table 2). This might be due to slow rate of softening of the fruits (Pangaribuan et al. 2003).

Total soluble solid

A gradual increase in TSS due to treatments was observed during the storage period of the tomatoes (Table 3). Among the treatments, $KMnO_4$ (2500ppm) + perforation had a slower evolution rate of TSS content, i.e., 4.7 and 4.8 under RT and CS respectively at 7 days, 4.9 and 5.1 under RT and CS respectively at 14 days and 5.6 at 28 days under CS. These results are in accordance with the finding of Silva et al. (2009). The increase in TSS content was mainly due to conversion of starch into sugars, thereby resulting in the increase of total soluble solids.

Titratable acidity

Conversely to TSS, the acidity was found to be declining with storage days. Among the treatments, $KMnO_4$ (2500ppm) + perforation showed minimum rate of declining of acidity with storage interval, i.e., 0.244 at 17 days and 0.25 at 28 days under RT and CS respectively.

Decrease in acid content was perhaps due to utilization of organic acid during respiration or their conversion to sugars (Sudheer et al. 2007).

Ascorbic acid

The ascorbic acid content also showed a declining trend during storage (Table 5). Among treatments, $KMnO_4$ (2500ppm) + perforation showed the maximum value at 14 days (32.1 mg/100gm) and at 28 days (34.2 mg/100gm) under RT and CS respectively. This indicated that treatment $KMnO_4$ (2500ppm) + perforation gave minimum reduction in the ascorbic content of tomato in all the storage days. However, the declining rate is minimum under cold storage. The reason for decreasing trend of ascorbic acid could be attributed to the existence of a balance between Vitamin C synthesis and aging of fruit (Miller 1945).

Colour 'a' value

There was a progressive increase in the colour with all the treatments, as indicated by value 'a' (Table 6). However, among treatments, $KMnO_4$ (2500ppm) + perforation exhibited slow rate of colour development both under RT and CS. Sammi and Masud (2008) found that plastic films incorporated with potassium permagnate were effective in delaying tomato ripening and colour development. This might be due to its ethylene absorbent capacity (Briceno et al. 1999).

Lycopene

Similarly, lycopene content followed the same pattern as colour 'a' value (Table 7) which exhibited slow rate of lycopene development both under RT and CS. $KMnO_4$ (2500ppm) + perforation gave maximum lycopene content (2.03 mg/100 g) under room temperature, while $KMnO_4$ (2000ppm) + perforation (2.11 mg/100 g) under cold storage. This was also confirmed by Silva et al. (2009) who reported the slower evolving of peel colour in papaya due to $KMnO_4$ treatment. This might be due to decrease in respiratory rate, inhibiting ethylene activity consequently reducing metabolism of the fruit (Hao and Hao 1993).

Conclusion

Based on this finding, it was observed that the rate of change of each of the mentioned parameters varied for different concentrations of $KMnO_4$. For increasing concentrations of $KMnO_4$, the rate of change of TSS, acidity, ascorbic acid, lycopene, firmness and colour slowed down, which was minimum in case of 2500 ppm $KMnO_4$ treated tomatoes. This could be further minimized in order to extend the shelf-life of tomatoes to one month by using 0.002 % perforated polypropylene (200 gauge) packets for packaging treated ripe tomatoes with 2500 ppm $KMnO_4$ at storage conditions of about 4^0C and 85% relative humidity. Applying of this finding will be helpful for the storage and transport of the produce without the occurrence of substantial loss in marketability and freshness quality

Acknowledgement

Authors are sincerely acknowledges the Director, ICAR Research Complex for NEH Region Umiam for providing all kind of support needed for completion of the work.

References

Bhagwan A, Reddy YN, Rao PV and KC Mohankumar (2000). Shelf life extension of tomato fruits by postharvest antioxidant application. J Applied Hortic 2 (2): 88-91

Briceno S, Zambrono J and E Castellanos E (1999). Retardo En La Maduracion De Frutos De Mango Cv. Keitt Y Palmer Mediante Las Mezclas VermiculitaKMnO4 Y Silicagel- KMnO4. Agron. Tropic 49(1), 41-49.

Cantwell M (2000). Optimum procedures for ripening tomatoes. In: Management of Fruit Ripening. University of California Post Harvest Horticultural Series No. 9: 80-88.

Hao HP and L Hao (1993). Study on storing strawberry at a temperature near the freezing point of water. J Fruit Sci 10(1): 21-24

Isabel OS, Robert SF and MB Olg (2008). Antioxidant properties and shelf life extension of fresh cut tomatoes stored at different temperatures. J Sci Food Agric 88 (15): 2606-2614

Markovic K, Hruskar M and N Vancic (2000). Lycopene content of tomato products and their contribution to the lycopene intake of Croatians. Nutr Res 26 (11): 556-560

Miller CD (1945). Fruits of Hawaii. Hawaii Agricultural Experiment Statistics Bulletin, 96 pp.

NHB (2011). National Horticulture Board, Indian Horticulture database. Ministry of Agriculture, New Delhi, India, pp 4-254

Nwufo ML, Okonkwo ML and JC Obiefune (1994). Effect of post-harvest treatments on the storage life of avocado pear (*Persea Americana*, Mill). Trop Sci 34: 364-370

O'Hare TJ, Wong LS and DJ Mc Grath (2004). Increasing visual appeal and health benefit of fresh-cut tomato slices using high-lycopene varieties. Acta Hortic 687: 395-398

Pangaribuan DH, Irving DE and TJO O'Hare (2003). Effect of an ethylene absorbent on quality of tomato slices. Poster presentations. Australian Postharvest Horticulture Conference, p 252

Ranganna S (1994). Handbook of analysis and quality control for fruit and vegetable products. Tata Mc Graw Hills Publishing Company Limited, New York

Rymbai H, Sharma RR and M Srivastav (2011). Biocolorants and its implications in health and food industry - a review. Int J PharmTech Res 3(4): 2228-2244

Sammi and T Masud (2008). Effect of different packaging systems on the quality of tomato (*Lycopersicon esculentum* var. Rio Grande) fruits during storage. Inter. J. Food Sci. Technol. 44(5): 918–926, DOI: 10.1111/j.1365-2621.2007.01649.x

Silva DFP, Salomão LCC, Lopes de Siqueira D, Cecon PR, and A Rocha (2009). Potassium permanganate effects in postharvest conservation of the papaya cultivar Sunrise Golden. Pesq Agropec Bras Brasília 44(7): 669-675

Sudheer KP and V Indira (2007). Post-harvest technology of horticultural crops, New India Publishing Agency, New Delhi, pp 87-90