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Shelf Life Study and Quality Changes of Bartlett Pear as Affected by Post Harvest Treatments under Ambient Storage

KEYWORDS: Shrink-wrap, Calcium Chloride, Ascorbic Acid and Overall acceptability, Storage

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ABSTRACT *The present investigation was carried out to study the effect of different 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 on quality and shelf life extension of William's Bartlett Pear under ambient storage conditions (Temperature 15-18^{0}C and 85-95%R.H.The untreated fruits were served as control .In physical characteristics PLW, spoilage, firmness, juice yield, color, texture, flavor and overall acceptability were studied during storage. In chemical characteristic TSS, total sugar, pectin, acidity, ascorbic acid and total chlorophyll were analyzed after 7, 14 , 21, 28, 35, 42 and 49 Days of storage. All the treatments had significant effect on the quality and shelf life of fruits. However shrink wrapped fruit after post harvest treatment with 1-MCP (1 ppm) recorded significant lower spoilage and physiological loss in weight but higher titrable acidity, ascorbic acid and total chlorophyll during 49 days of storage under ambient conditions. However irrespective of treatments the value of total soluble solids and total sugars were maximum at 35 days of storage under ambient conditions and therefore declined with advancement in age.*

Introduction

Pear (*Pyrus communis* L.) belongs to family Rosacee and is an important fruit cultivated throughout the temperate regions of the world. It is undoubtly one of the most ubiquitous of all the fruits and rank 2nd next only to apple in the deciduous fruits of the world (Meheriuk and Lau, 1988; Anonymous, 2005).The Greek poet 'Homer' giving an insight on early fruit culture praised '' pears as one of the gift of God''. Pear is grown under the temperate and subtropical conditions because of its vital climatic and soil adoptability. It is primarily grown in hills at 1,700-2,400 m above mean sea-level in

Himachal Pradesh, Jammu and Kashmir and Utter-Pradesh. In Jammu and Kashmir, Pear ranks 2nd after apple in production with the annual production of 47.38 (000 MT) cultivated over an area of 12.359 (000 Hectares). The important cultivars grown in 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 and K state (Anonymous 2005).Post Harvest Management systems maintain the quality, increase the period of availability of fruit for table purpose, avoids gluts in market at certain periods and thus fetch higher profits to the growers with increase export potentialities. Post harvest Management practices have been attempted to prolong the post harvest quality for pear fruit with variable degree of success (Banks *et al*, 1993). 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 William's Bartlett. Therefore, keeping in view the above facts, the present investigations were aimed to improve the shelf life of the pear under ambient conditions by the applications of the various post harvest treatments.

Material and Methods:-

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, control, shrink-wrap, 1-Methylcyclopropene@1ppm, 1-Methylcyclopropene@1ppm + shrink-wrap, Carbendazim@500 ppm, Carbendazim@500 ppm + shrink-wrap, calcium Chloride @ 4%, Calcium Chloride @ 4%, + Shrink Wrap, Shellac Wax (SHoo2) @ 10%, Shellac Wax (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 ambient conditions (temperature 15-18°C and 85-95 % R.H) and were analyzed for different quality parameters @0, 7, 14,21,28,35 and 49 days after storage. The fruits were weighed at regular intervals and weight loss during storage was calculated. Spoilage percentage was recorded at regular intervals. Fruit

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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:-
Analysis for all the treatments, storage intervals and their interaction depicted highly significant ($P \leq 0.05$) values for all parameters of study as indicated in tables.

Spoilage:-
Comparison of treatment means showed highly significant results ($p \leq 0.05$) among different treatment and different storage treatments intervals as shown in tables. Comparison of treatment means showed that maximum spoilage (6.81 %) was observed in control, whereas lowest (2.00 %) was noticed in 1-MCP @ 1ppm + shrink-wrapped fruits. Data regarding storage intervals showed that there was gradual increase in spoilage percent as shown in table-1. The maximum spoilage (8.38 %) was found after 49 days of storage in all treatments as compare to 0 days of storage (i.e. 0.00 %). These results are in accordance with the findings of Singh (1993).

Physiological loss in weight:-
A significant ($p \leq 0.05$) physiological weight loss was noticed during storage for 49 days. Weight loss was maximum in untreated fruits and minimum in 1 MCP@ 1ppm + shrink-wrap fruits (1.57%) followed by 1MCP @ 1ppm treated fruits. The weight loss in 1 MCP @ 1ppm treated fruit was 1.65% and in control PLW was 6.59%.Weighted loss recorded after 7, 14, 21, 28, 35, 42 and 49 days were 1.35, 2.41, 3.78, 5.13, 6.22, 7.21 and 8.38 percent respectively. These results are in line with the findings of Banday (1995).

Fruit Firmness:-
The pear fruits lost their firmness from the initial value of (17.28 lb / sq. inch) to (14.85lb / sq. inch) during 49 days of storage (table-1). Higher values of firmness (16.89lb / sq. inch) was observed in 1-MCP @ 1ppm + shrink-wrap fruit, while as in control lower fruit firmness values (15.26 lb / sq. inch) was observed in table-1. Pear fruit exhibited 16.79, 16.44, 16.09, 15.76, 15.47, 15.17 and 14.85 lb / sq. inch values of firmness during 7, 14, 21, 28, 35, 42 and 49 days of storage respectively.

Juice yield:-
Pear fruits showed significant ($P \leq 0.05$) decrease in juice content with increase in storage period. Maximum juice content was found in 1MCP @ 1ppm + shrink-wrapped fruit (57.21%) followed by 1-MCP @ 1ppm treated fruit (57.12%) (Table-1). The decrease in juice content is attributed to moisture loss during storage where as 1-MCP @ 1ppm + shrink-wrap prevented water loss through fruit surface.

Total soluble solids (TSS):-
Total soluble solids in pears increased from 13.15% to maximum of 14.90% during 35 days of storage and decrease significantly up to 49 days of storage (Table-1). Maximum total soluble solids were found in untreated fruits (14.60%) and minimum in fruits treated with 1-MCP @ 1ppm + shrink-wrapped fruit. An increased fruit TSS level during initial storage might be due to the loss of water and hydrolysis of starch into sugars. However decreased TSS with the corresponding prolongation in storage periods may be due to faster utilization of carbohydrates in senescence and oxidation processes. These findings are in line with that of Singh *et al*; 1998.

Pectin:-
Pear fruits showed significant decrease in pectin content with increase in storage period (Table-1). Maximum pectin content was found in 1-MCP @ 1ppm + shrink-wrap fruit (0.76%) and minimum pectin content (0.66%) was found in untreated fruit .

Titrable Acidity:-
The acid contents of pear during storage exhibited a significant decline with increase in storage period (Table-2). Among all treatments 1-MCP @ 1ppm + shrink-wrap fruit exhibited maximum acid contents of (0.35%) titrable acidity followed by 0.34% in 1-MCP@ 1ppm treated fruit (table-1). Other treatment showed lesser values of 0.24% to 0.30% titrable acidity and minimum contents of 0.23% titrable acidity was recorded in control fruits. Significant decline in acidity have also been reported by different workers (Miani *et al*; 1985, Gupta *et al*; 1987, Sud *et al*; 1992). The loss in acidity is ascribed to its utilization as a partial substrate for respiration.

Total Sugars :-
The total sugar contents in pears increased up o 35 days of storage and decreased significantly during storage (table-1) with maximum in untreated fruits (12.67%) followed by shrink-wrapped fruits (12.63%). Total sugar contents in 1-MCP @ 1ppm + shrink-wrapped fruits were 11.35%. The sugars content after storage depends upon the level at the harvest plus a contribution from hydrolysis and amount lost in respiration. The increase in total sugar contents in present investigation seems due to conversion of starch to sugars (Singh *et al*; 1998).

Ascorbic Acid:-
Ascorbic acid showed highly significant results ($p \leq 0.05$) among different treatments and storage intervals as shown in tables. Comparison of treatment means showed highest value (2.78 mg/100g) of ascorbic acid content was found in 1-MCP @ 1ppm + shrink-wrapped fruits, where as lowest value (1.85 mg/100g) was found in control (Table-1).Highest values of ascorbic acid mean (3.20 mg/100g) were found during 0 days of storage and decreased significantly up to 49 days of storage (1.44 mg/100g). Treatment 1-MCP @ 1ppm + shrink-wrap delayed the oxidation of fruits, resulting in more ascorbic acid. These results are in accordance with findings of Kropp and Bin (1985).

Total Chlorophyll Content:-
Total chlorophyll contents of pears decreased significantly with increase in the storage period. Maximum chlorophyll (10.28 SPAD Unit) was found during 0 days of storage and (4.52 SPAD Unit) was found during 49 days of storage (table-2). Maximum total chlorophyll contents (8.39 SPAD Unit) was found in 1-MCP @ 1ppm + shrink-wrapped fruit and minimum total chlorophyll contents (6.52 SPAD Unit) was found in control. Argenta *et al*;(2003) also reported the same findings.

Table 1: Effect of Post harvest treatments on physico-chemical quality attributes of William's Bartlett pear during 49 days of ambient storage (Temperature 15-18 C and 85-95% R.H).

Treatments	Spoilage (%)	PLW (%)	Firmness (Lb/sq. inch)	Juice Yield (%)	TSS(Brix)	Pectin (%)	Acidity (%)	Total Sugars (%)	Ascorbic Acid (mg/100gm)	Total Chlorophyll (SPAD Unit)
Control	6.81	6.59	15.26	52.76	14.60	0.66	0.23	12.67	1.85	6.52
Shrink Wrap	6.68	6.48	15.32	52.85	14.56	0.67	0.24	12.63	1.90	6.62
1-MCP @1 ppm	2.11	1.65	16.83	57.12	13.54	0.75	0.34	11.40	2.72	8.32

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1-MCP @1 ppm + Shrink Wrap	2.00	1.57	16.89	57.21	13.49	0.76	0.35	11.35	2.78	8.39
Carbendazim @ 500 ppm	6.17	5.99	15.47	53.93	14.49	0.68	0.25	12.47	2.04	6.95
Carbendazim @ 500 ppm + Shrink Wrap	6.06	5.87	15.54	53.92	14.43	0.69	0.26	14.42	2.10	7.03
Calcium Chloride @ 4 %	5.46	5.27	15.76	55.27	14.26	0.70	0.28	12.15	2.19	7.26
Calcium Chloride @ 4 % + Shrink Wrap	5.34	5.17	14.83	55.37	14.22	0.71	0.28	12.09	2.26	7.35
Wax (SHOO2) @ 10%	4.36	4.09	16.36	56.47	13.92	0.71	0.29	11.85	2.33	7.80
Wax (SHOO2) @ 10% + Shrink Wrap	4.24	3.98	16.41	56.57	13.87	0.72	0.30	11.78	2.40	7.90
CD(p≤0.05)	0.02	0.03	0.02	0.08	0.02	0.01	0.02	0.02	0.01	0.02
Storage Period(Days)										
0	0.00	0.00	17.28	60.50	13.15	0.81	0.38	10.89	3.20	10.28
7	1.35	1.06	16.79	58.24	13.52	0.76	0.34	11.36	2.83	9.47
14	2.41	2.12	16.44	56.79	13.85	0.74	0.32	11.68	2.57	8.66
21	3.78	3.49	16.09	55.62	14.11	0.72	0.29	11.98	2.36	7.69
28	5.13	4.83	15.76	54.44	14.47	0.69	0.26	12.24	2.12	7.00
35	6.22	5.93	15.47	53.77	14.90	0.66	0.24	13.14	1.87	6.29
42	7.21	7.04	15.17	51.40	14.59	0.64	0.22	12.79	1.66	5.41
49	8.38	8.19	14.85	50.42	14.49	0.61	0.20	12.57	1.44	4.52
CD(p<0.05)	0.05	0.03	0.02	0.08	0.01	0.01	0.002	0.02	0.01	0.02

Sensory Quality:-

1-MCP @ 1ppm + shrink-wrapped '' William Bartlett'' pear showed maximum colour scores of 3.53 compared to lower scores of 2.44 in control. There was decline in colour scores with the passage of time in all treatments (Table-2). The beneficial effect of 1-MCP @ 1ppm + shrink-wrap was also reported by Ahmad *et al*; (2007). The maximum texture score of 4.00 initially observed after harvest declined significantly with storage period (Table-2). Among the treatments maximum beneficial effect of post harvest treatment as retention of firmness was recorded in 1-MCP @ 1ppm +shrink-wrapped fruit (3.45) compare to mean score of 2.54 in untreated fruit. The initial flavour scores of pear were 4.00 which showed decreased value with the passage of storage time up to the flavor score of 1.40 (Table-2). Among the treatments maximum flavour scores 3.49 was awarded to 1-MCP @ 1ppm + shrink-wrapped fruit. The samples treated with 1-MCP @ 1ppm + shrink-wrap showed superiority in maintaining the overall acceptability than control throughout the storage period. The control samples were rated with overall acceptability score of 2.49 and 1-MCP @ 1ppm + shrink-wrapped fruit was rated with overall acceptability of 3.56. Overall acceptability decreased significantly with increase in storage period. These observation are in conformity to the findings of Ekman *et al*; (2004).

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, colour, taste, flavour. 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 quality up to 49 days of storage. The post harvest treatment of "William Bartlett'' pear maintained the quality attributes of fruit, thus helping the growers to make marketing decision accordingly. Application of 1-MCP for shelf life extension of Bartlett pear has tremendous economic potential in reduction of post harvest loss and overcoming demand supply price variations.

Table 2: Effect of Post harvest treatments and storage period on Sensory Quality attributes of William's Bartlett pear during 49 days of ambient storage (Temperature 15-18 C and 85-95% RH).

Treatments	Color	Texture	Flavor	OAA
Control	2.44	2.54	2.60	2.49
Shrink Wrap	2.51	2.60	2.66	2.57
1-MCP @1 ppm	3.46	3.38	3.44	3.49
1-MCP @1 ppm + Shrink Wrap	3.53	3.45	3.49	3.56
Carbendazim @ 500 ppm	2.60	2.73	2.75	2.68
Carbendazim @ 500 ppm + Shrink Wrap	2.68	2.80	2.81	2.76
Calcium Chloride @ 4 %	2.81	2.91	2.94	2.85
Calcium Chloride @ 4 % + Shrink Wrap	2.89	2.97	2.99	2.93
Wax (SHOO2) @ 10%	3.10	3.06	3.10	3.25
Wax (SHOO2) @ 10% + Shrink Wrap	3.16	3.13	3.12	3.33
CD(p≤0.05)	0.02	0.02	0.02	0.02
Storage Period(Days)				
0	4.00	4.00	4.00	4.00

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7	3.68	3.68	3.39	3.68
14	3.44	3.49	3.52	3.55
21	2.98	3.13	3.70	3.04
28	2.72	2.76	2.91	2.75
35	2.45	2.45	2.87	2.54
42	2.14	2.22	2.22	2.31
49	1.90	1.93	1.40	2.05
CD($p<0.05$)	0.01	0.01	0.01	0.01

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