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**Nasir Ahmad Sahel**
Department of Postharvest Technology, College of Horticulture, UHS Campus, GKVK, Bengaluru, Karnataka, India

**HC Krishna**
Department of Postharvest Technology, College of Horticulture, UHS Campus, GKVK, Bengaluru, Karnataka, India

**GJ Suresh**
Department of Postharvest Technology, College of Horticulture, UHS Campus, GKVK, Bengaluru, Karnataka, India

**S Bhuvaneswari**
Senior Scientist Post-harvest Technology and Agri-Engineering, IIHR, Bengaluru, Karnataka, India

**B Anjaneya Reddy**
Department of Plant pathology, University of Agriculture Science, GKVK campus, Bengaluru, Karnataka, India

**Foshanji AS**
Department of Postharvest Technology, College of Horticulture, UHS Campus, GKVK, Bengaluru, Karnataka, India

**Correspondence**
**Nasir Ahmad Sahel**
Department of Postharvest Technology, College of Horticulture, UHS Campus, GKVK, Bengaluru, Karnataka, India

# Effect of modified atmosphere package on biochemical properties of pomegranate (*Punica granatum* L.) fruits

**Nasir Ahmad Sahel, HC Krishna, GJ Suresh, S Bhuvaneswari, B Anjaneya Reddy and Foshanji AS**

## Abstract
Pomegranate (*Punica granatum* L.) is an important, as a table and processed fruit, due to its nutritional quality. An experiment was conducted to investigate the effect of different packaging material on chemical compositions of pomegranate fruits during storage. Pomegranate fruits were harvested from field washed with 150 ppm sodium hypochlorite, air dried, and graded based on uniformity (size, color, weight). Graded fruits were subjected to four modified atmospheric packaging treatments: 1) polyethylene; 2) polypropylene; 3) Xtend® bag 4) Silver nano bag. Pomegranates fruits without packaging served as controls. All pomegranates were stored at 7 ± 2 °C and 90 ± 5% relative humidity for 100 days. MAP treated pomegranates maintained higher quality measurements compared to unpacked pomegranates. Overall, TSS, sugars and ascorbic acid decreased in all treatment groups with prolonged storage while, anthocyanin and antioxidant activity increased upto 60 days again decreased with prolonged storage, but the rate of decrease was highest in unpacked fruits. Overall, application of MAP maintained quality of pomegranate fruits up to 100 days compared to unpackaged fruits.

**Keywords:** pomegranate, MAP, storage life

## Introduction
Pomegranate (*Punica granatum* L.) belongs to the family punicaceae. It is one of the most favorite table fruits and also one of the hardiest fruit plants that thrives well under arid and semiarid climatic conditions. Pomegranate, being a non-climacteric fruit has potentiality for modified atmosphere packaging (MAP) by using polymeric films which will not only retain fruit quality during storage but also help in prevention of chilling injury during refrigerated transport and storage. Therefore, an integrated approach on both production and postharvest management using recent technologies *viz.*, individual shrink wrapping, waxing, controlled atmosphere (CA) storage coupled with judicious temperature management practices needs more attention for wide distribution of this delicious fruit in the global market. Modified atmosphere packaging (MAP) is a passive or active dynamic process of altering gaseous composition within a package. This is achieved by the interaction between two processes; the respiration rate of the produce and the transfer of gases through the packaging material, passive MAP no further control exerted over the initial gas composition (Mahajan *et al*. 2007) [1]. In MAP, respiration rate is reduced by decreasing $O_2$concentration. This metabolic response is due to the decrease in the activity of oxidizing enzymes such as, glycolic acid oxidase and ascorbic acid oxidase. Hence, a decrease in respiration rate delays enzymatic degradation of complex substrates, thereby extending the shelf life of the produce and maintained quality. In MAP, respiration rate is reduced by increasing $CO_2$ and decreasing $O_2$concentration. MAP for pomegranates has been shown to reduce weight loss, shrinkage, scald development, decay, delay senescence and maintain postharvest fruit quality of pomegranates (Selcuk and Erkan, 2014) [2].

## Material and Methods
The pomegranate fruits (*cv*. Bhagwa) were hand harvested at ripe stage, The harvested fruits were brought to the laboratory to carry out the experiment, in the subsequent next day; they were sorted out to remove misshaped, bruised, diseased and insect infested fruit. Fruits were graded based on the uniformity, fruits were washed with 150 ppm sodium hypochlorite as sanitizer to make the fruits free from microbes and postharvest pathogens, later washed fruits air dried to remove free water from pomegranate fruits surface. Pomegranate fruits weighed and packed in modified atmosphere package along with control and kept in corrugated

fiberboard boxes as per treatment and stored at low temperature (7±2°C). Completely Randomized Design (CRD) was used for conducting the experiment and results were analysed as per the guidelines suggested by Panse and Sukhatme (1978) [3].

**Methods of analysis**

The content of total soluble solids (TSS) determined with the help of digital hand refractometer (Make: Erma Optical Work Ltd., Tokyo, Japan, 0-32°B range) and expressed as degree Brix (°B) (Anon., 1984) [4]. Sugars present in the pomegranate fruits sample were estimated, following the method of Lane and Eynon described by Ranganna (1986) [5]. Ascorbic acid content of pomegranate fruit samples was determined by modified method using 2, 6-dichlorophenol indophenol sodium salt described by AOAC, 2006 [6]. Total monomeric anthocyanin content was quantified using a pH differential method described by Giusti and Wrolstad, (2001) [7]. The total antioxidant activity (mg AEAC 100 $ml^{-1}$) of pomegranate fruits was determined by the FRAP method explained by Benzie and Strain (1996) [8].

**Result and Discussion**

The data presented in the table 1 reveals that decrease in the total soluble solids (TSS) during storage of pomegranate fruits, no significant differences were recorded among treatments at all days of storage. The mean loss of TSS was reported to be 0.7 to 0.98 $^0$B in $T_3$ and $T_4$ respectively at 100 days after storage. This is might be due to lower respiration rate in MAP fruits. Selcuk and Erkan (2016) [9] and Nanda *et al.* (2001) [10].

**Table 1:** Effect of modified atmosphere package on total soluble solids of pomegranate fruits under low temperature storage (7±2°C)

| Treatment | Total soluble solid (°B) | | | | |
|---|---|---|---|---|---|
| | 20 DAS | 40 DAS | 60 DAS | 80 DAS | 100 DAS |
| $T_1$- Polyethylene bag | 14.28 | 14.00 | 13.93 | 13.74 | 13.56 |
| $T_2$- Polypropylene bag | 14.36 | 14.22 | 14.09 | 13.80 | 13.62 |
| $T_3$- Xtend® bag | 14.12 | 13.94 | 13.82 | 13.66 | 13.52 |
| $T_4$- Silver nano bag | 14.42 | 14.32 | 14.20 | 13.94 | 13.80 |
| $T_5$- Control (unpack) | 14.07 | 13.58 | -- | -- | -- |
| S. Em± | 0.197 | 0.258 | 0.382 | 0.231 | 0.198 |
| CD @ 5% | NS | NS | NS | NS | NS |

NS: Non significance at 5% level DAS: Days after storage
--: End of storage life D0 TSS: 14.50 $^O$B

There was marked decrease in total sugars in fruits in all the treatments which were packed in different packaging material as shown in Table 2. Non-significant differences were observed with respect to total sugars of pomegranate fruits during storage when compared to D0, except at 40 days after storage, where significant difference was observed, the minimum (11.08%) total sugar was recorded in unpacked control fruits whereas maximum (11.27%) reducing sugars was recorded in treatment $T_4$ which packed in Silver nano bag In control low sugars were recorded due to exposure of fruit to atmosphere condition where there is no change in gas composition around the fruits and increase in respiration rate. Nanda *et al.* (2001) [10].

**Table 2:** Effect of modified atmosphere package on total sugars of pomegranate fruits under low temperature storage (7±2°C)

| Treatment | Total sugars (%) | | | | |
|---|---|---|---|---|---|
| | 20 DAS | 40 DAS | 60 DAS | 80 DAS | 100 DAS |
| $T_1$- Polyethylene bag | 11.44 | 11.21 | 11.02 | 10.86 | 10.76 |
| $T_2$- Polypropylene bag | 11.45 | 11.24 | 11.05 | 10.88 | 10.80 |
| $T_3$- Xtend® bag | 11.38 | 11.17 | 11.01 | 10.82 | 10.73 |
| $T_4$- Silver nano bag | 11.46 | 11.27 | 11.06 | 10.91 | 10.82 |
| $T_5$- Control (unpack) | 11.36 | 11.08 | -- | -- | -- |
| S. Em± | 0.038 | 0.034 | 0.022 | 0.037 | 0.033 |
| CD @ 5% | NS | 0.102 | NS | NS | NS |

* Significant at 5% level NS: Non significance at 5% level
DAS: Days after storage --:End of storage life D0 Total sugars:11.55 %

The ascorbic acid of pomegranate fruits in all the treatments decreased with prolonged storage as shown in Table 3. Significant differences were recorded among treatments. The ascorbic acid of pomegranate fruits at 40 day was recorded highest (11.60 mg $100g^{-1}$) in Silver nano bag ($T_4$) and least (11.05 mg $100g^{-1}$) ascorbic acid was observed in unpacked fruits($T_5$). The same trend continued till 100 days of storage, where highest (10.46 mg $100g^{-1}$) ascorbic acid was observed in Silver nano bag ($T_4$) and least (10.09 mg $100g^{-1}$) ascorbic acid was recorded in Xtend® bag ($T_3$). This might be due to partly degradation of ascorbic acid through oxidation, reduced enzymatic oxidation at low $O_2$ and high $CO_2$ levels in Silver nano bag. Similar result reported by Selcuk and Erkan, (2016) [9] and Arendse *et al*. (2014) [11].

**Table 3:** Effect of modified atmosphere package on ascorbic acid of pomegranate fruits under low temperature storage (7±2°C)

| Treatment | Ascorbic acid (mg $100g^{-1}$) | | | | |
|---|---|---|---|---|---|
| | 20 DAS | 40 DAS | 60 DAS | 80 DAS | 100 DAS |
| $T_1$- Polyethylene bag | 11.57 | 11.39 | 11.16 | 10.68 | 10.10 |
| $T_2$- Polypropylene bag | 11.62 | 11.47 | 11.35 | 10.75 | 10.39 |
| $T_3$- Xtend® bag | 11.53 | 11.32 | 10.99 | 10.43 | 10.09 |
| $T_4$- Silver nano bag | 11.72 | 11.60 | 11.46 | 11.03 | 10.46 |
| $T_5$- Control (unpack) | 11.43 | 11.05 | -- | -- | -- |
| S. Em± | 0.076 | 0.060 | 0.065 | 0.144 | 0.111 |
| CD @ 5% | 0.107 | 0.177 | 0.194 | 0.431 | 0.333 |

* Significant at 5% level DAS: Days after storage
--: End of storage life D0 Ascorbic acid: 11.80 mg $100g^{-1}$

The data in (Table 4) indicated that there was initial increase in anthocyanin (mg 100 ml) content of pomegranate fruits and later decreased with prolonged storage. Significant differences were recorded among treatments. The anthocyanin content of pomegranate fruits at 40 day was recorded highest (21.72 mg 100 $ml^{-1}$) in unpacked $T_5$ fruits, followed by Xtend® bag $T_3$ (21.66 mg 100 $ml^{-1}$) and least (20.14 mg 100 $ml^{-1}$) anthocyanin was observed in Silver nano bag ($T_4$). The same pattern continuous till 100 days of storage, where highest (19.43 mg 100 $ml^{-1}$) anthocyanin was observed in Xtend® bag ($T_3$) and least (16.06) anthocyanin was recorded in Silver nano bag ($T_4$). This might be due to Xtend® bag maintained optimum gas composition $O_2$ and $CO_2$ that prevent the loss of anthocyanin by creating modified atmosphere and modified humidity where as high $CO_2$ and low $O_2$ that cause fast degradation or delay biosynthesis of anthocyanin. Similar changes in anthocyanin content were observed in pomegranates by Miguel *et al*. (2004) [12] and Selcuk and Erkan, (2014) [2].

**Table 4:** Effect of modified atmosphere package on anthocyanin content of pomegranate fruits under low temperature storage (7±2ºC)

| Treatment | Anthocyanin content (mg 100ml$^{-1}$) | | | | |
|---|---|---|---|---|---|
| | 20 DAS | 40 DAS | 60 DAS | 80 DAS | 100 DAS |
| $T_1$- Polyethylene bag | 19.43 | 21.02 | 22.86 | 21.13 | 18.48 |
| $T_2$- Polypropylene bag | 19.25 | 20.82 | 21.54 | 20.68 | 16.22 |
| $T_3$- Xtend® bag | 19.47 | 21.66 | 23.13 | 21.23 | 19.43 |
| $T_4$- Silver nano bag | 19.23 | 20.14 | 20.64 | 19.61 | 16.06 |
| $T_5$- Control (unpack) | 19.53 | 21.72 | -- | -- | -- |
| S. Em± | 0.287 | 0.284 | 0.230 | 0.269 | 0.231 |
| CD @ 5% | 0.846 | 0.837 | 0.688 | 0.805 | 0.692 |

* Significant at 5% level
NS: Non significance at 5% level
DAS: Days after storage
--: End of storage life D0 Anthocyanin content: 18.57 mg 100ml$^{-1}$

The data revealed that, the antioxidant activity of the pomegranate fruits first increased upto 60 days then decreased of upto 100 days of storage Table 5. Significant differences were recorded among treatments with respect to antioxidant activity at 20 and 40 days after storage. The antioxidant activity of pomegranate fruits at 40 day was recorded highest (56.64 mg AEAC 100 ml$^{-1}$) in Silver nano bag ($T_4$) followed by polypropylene $T_2$ (56.59 mg AEAC 100 ml$^{-1}$) and least (56.28 mg AEAC 100 ml$^{-1}$) antioxidant activity was observed in unpacked fruits ($T_5$). The similar trend was observed till 100 days of storage, where highest (56.26 mg AEAC 100 ml$^{-1}$) antioxidant activity was observed in Silver nano bag ($T_4$) and least (55.91 mg AEAC 100 ml$^{-1}$) antioxidant activity was recorded in Xtend® bag ($T_3$). Retained antioxidant activity in MAP fruits might be due to low availabity of $O_2$ which reduce respiration rate, loss of substrates and other metabolic activity and high ascorbic acid. Our finding is in agreement with Dhineshkumar *et al.* (2017) [13] and Mirdehghan *et al*. (2007) [14].

**Table 5:** Effect of modified atmosphere package on antioxidant of pomegranate fruits under low temperature storage (7±2ºC)

| Treatment | Total antioxidant activity (mg AEAC 100 ml$^{-1}$) | | | | |
|---|---|---|---|---|---|
| | 20 DAS | 40 DAS | 60 DAS | 80 DAS | 100 DAS |
| $T_1$- Polyethylene bag | 56.13 | 56.54 | 56.90 | 56.54 | 55.97 |
| $T_2$- Polypropylene bag | 56.17 | 56.59 | 56.95 | 56.64 | 56.13 |
| $T_3$- Xtend® bag | 56.07 | 56.49 | 56.85 | 56.46 | 55.91 |
| $T_4$- Silver nano bag | 56.32 | 56.64 | 57.16 | 56.80 | 56.26 |
| $T_5$- Control (unpack) | 56.01 | 56.28 | -- | -- | -- |
| S. Em± | 0.103 | 0.100 | 0.119 | 0.126 | 0.147 |
| CD @ 5% | 0.304 | 0.296 | NS | NS | NS |

* Significant at 5% level
NS: Non significance at 5% level
DAS: Days after storage
--: End of storage life D0 Antioxidant activity: 55.44 mg AEAC 100 ml$^{-1}$

## Conclusion
Pomegranate fruits were packed with different MAP bags and stored in low temperature (7±2°C and relative humidity of 90±5 %) prolonged the storage and shelf life. The MAP bags such as Polyethylene, Polypropylene, Xtend® bag and Silver nano bag (Hima fresh®) had shown to maintained quality of the fruits up to 100 days with minimum losses.

## References
1. Mahajan BVC, Dhatt AS, Kumar S, Manohar L. Effect of pre-storage treatments and packaging on the storage behavior and quality of Kinnow mandarin. Journal of Food Science and Technology. 2007; 6:589-593.
2. Selcuk N, Erkan M. Changes in antioxidant activity and postharvest quality of sweet pomegranates cv. Hicrannar under modified atmosphere packaging. Journal of Postharvest Biology and Technology. 2014; 92:29-36.
3. Panse Sukhatme. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, 1978, 87-89.
4. Anonymous. Official method of Analysis. 14th Edn. Sioney Williams, Association Official Analytic Inc. Virginia, 1984, 423-462.
5. Ranganna S. Handbook of analysis and quality control for fruits and vegetable products. 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 1986, 9-10.
6. Association of Official Analysis Chemists (AOAC), In: Official Methods of Analysis, Ascorbic acid, 2006; 967.21, 45.1.14. AOAC International, Gaithersburg.
7. Giusti MM, Wrolstad RE. Anthocyanins Characterization and measurement with UV-visible spectroscopy. In: Wrolstad RE, editor. Current Protocols in Food Analytical Chemistry. John Wiley and Sons, New York., 2001, 1-13.
8. Benzie IF, Strain JJ. The ferric reducing ability of plasma (FRAP) as a measure of antioxidant power: The FRAP assay. Analysis Chemistry., 1996; 239:70-76
9. Selcuk N, Erkan M. Impact of passive modified atmosphere packaging on physicochemical properties, bioactive compounds, and quality attributes of sweet pomegranates. Turkish. Journal of Agriculture and Forestry. 2016; 40:475-488.
10. Nanda S, Sudhakarrao DV, Krishnamurthy S. Effects of shrink film wrapping and storage temperature on the shelf life and quality of pomegranate fruits cv. Ganesh. Journal of Postharvest Biology and Technology. 2001; 22(1):61-69.
11. Arendse E, Fawoleo A, Opara UL. Effects of postharvest storage conditions on phytochemical and radical-scavenging activity of pomegranate fruit (cv. Wonderful). Journal of Scitific Horticulture. 2014; 169:125-129.
12. Miguel G, Fontes C, Antunes D, Neves A, Martiusd. Anthocyanin concentration of ‘Assaria’ pomegranate fruits during different cold storage conditions. Journal of Biomedicine and Biotechnology. 2004; 5:338-342.
13. Dhineshkumar VD, Ramasamy, Pugazhenthi. Influence of packaging material on quality characteristics of minimally processed Bhagwa Pomegranate arils during storage. Journal of Pharmacognosy. Phytochemistry. 2017; 6(6):1042-1046.
14. Mirdehghan SH, Rahemi M, Castillo S, Martínez RD, Serran O, Valero D. Pre-storage application of polyamines by pressure infiltration or immersion improves shelf-life of pomegranate stored at chilling temperature by increasing endogenous polyamine levels. Journal of Postharvest Biology and Technology. 2007; 44:26-33.