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IMPACT OF DIFFERENT CHEMICALS ON THE POST HARVEST QUALITY OF PEAR (*Pyrus Spp* L.) FRUIT: A REVIEW

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ABSTRACT

Pear (*Pyrus Spp* L.) is one of the most harvested temperate fruit crop right after Apple. Pear belongs to the family Rosaceae along with some best known temperate tree fruits. Pear being one of the popular temperate fruit but is having a short storable life under room temperature conditions. The capability of being able to manage keeping quality of the stored fruit is must during the post harvest storage of the crops along with being able to increase the storable life of those fruits. Various post harvest technology are being used to sustain the fruit's keeping quality and also to increase those fruits storable time period. Being a crop prone to decay, diseases such as fungal diseases (mould) and short shelf life different researcher has recommended the use of different chemicals to preserve the quality as well as increase the storage lifetime of the fruits. Chemical such as Calcium have been proven to be effective in this post harvest management of fruits by having effects on the physiochemical fruits.

Keywords: Postharvest, Quality of fruits, Chemicals, storage life, Calcium, 1-MCP.

INTRODUCTION

Pear (*Pyrus Spp* L.) is one of the popular temperate fruit crop behind apple. It has a high productivity, high nutritive value and good range of adaptability under different agro climatic areas. Common Pear (*Pyrus communis*) is said to be originated from the temperate region of the Europe and Western Asia. Pear is diploid with chromosome no. $2n = 2x = 34$ and belong the family of Rosaceae and sub family being Amygdaloideae and Genus is *Pyrus*. *Pyrus communis* is a cultivated form and is derived generally from *P. caucasica* Fed. and *P. fivalis* Jaq. Pear is deciduous, rarely evergreen trees or shrubs. All species are self sterile, cross fertile and sexually diploids ($2n = 34$) in nature. The different species are graft compatible in nature. The fruits are of pyriform pome in shape and flesh of pear fruit contains the stone cell. Pear is rich in foliate vitamin C, copper and potassium. They are also a good source of polyphenol antioxidant.

Pear being a popular crop across the world with China being the largest producer of Pear followed by countries like Argentina, Italy, USA. India currently stands in at 8th position in production. The total estimated production in world was of about 24,168,309 metric tons with contributing with approximately 16,410,000 metric tons which being about two third of the total production and 67% of total world production and India contributing with about 346,000 tones (FAO, 2017). In India Pear is cultivated in the Jammu & Kashmir, Himachal Pradesh, Uttarakhand and Punjab, Haryana, Uttar Pradesh cultivating the low chilling Pears. Jammu and Kashmir is the leading state in the production of Pear being 94.42 in 000 tones with a share of 29.23% of total production of 322.99 in 000 tones of that year. (NHB, 2015-16).

The objective of this review is to determine that whether the chemical can be used for the purpose of retaining the Qualities of the Pear fruit while also having a desirable

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impact on the storage time of the Pear fruits. This can be determine if the chemicals have good effect on the physiochemical parameters such as Fruit firmness, TSS, Core-Browning, respiration rate and other parameters.

IMPORTANCE OF CHEMICALS ON THE POST HARVEST QUALITY OF THE PEAR FRUIT

During the Post harvest of the fruits different Post harvest technologies are used for the of maintaining the quality of the fruit and use of chemical treatment is one of those technology which is advised by many researcher for the increasing the storable time period of the produces and to sustain the keeping quality of the produce.

a) Impact of Calcium in the Post harvest Quality and Physiochemical Parameters

Calcium is considered to be an essential plant nutrient which is closely linked to quality and firmness of fruits (Sams, 1999). Calcium being an important nutrient required by the cells for different role in structural area of cell wall and membranes. Its need by the cell is to act as a counter-cation for the organic and inorganic anions of cell's vacuole while also acting as a messenger within the cell in the cytosol (Marschner, 2011). Application of Calcium in the pre harvest or post harvest phase is said to be able in prevention of the physiological order and also increase the disease resistance ability of the harvest also said to be helpful in delaying of the ripening period of the fruit and along with it also helps in enhancing the quality of the fruits. (Manganaris *et al.*, 2007).

The fruits were able to maximum value of mean Fruit firmness (5.78 kg/cm²) while maintaining lower mean values of TSS to acid ratio (37.37), PME activity (2.01), Polygalacturonase (PG) (14.75) and also lowest loss in the Physiological weight of the Fruit (5.98%) when treated with 4% of CaCl₂ as compared to other treatment. The treatment of freshly harvested fruits treated with the 4% of CaCl₂ for a time period of 20 and 30 minutes were effective along with treatment of 3% of CaCl₂ in ambient conditions of storage. (Kumar *et al.*, 2017)

The fruits of Asian pear cv. Pathernakh were treated with CaCl₂ at different concentration and were kept for a period of 75 days under a temperature of 0-1°C and relative humidity of 90-95%. The Mean Fruit firmness (15.82 lb) of Asian Pear was lowest in stored fruits which were dipped in the solution of CaCl₂ of 4% concentration. The core

browning was not noticed in the CaCl₂ @ 2% and @4% up to 45th day of storage period and even with succession in the storage period browning was observed in just 5% of the total fruits after 60th and 75th day of storage in fruit treated with CaCl₂ @ 2% and @4% respectively. The fruits dipped in solution of CaCl₂ @ 4% concentration had maximum TSS (14°B) and total sugar (8.30%). The fruits which were treated with 4% of CaCl₂ had a favorable and desired impact on the physiochemical parameters during storage as compared to those untreated fruits. (Mahajan *et al.*, 2004)

The fruits were experimented were kept in a temperature of -1°C for period of 12 weeks. The slices that were stored in Controlled atmosphere of 0.5% of O₂ of the dipping of 1% % of CaCl₂ were very effective in keeping the firmness and a lighter colour of those slices. On the 8th day of the storage in treatment of 1% of CaCl₂ at a controlled atmosphere of 0.5% O₂ had much firmed slices as compared to 1% of CaCl₂ at air. A 1% of CaCl₂ dip proved to be effective to reduce the browning and also in reducing the loss of firmness of the sliced fruits. The combination of 0.5% O₂ and 1% of CaCl₂ was more effective in nature and was able to control the browning and maintain the fruit firmness of the sliced fruits compared to that the treatment which was introduced to the air. (Rosen *et al.*, 1989)

The various treatments of CaNO₃ and GA₃ were effective in the process of minimizing the Physiological Loss of weight, in maintaining the Firmness of the fruits, TSS, titratable acidity, total sugar content and other parameters. After the end of the storage period the most effective treatment was noted to be in the fruits which were treated with CaNO₃ treatment of 3% with lowest PLW of 4.81%, and highest in fruit firmness (3.88 kgf), sensory quality (7.15), TSS (12.35%), total sugar (8.45%). In case of GA₃ the minimum PLW (5.59%) was noticed in the treatment with 60 ppm concentration and maximum values of fruit firmness were noticed in those fruit which were treated with GA₃ @ 40, 60 ppm of 3.55 kgf in both cases. In case of TSS (12.31%) and Total sugar (8.38%) were highest noticed in treatment of GA₃ @ 60 ppm. Both CaNO₃ and GA₃ were both effective in reducing the PLW, maintaining the fruit firmness, TSS, Total Sugar content and other parameters with most effective being the 3% of CaNO₃ and in case of GA₃ the treatment of GA₃ @ 60 ppm (Kaur *et al.*, 2017).

Table 1: Effect of Calcium Treatment on different Fruit Crops.

S No.	Crop	Treatment used of Calcium	Effect of Calcium treatment	Source
01	Apple	4% of CaCl ₂	Decrease in the weight loss, pH, TSS/acidity and increased the fruit firmness of fruits	Shirzadeh <i>et al.</i> , 2011
02	Peach	6% of CaCl ₂	Retarded the spoilage, sustained the fruit firmness, acidity and vitamin A content	Gupta <i>et al.</i> , 2011
03	Papaya	2.5% of CaCl ₂	Increased the storage life, control on the disease incidence and retarded the timing of ripening process	Mahmud <i>et al.</i> , 2008
04	Apricot	1% of CaCl ₂	Increased the storability period of fruits.	Antunes <i>et al.</i> , 2003
05	Orange	2%,4%,6% of CaCl ₂	Reduce the incidence of rot	El Gali, 2014
06	Loquat	2% and 3% CaCl ₂	Were able to sustain the highest fruit firmness, TSS, ascorbic acid content reduced browning index and weight loss	Akhtar, 2010

a) Impact of Aminoethoxyvinylglycine (AVG) and/or Oxalic acid on the Pear fruit's Quality

The treatment of AVG and/or oxalic acid were proven efficacious in decreasing the production of ethylene and the result of which was delay in the ripening of the fruits and also was able to reduced the fruit decay. Also, AVG+ oxalic acid was very successful in reducing the respiration rate, displayed a little bit of browning while the treated fruits also produced a lower amount of sugar. The loss in the weight percentage did effectively lowered in AVG treated fruit only and also it was very impactful in maintaining the firmness of fruits and by the finishing of the storage time period AVG treatment was able to preserve a higher green colour of the fruits. Additionally, fruits treated which were treated using oxalic acid single handedly retarded the decay as well as the total loss percentage following the end of cold storage conditions and also during the short period of the marketing period (Tarabih, 2014)

The fruit's ripening of 'Abbe Fetel' fruits which were treated in the pre harvest was retarded by 5 to 15 days on the basis of the harvesting dates. After the 7th and 14th of the cold storage period, fruits which were treated with AVG treatment retained their unripe features partially as compared to those untreated fruits. The process of flesh softening was declined due to the post harvest application of dip treatment of AVG on the fruits. (Anderotti *et al.*, 2004)

b) Impact of Application of 1-Methylcyclopropene (1-MCP) on the storage life of the Pear fruit

The compound 1-MCP is said to being able to prevent the ill-effects of ethylene in vast range of fruits. Fruits which were

treated with 1-MCP showed lesser levels of Hydrogen peroxide, Ascorbate content while also showing lowered ionic leakage in the storing period of fruits. The fruits which were treated with 1-MCP also showcased higher enzymatic antioxidant potential. The desirable impacts of 1-MCP on the ripening process were just not limited because of its influence on the ethylene but it was due to rise in the potential in the Pears fruits. (Larrigaudiere *et al.*, 2004)

The fruits which were exposed to the 2 μ L L⁻¹ 1-MCP while also were kept in cold conditions storage did increased the storage period with one another months as compared to fruits which were just kept under the cold storage conditions. The total sugar content of theses fruits was steady during the storage period in each and every treatment. The application of 1-MCP on the fruits and keeping them in the cold storage showcased inhibition of the sucrose loss and also in the amassing of the hexoses. The reason this was the inhibition of amassing of PpAIVI transcript and the reduction in PpSPSI transcript which resulted in the retardation of sucrose losses. Cold+ 1-MCP treatment can be proven to be beneficial to the market as it inhibit the sugar losses and maintaining the fruit firmness and appearance in the Japanese pear. (Itai *et al.*, 2007)

The fruits which were treated with the 1-MCP @ 300 ppb had impact on the flesh firmness, texture and peel green colour had higher values and apart from that respiratory rate and ethylene production of fruits showcased lower values. Fruits treated with NO and SNP were not able to decline the fruit's rate of respiration and also the production rate of the ethylene. NO @ 20 ppm treatment of fruits was able to maintain their fruit firmness and textural features after leaving the chambers. The fruits which were treated

with SNP @1mM and NO@ 20 ppm were able to maintain their peel green color when they were compared to control fruits without having any effect on the yellowing of the treated fruits during the storage. The application of treatment of 1-MCP @ 300 ppb inhibited the buttery texture and yellowing in the fruits even during exposure to environmental conditions was done. (Hendeges *et al.*, 2016)

The fruits which were treated with a treatment of 1-MCP @ $0.2 \mu\text{l l}^{-1}$ the rate of softening lowered after 7 days of storage at a temperature of 20°C . The firmness of these fruits was considered acceptable for consuming even after storage time period of 14 days at the temperature of 20°C . 1-MCP @ $0.2 \mu\text{l l}^{-1}$ when combine with cooling techniques can delay the ripening process as well can sustain an acceptable keeping quality of Pear fruits throughout the span of the storage. (Calvo *et al.*, 2004).

Table 2: Impact of 1-MCP treatments on the different fruit's Postharvest.

S No.	Crop	Effect of 1-Methylcyclopropane on the fruit crops	Source
01	Orange	Inhibitory effect on the process of Degreening	Porat <i>et al.</i> , 1999
02	Guava	Lowered the rate of respiration and also retaining the quality	Bassetto <i>et al.</i> , 2005
03	Loquat	Lowered Lipoxxygenase, PPO activities while also retarding the browning resulted in quality sustaining and prolonged shelf life	Cai <i>et al.</i> , 2005
04	Papaya	When fruits treated with 1-MCP the fruits show delay in the softening process. The treatment increased storage life while maintaining the quality of the Fruit	Ahmad <i>et al.</i> , 2013
05	Mango	Suppressed Anthracnose of Mango fruit in post harvest by having inhibiting impact on the spore germination and mycelial growth of <i>C. gloeosporioides</i>	Xu <i>et al.</i> , 2016

a) Impact of Ascorbic acid and /or Calcium lactate and/or Cysteine on the Quality of Pear

The low concentration of O_2 (0.25 or 0.5 kPa), elevated amount of the CO_2 (air rich with 20,10 or 5 kPa of CO_2) or the superatmospheric O_2 (40,60 or 80 kPa concentration) controlled atmosphere single handedly did not efficaciously prohibited surface browning caused due to softening of these fresh cut pear slices. After cutting, the dip treatment of the 2%(w/v) ascorbic acid, 1%(w/v) calcium lactate and 0.5% (w/v) cysteine with a pH of 7.0 notably extended the storage life of Bartlett, by preventing the loss of firmness of flesh from the slices as well also inhibiting browning on the cut surface. There was no differentiation observed in the quality evaluation of the cut slices treated with chemical preservatives and stored over night at 0°C and the slices which were freshly cut. The 82% of total participant judged the treated slices after the interval of stored in air at 0°C to be acceptable appearance wise after 10 days of interval of storage period whereas 70% from total participants determined the flavor to be acceptable of those treated slices. (Grony *et al.*, 2001)

The fruits which were applied with a treatment of 0.1, 1.0 and 10 mM of Ascorbic Acid showed a reduction in Core Browning Index of 10.4%, 24.5% and 40.0% respectively after 180th day of storage. The highest TSS and firmness of

the fruit which were treated with AsA @ 10 mM in comparison to that of controlled fruits. AsA treatment of fruits had retarding impact on the amassing of the malondialdehyde and Hydrogen Peroxide. Furthermore, the Ascorbic Acid treatment significantly postponed the retardation of Ascorbic Acids and glutathione levels while also it preserved activates of superperoxide dismutase catalase and Ascorbate Peroxide. (Lin *et al.*, 2007).

The application of a combination that of Chitosan coating and Ascorbic acid can prolong the time period of the weight loss and sustain a higher fruit firmness, TSS as compare to that of untreated ones. There was also decrease in the respiration rate as well as the membrane permeability while also restricting the Core browning of fruits in an effective manner even after 60 days of storage time period. This combined treatment was also able to sustain and higher amount of Ascorbic acid content and also maintaining a higher level of antioxidative enzymes activities. (Lin *et al.*, 2008)

b) Impact of other chemicals (Hydrogen Sulfide, Nitric Oxide, GRAS chemical, Sodium Chlorite) on the keeping life of Pear

Hydrogen sulfide gas released by Sodium Hydrosulfide was able to increase the shelf life period of the fresh sliced

Pear. Additionally H_2S retained the higher reducing sugar levels as well as also the soluble proteins in those freshly cut Pear slices. The amassing of the hydrogen Peroxide, superoxide radicals also Malondualdehyde was retarded with the introduction of H_2S gas. Moreover H_2S was able to up-regulate the activity process of the antioxidant enzymes such as ascorbate peroxidase, guaiacol peroxidase and also catalase. H_2S was able to down regulate the activities of lipoxygenase, phenylalanine, and polyphenol oxidase as well as ammonia lyase. In addition to this the fumigation process of H_2S was able to efficaciously restricted the growth of 2 different types of the fungal microbe of the Pear fruits, *Asperigillus niger*, *Penicillium expansum*. The meaning of this was that H_2S can work as an efficacious fungicide during the Post harvest storage process. (Hu et al., 2014).

Fruits which were treated with the treatment of $NO @ 10\mu l l^{-1}$ for a period of 2 hours the stage of ethylene climacteric was postponed to 4 days period of time while reducing the maximum production of the ethylene by 28% and the delay in the fruit's firmness as well change of colour by 2 days time. When the same fruits were treated with another $NO @ 10\mu l l^{-1}$ after a period of 4 days there was even more reduction in the production of the fruits was noticed by 48%. While the fruits which were treated with different concentration of $NO @ 10\mu l l^{-1}$ and $50\mu l l^{-1}$ for the period of 12 hours postponed the yellowing of fruits by a time period of 2days but the rate softening rate of fruits was very much unaltered. (Sozzi et al., 2003).

The application of GARS such as Boric Acid, Sodium bicarbonate and Sodium benzoate chemical's as external treatment had a positive effect in the fruits as they retarded the TSS/acid ratio, SOD enzyme activity and decreased the pH while lowering the Reducing sugar and non reducing sugar's values as compared to that of untreated fruits. The concentration of Boric acid @ 3% treatment was proved to be much more effective than other treatments of GRAS chemical in increasing the Storage time period while also keeping the quality of fruits acceptable in the low temperature condition storage. (Kaur et al., 2019).

Sodium chlorite showed a vital prohibition in the browning of sliced fruits and also inhibited the PPO activity of the slices of Pears. Sodium chlorite treatment also was efficacious in deactivation of the *Escherichia coli* O157:H7 slices of Pear fruits. The combination of carboxymethyl chitosan coating and sodium chlorite on the sliced pears had a noticeable inhibitory impact on the browning reaction as well as was able to prevent the PPO activity. Furthermore the combination of Sodium chlorite

with coating of either Chitosan or Carboxymethyl chitosan was able to sustain the tissues firmness. (Xiao et al., 2011)

CONCLUSION

Application of different chemical such as Calcium based solution, Ascorbic acid, Gibberellic acid, Oxalic acid, 1-MCP and Aminoethoxyvinylglycine etc. has a positive effect on the Pear fruits as Post harvest treatment. The Calcium based solutions were able to maintain the desirable quality of the produce of fruit tree by having positive impact on the physiochemical parameters of the fruits at different concentration. Gibberellic acid, Oxalic acid and Ascorbic acid can also play an important role as post harvest treatment for the storage of the fruits. Aminoethoxyvinylglycine and oxalic acid treatment were effective in delaying the respiration rate and also the ripening of the fruits. The combination of both AVG+ Oxalic acid were deemed to be effective in the retarding the respiration rate and small to less browning and also synthesis of lower sugar in fruits. 1-Methylcyclopropene was able to inhibited the sucrose loss while extending the storage period in fruits also preventing the amassing of the hexoses. The chemical treatments for post harvest can be applied for the purpose of extending the shelf life while also preserving the quality of the fruits at an acceptable level.

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