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# Effect of Post Harvest Application on Fruit Quality Changes and Storage Stability in Bartlett Pear under Refrigerated Storage.

KEYWORDS: 1MCP @ 1ppm, Shrink-wrap, refrigerated storage, William's Bartlett pear, post cold storage

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**ABSTRACT** *The present investigation was carried out to study the effect of various post harvest treatments (shrink wrap, 1-MCP@1ppm, 1-MCP@1ppm + Shrink Wrap, Carbendazim @ 500 ppm, Carbendazim @ 500 ppm + Shrink Wrap, Calcium Chloride @ 4%, Calcium Chloride @ 4%, + Shrink Wrap, Wax (SH002) @ 10%, Wax (SHOO2)@10% + Shrink Wrap ) in order to increase the shelf life and to avoid post harvest losses of William's Bartlett Pear under refrigerated storage conditions (Temperature 1-2°C and 85-95% RH). In physical characteristics PLW, spoilage, firmness, juice yield, colour, texture, flavour and overall acceptability were studied during refrigerated storage conditions. In chemical characteristic TSS, total sugar, pectin, acidity, ascorbic acid and total chlorophyll were analyzed after 15, 30, 45, 60, 75, 90 and 105 Days of storage. After 105 days of refrigerated storage best two treatments i.e. T3 (1-MCP@1ppm) and T4 (1-MCP@1ppm + Shrink Wrap) were subjected to quality evaluation for 10 days under ambient storage conditions. 1-MCP@1ppm + Shrink Wrap was reported superior to all other treatments. 1-MCP@1ppm + Shrink Wrap proved very useful for reducing storage loss, spoilage. Sensory panel evaluation exhibited fair to good acceptability response of 1 MCP@ 1ppm +shrink-wrapped fruit up to 105 days of storage, where as in control lots the quality attributed showed maximum acceptability only up to 75 days under refrigerated storage conditions.*

**Introduction**

Fruit culture is an important industry in the economy of Jammu and Kashmir State. Pear (*Pyrus communis* L.) belongs to family Rosaceae and is an important fruit cultivated throughout the temperate regions of world (Meheriuk and Lau, 1988; Anonymous, 2005). In Jammu and Kashmir, pear ranks second after apple in production with the annual production of 47.38 (000 MT) cultivated over an area of 12.359 (000 hectares) (Anonymous, 2008). The important cultivars grown in the valley include Bartlett, Monarch, Devoes, Fertility, Chinese Sandy Pear, and Vicar of Wink Field (Farooqui and Happa, 1990). Amongst them, Bartlett occupies more area throughout the world including J&K state (Anonymous, 2005). Fresh Bartlett pear contains moisture (86.5%), protein (0.4%), fat (0.1%), minerals (0.3%), fiber (2.15%), other carbohydrates (10.6%), calcium (20mg/100g), phosphorus (20mg/100g), Iron (1.5mg/100g), Vitamin A (0 IU/100g), Nicotine acid (0.2mg/100g), Vitamin C (1mg/100g)

(Rathore, 1991). The cultivar matures usually in the 3rd week of July (110 DAFB) and is harvested in August. The fruit is traditionally packed in wooden boxes and is transported outside the valley for either cold storage or fresh marketing. Being climacteric in nature, its rate of ripening is very fast after harvesting and has very limited shelf life. After harvest a good portion of fruit gets wasted resulting in greater economic losses to the growers, due to lack of proper post harvest infrastructure facilities (Ghani *et al.*, 2003).

Post harvest management practices such as harvesting at optimum maturity, controlled atmosphere storage, post harvest dipping of fruits in various chemicals e.g. Calcium chloride, wax coating, anti ethylene (1-MCP) treatment, etc. have been attempted to prolong the post harvest quality for pear fruit with variable degree of success (Banks *et al.*, 1993). The main purpose of post harvest management systems is to maintain quality, increase the period of availability of fruit for table purpose, extending the working period of food processing plants, avoiding gluts in the market at certain periods, providing variety to the consumers and fetch higher profits to the growers with increased export potentialities. However, in Kashmir valley, very little information is available regarding the impact of post harvest treatments and storage conditions on the shelf life of pear particularly Bartlett. Therefore, keeping in view the above facts, the present investigations are aimed to improve the shelf life of the pear under controlled conditions by the application of various post harvest treatments

**Material and Methods:-**

The present investigation was carried out in the department of post harvest technology Sher-e-Kashmir University of science and technology Shalimar Jammu and Kashmir. Freshly harvested healthy and uniform sized fruits taken from the orchard during autumn seasons were subjected to pre-cooling treatment at 4°C for 24 hrs to remove field heat. The experiment consists of 10 post harvest treatments viz,

T0= control,

T1= Shrink-wrap.

T2= 1-Methylcyclopropene@1ppm.

T3=1-Methylcyclopropene@1ppm+shrink-wrap.

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T4= Carbendazim@500 ppm.

T5= Carbendazim@500 ppm + shrink-wrap.

T6= Calcium Chloride @ 4%.

T7=Calcium Chloride @ 4%, + Shrink Wrap.

T8= Shellac Wax (SHOO2) @ 10%.

T9=ShellacWax(SHOO2)@10% + Shrink Wrap.

For post harvest calcium chloride dip fruits were taken in perforated plastic bucket 10 litre capacity and dipped in a bigger bucket of 20 litre capacity containing (4% calcium chloride) for a period of 10 minutes.Lac based wax Shellac (SHOO2) was sprayed on the fruits in the waxing unit of grading line designed by M/S Agrosaw Limited Ambala (India). The coated fruits were passed through infra-red drying chamber for drying of the wax coat.For shrink wrapping the 2kg fruits were packed in CFB boxes(L x B x H) (26 x 18 x 8 cm) over wrapped with heat shrinkable polyfilm and sealed in Agrasow shrink wrapping machine. For 1-MCP treatment the fruits were sorted and kept in plastic crates. Plastic tent of 4 $m^3$ volume was erected in the laboratory floor and crates containing fruits were kept inside the tent. Before sealing the tent, 1-MCP was placed in 500ml glass jar to which 30 ml of distilled water was added. The lid was sealed and jar shaken till all the powder dissolved and I-MCP gas released into the jar. The jar was placed in the tent.

Control and treated fruits were kept under refrigerated conditions (Temperature 1-2°C and 85-95 % R.H) and were analyzed for different quality parameters @ 0, 15, 30, 45, 60, 75, 90 and 105 days after storage. For post cold storage studies samples of treatment T3 (1-MCP@1ppm) and T4 (1-MCP@1ppm + Shrink Wrap) were subjected to quality evaluation for 10 days under ambient storage conditions, (Temperature 8-10°C and 95% R.H) and observations were recorded at 2,5,8,10 days of storage. The fruits were weighed at regular intervals and weight loss during storage was calculated. Spoilage percentage was recorded at regular intervals. Fruit flesh firmness was measured with Effegi model Penetrometer FT-327 using 8 mm plunger. TSS (%) was measured by hand Refractrometer (0-32 °Brix), Atago, NI (make Japan) and juice yield was measured volumetrically. TSS, pectin, total sugars and ascorbic acid were determined by method given by Ranganna (1986). Acidity was determined by the method given by A.O.A.C (1995) and total chlorophyll was evaluated with portable chlorophyll meter, SPAD-502 (Futuhara *et al*, 1979). The data was analyzed by the method given by Gomez and Gomez (1984).

**Result and Discussion:-**

**Spoilage**

A significant spoilage was noticed during the storage of 105 days under refrigerated condition. Spoilage was maximum in T1 (control) and minimum in T4 (1MCP @ 1ppm + shrink-wrap) fruits. Comparison of treatment means showed that maximum spoilage percent (6.02%) was found in control and minimum (1.05%) in T4 (1MCP @ 1ppm + shrink-wrap).This might be due to the reason that 1MCP @ 1ppm + shrink-wrap helps in maintaining the structural integrity of cell wall and cell membrane. Data regarding storage intervals showed that there was a gradual increase in the spoilage as storage period increased. The maximum spoilage (7.39%) was found after 105 days of storage in all treatments compared to 15th day of storage i.e. 0.78% (Table-1). These results are in line with the findings of Sandu and Randhawa (1988).

**Physiological Loss in weight:-**

Results showed highly significant results (P≤ 0.05) among different treatments and storage intervals as shown in tables. Comparison of treatment means showed that maximum weight loss (5.85%) was observed inT0 (control) where as the lowest (0.88%) was noticed in T4 ((1MCP @ 1ppm + shrink-wrap (Table-1). The possible reason may be that 1MCP @ 1ppm + shrink-wrap served as semi-permeable membrane around fruit surface which resulted in reduction of evapotranspiration. The results are in accordance with findings of Bhullar *et al*; (1980), Drake and Nelson (1990). Data regarding storage intervals showed that there was a gradual increase in the weight loss percentage during storage. The maximum weight loss (7.24%) was found after 105 days of storage in all treatments as compared to 15th days of storage i.e. 0.63% under refrigerated condition.

**Fruit Firmness:-**

Comparison of treatment means showed maximum value for fruit firmness (16.92 lb/sq. inch) in T4 (1MCP @ 1ppm + shrink-wrap) where as in (control) fruit firmness value was found to be 15.76 lb/sq inch (Table-1). This might be the fact that low temperature and 1MCP @ 1ppm + shrink-wrap delayed the loss of pectic substances in middle lamella of the cell wall and thus preventing the loss of cell wall integrity. Same finding were reported by Solomos and Latles, (1973). Comparison of storage interval means illustrated that fruit firmness decreases as storage period prolonged. Fruit firmness on 0 day of storage was (17.28 lb/sq. inch) and after 150 days the value was decreased to 15.33% under refrigerated conditions.

**Juice yield:-**

Pear fruits showed significant (p≤0.05) decrease in juice content with increase in storage period (Table-1). The juice yield (60.50%) was noted on the 0 days of storage, whereas after 150 days juice yield decreased up to 51.61%. Maximum juice content was found in T4 (1MCP @ 1ppm + shrink-wrap) fruit i.e. 57.69% and in T0 (control) juice yield was observed to be 53.59%. The decrease in juice yield is attributed to loss of moisture during storage, where as 1MCP @ 1ppm + shrink-wrap and refrigerated temperature prevented loss of water through the fruit surface. Same findings were also reported by Gupta *et al* ;( 1987).

**Total Soluble Solids:-**

Comparison of treatment means showed that maximum TSS percent (14.43%) was found in T0 (control) and minimum (13.47%) was observed in T4 (1MCP @ 1ppm + shrink-wrap) followed by T3 (1MCP @ 1ppm + shrink-wrap) i.e. 13.52%. This might be due to the fact that 1MCP @ 1ppm + shrink-wrap enhances the conversion of starch into sugar. Data regarding storage means depicted that there was increase in TSS percent as the storage interval increased (Table-1). Maximum percentage (14.93%) was found after 75 days of storage as compared to 0 days storage i.e. (13.15%). These results are in accordance with the findings of Badshah *et al*;(1994).

**Pectin:-**

Pear fruit showed significant decrease in pectin content with increase in storage period. (Table-1). Maximum pectin content (0.815%) was found on 0 days of storage compared to (0.659%) observed after 105 days of storage under refrigerated conditions. Comparison of treatment means showed that maximum pectin content was found in T4 (1MCP @ 1ppm + shrink-wrap) fruit 0.78% compare to T0 (control) which was observed to be 0.691% (Table-1). These results are in accordance with findings of Abu-Goukh and basher (2003).

**Titrable Acidity:-**

Data pertaining treatment means showed that T4 (1MCP @ 1ppm + shrink-wrap) have highest values (0.35%) of acidity, where as acidity values (0.26%) was observed in T0 (control) as indicated in Table-1. Other treatments showed lower values of acidity. Data regarding storage intervals showed that there was decrease in acidity in all treatments during storage. On 0 day of storage the acidity values was (0.38%) which deceased up to (0.21%) after 105 days of storage under refrigerated conditions. These results are in accordance with the findings of Wills *et al,* (1982), who found that acidity percent-

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age decreased as storage period, increased.

**Total Sugars:-**
The results of Table-1 showed an increased trend of total sugars in all the treatments up to 75 days of storage followed by significant decrease up to 105 days of storage. Results showed that on 0 days of storage total sugar value was (10.89%) and on 75 and 105 days of storage the values were 12.88% and 12.25 %. The maximum total sugar percent (12.46%) was found in T0 (control) and minimum total sugar (11.24%) was found in T4 (1MCP @ 1ppm + shrink-wrap) fruit. The total sugar content after storage depends upon the level at the harvest plus contribution from hydrolysis and amount lost in respiration. The increase in total sugar content in present investigation seems due to conversion of starch into sugar and decrease in total sugars content may be due to breakdown of sugar in simpler constituents. (Sing *et a*l, 1991).

**Ascorbic Acid:-**
Comparison of treatment means showed that highest value (2.85 mg/100g) of ascorbic acid content was observed in T4 (1MCP @ 1ppm + shrink-wrap), where as the lowest value (1.95 mg/100g) was found in T0(control) Table-1. The possible reason may be that both 1MCP @ 1ppm + shrink-wrap and refrigerated storage delayed the oxidation of fruits result in more ascorbic acid content. These results are in line with the findings of Bassetto *et al*, (2005). Data regarding storage interval showed that in all treatments ascorbic acid content decreased as storage prolonged. During 0 day of storage the ascorbic acid content of different treatments was 3.20 mg/100g, which decreased up to 1.58 mg/100g after 105 days of storage under refrigerated conditions.

**Total Chlorophyll Content:-**
Comparison of storage means showed decrease trend of chlorophyll (SPAD unit) in all treatments during storage (Table-1). Data regarding storage interval showed that maximum chlorophyll (10.28 SPAD Unit) was found during 0 days of storage which decreased up to (4.70 SPAD Units) after 105 days of storage under refrigerated condition. Minimum chlorophyll content (6.67 SPAD Unit) was found in T0 (control) and maximum chlorophyll content (8.73 SPAD unit) was found in T4 (1MCP @ 1ppm + shrink-wrap) (Table-1). The decrease in chlorophyll content during storage is a consequence of a process of bio-degradation catalyzed by chlorophyllase enzyme. However 1MCP @ 1ppm + shrink-wrap and refrigerated storage delayed the bio-degradation process. These results are in conformity with that of Jeong *et al*,( 2002).

Data regarding storage intervals means indicate that maximum colour score 4.00 was found during the initial days of storage which declined up to 2.19 during 105 days of refrigerated storage. Comparison of treatment means showed that maximum colour score 3.59 was observed in T4 (1MCP @ 1ppm + shrink-wrap). The beneficial effect of 1MCP @ 1ppm + shrink-wrap on colour score was reported by Ahmad *et al* (2007). The maximum texture score of 4.00 initially was observed after harvest which declined significantly with storage period (Table-2).Among the treatments maximum beneficial effect of post harvest treatment as a retention of texture (3.46) was recorded in T4(1MCP @ 1ppm + shrink-wrap) and in T0 (Control) the score was observed to be 2.68 (Table-3). Data revealed that flavour scores decreased significantly with increase in storage period. Samples of treatment T4 (1MCP @ 1ppm + shrink-wrap) showed superiority in flavour score(3.26) than T0 (control) throughout the storage period i.e. 2.50. The T0 (control) samples were rated with overall acceptability score of 2.65 and T4 (1MCP @ 1ppm + shrink-wrap) fruit was rated with overall acceptability score of 3.64. Data regarding storage intervals showed that overall acceptability score decreased significantly with increase in storage period during 105 days of refrigerated storage.

**Table 2: Effect of Post harvest treatments and Storage period on Sensory Quality attributes of William's Bartlett Pear during 105 days of refrigerated storage (Temperature 1-2˚C and 85-95% RH).**

| Treatments | Color | Texture | Flavor | OAA |
|---|---|---|---|---|
| Control | 2.59 | 2.68 | 2.5 | 2.65 |
| Shrink Wrap | 2.67 | 2.74 | 2.58 | 2.71 |
| 1-MCP @1 ppm | 3.52 | 3.39 | 3.18 | 3.59 |
| 1-MCP @1 ppm + Shrink Wrap | 3.59 | 3.46 | 3.26 | 3.64 |
| Carbendazim @ 500 ppm | 2.84 | 2.85 | 2.67 | 2.79 |
| Carbendazim @ 500 ppm + Shrink Wrap | 2.91 | 2.93 | 2.75 | 2.87 |
| Calcium Chloride @ 4 % | 3.00 | 3.04 | 2.86 | 3.21 |
| Calcium Chloride @ 4 % + Shrink Wrap | 3.08 | 3.10 | 2.94 | 3.28 |
| Wax (SHOO2) @ 10% | 3.19 | 3.21 | 3.02 | 3.39 |
| Wax (SHOO2) @ 10% + Shrink Wrap | 3.26 | 3.27 | 3.1 | 3.45 |
| CD($p \leq 0.05$) | 0.02 | 0.02 | 0.01 | 0.01 |
| Storage Period(Days) | | | | |
| 0 | 4.00 | 4.00 | 4.00 | 4.00 |
| 15 | 3.76 | 3.71 | 3.49 | 3.74 |
| 30 | 3.55 | 3.55 | 3.7 | 3.47 |
| 45 | 3.11 | 3.23 | 2.78 | 3.25 |
| 60 | 2.88 | 2.96 | 2.60 | 3.02 |
| 75 | 2.62 | 2.60 | 2.35 | 2.82 |
| 90 | 2.42 | 2.35 | 2.11 | 2.58 |
| 105 | 2.19 | 2.11 | 2.08 | 2.39 |
| CD($p < 0.05$) | 0.01 | 0.02 | 0.01 | 0.01 |

**Post Cold Storage**
**Spoilage**
Comparison of treatment means ($p \leq 0.05$)showed that maximum percentage of spoilage (3.13%) was observed in T3 (1MCP @ 1ppm) and minimum spoilage 3.00 was observed in T4 (1MCP @ 1ppm + shrink-wrap) . Comparison of storage means showed that spoilage percentage increased with increase in spoilage period. Maximum values of spoilage (3.64%) was observed after 10 days of post cold storage compared to minimum values of spoilage (2.57%) observed after 2 days of post cold storage followed by 105 days of refrigerated storage (Table-3).

**Physiologic loss in weight.**
A significant physiological loss in weight was noticed during 10 days of post cold storage after 105 days of refrigerated storage. Minimum physiological loss in weight (2.77%) was observed during 2 days of post cold storage which increased up to (3.84%) after 10 days of post cold storage. Comparison of treatment means showed that maximum physiological loss in weight (3.37%) was noticed in T3(1MCP @ 1ppm) and minimum in T4((1MCP @ 1ppm + shrink-wrap) i.e. 3.16% during 10 days of post cold storage followed by 105 days of refrigerated storage (Table-3).

**Fruit firmness.**
Table-3 revealed that highest values of fruit firmness was observed in T4(1MCP @ 1ppm + shrink-wrap) i.e. 15.79 lb/sq inch and minimum in T3 (1MCP @ 1ppm ) i.e. 15.70. Data regarding storage means showed that fruit firmness decreased with increase in storage period. Maximum fruit firmness was observed after 2 days of post cold storage i.e. 16.08 lb/sq inch which decreased up to 15.37 lb/sq inch during 10 days

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of post cold storage after 105 days of refrigerated storage.

**Table 3: Effect of Post harvest treatments and storage period on Quality attributes of William's Bartlett pear during post cold storage periods (Temperature 7- 8˚C and 85-90% RH) after 105 days of refrigerated storage**

| Treatments | Spoilage (%) | PLW (%) | Firmness (Lb/sq. inch) |
|---|---|---|---|
| T3=1-MCP @1 PPM | 3.37 | 3.13 | 15.70 |
| T4=1-MCP @1 PPM + Shrink Wrap | 3.16 | 3.00 | 15.79 |
| CD(p≤0.05) | 0.03 | 0.02 | 0.02 |
| Storage Period (Days) | Spoilage (%) | PLW (%) | Firmness (Lb/sq. inch) |
| 2 | 2.77 | 2.57 | 16.08 |
| 5 | 3.15 | 2.84 | 15.88 |
| 8 | 3.30 | 3.22 | 15.64 |
| 10 | 3.84 | 3.64 | 15.37 |
| CD(p≤0.05) | 0.01 | 0.02 | 0.02 |

**Conclusion**

The results revealed that post harvest treatment of "William Bartlett" pear reduced spoilage, physiological loss in weight, and maintained juiciness, ascorbic acid, total chlorophyll, TSS, total sugar, acidity, texture, color, taste, flavor. Among the treatments 1-MCP @ 1ppm + shrink-wrap was promising and beneficial followed by 1-MCP @ 1ppm treatment. The treated fruits remained in fair to good eating quality up to 105 days of refrigerated storage. The post harvest treatment of "William Bartlett" pear helped to maintain the quality attributes of fruit, thus helping the growers to make marketing decision accordingly. These low cost treatments shall prove beneficial in getting remunerative price of product. Application of 1-MCP@1ppm has resulted in tremendous economic potential by increasing the post cold storage stability of fruit.

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