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Shelf life study and quality changes of bartlett pear as affected by post-harvest treatments under ambient storage and refrigerated storage conditions

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Abstract
Pear William Bartlett after commercial maturity stage were subjected to various treatments like 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. The untreated fruits served as control. The fruits after post harvest treatments packed and kept under observations for 49 days of ambient conditions and 105 days of refrigerated conditions. Samples were analyzed for various parameters like pH, Total solids and reducing sugars after 17,14,21,28,35.42 and 49 days of ambient storage (Temperature 15-18˚C and 85-95 % R.H) and 15,30,45,60,75,90 and 105 days of refrigerated storage (Temperature 1-2˚C and 85-95 % R.H). 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 pH, higher Total solids and reducing sugars during 49 days of storage under ambient conditions and 105 days of refrigerated storage conditions.

Keywords: ambient storage, post-harvest treatments, shelf life, refrigerated storage conditions, william bartlett pear

Introduction

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) [11, 2]. Pear is undoubtly one of the most ubiquitous of all the fruits, and ranks second next only to apple in the deciduous fruits of the world. The Greek poet 'Homer' giving an insight on early fruit culture praised "pears as one of the gifts of the God". Pear is grown under temperate and subtropical conditions because of its wider climatic and soil adaptability. It is primarily grown in hills at 1,700-2,400 m above mean sea-level in Himachal Pradesh, Jammu and Kashmir and Uttar Pradesh. Low-chilling pears have adapted very well in the subtropical regions. It can be grown in a wide range of climatic conditions, as it can tolerate as low as -26°C temperature when dormant and as high as 45°C during growing period. A large number of pear cultivars require about 1,200hr below 7°C during winter to complete their chilling requirement to flower and fruit satisfactorily. However, Bartlett needs about 1,500 hr compared with other temperate pears. Rathore (1990) [14] under diversified horticulture programme, pear growing assumes tremendous significance in our state where it meets the ideal agro-climatic conditions for its cultivation. In India the annual production of pear was 200000 tonnes and area was 23000 hectares (Anonymous, 2008) [1]. 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). The important cultivars grown in the valley include Bartlett, Monarch, Devoes, Fertility, Chinese Sandy Pear, and Vicar of Wink Field (Farooqui and Happa, 1990) [5]. Amongst them, Bartlett occupies more area throughout the world including J&K state (Anonymous, 2005) [2]. 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) [15]. 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 lift. 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) [6].

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) [4]. The main purpose of such 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.

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 refrigerated conditions (Temperature 1-2˚C and 85-95 % R.H) and were analyzed for different quality parameters. The total solids of representative fruits were determined by drying the fruit samples in a vacuum oven at 70ºC as discussed by Ranganna (1986) [12]. The moisture content recorded by drying was subtracted from 100. The value obtained includes water soluble and insoluble matter, i.e. total solids. pH was determined by using digital pH Meter (Tanco, DB-101). The pH Meter was first calibrated using buffers of pH 4.0 and pH 7.0 at room temperature. A 10 ml of sample was then taken in a 100 ml beaker, stirred and electrode of pH meter put in it and direct reading from pH meter was taken when the reading stabilized. Reducing sugars were estimated by the Lane and Eynon method, as described by Ranganna (1986) [12]. The data of the storage studies was analyzed as per complete randomized design (CRD) with 3 replications. The coating/dip treatment and storage period were considered as variants for assessing the variations in the physic-chemical characteristics of fruit. The data was analyzed as suggested by Gomez and Gomez (1984) [7].

Results 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 table.

Reducing Sugars

The results of Table-1 showed an increased trend of reducing sugars in all the treatments up to 35 days of storage followed by significant decrease up to 49 days of storage during ambient storage conditions. Results showed that on 0 days of storage reducing sugar value was (7.15%) and on 35 and 49 days of storage the values were 9.59% and 8.99 %. The maximum reducing sugar percent (9.24%) was found in T0 (control) and minimum reducing sugar (16.26%) was found in 1MCP @ 1ppm + shrink-wrapped fruit during 49 days of ambient storage. In case of refrigerated storage reducing sugar content increased up to 75 days of storage and decreased afterwards. Comparison of treatment means showed that minimum reducing sugar of 7.49 % was observed in 1MCP @ 1ppm + shrink-wrapped fruit compared to control (8.65%) during 105 days of refrigerated storage. 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. (Singh *et a*l; 1991, Arapaie *et al*: 1984) [16, 3].

Total Solids

The most effective post-harvest treatment for maintaining the soluble solids of the fruit during storage was established as (16.26%) in case of 1-MCP@1ppm plus shrink wrap seconded by the 1-MCP @ 1ppm alone (16.33%) followed by the other treatments. The maximum soluble solid percent of 17.94 per cent was reported in control fruits as revealed in table-1. There was increase in soluble solid content with the increase in storage period. Minimum soluble solid content of 15.75 per cent was found at 0 day and maximum of 18.29 per cent was found after 49 days of ambient storage. Table-1 revealed that the minimum soluble solid content of 16.17 per cent was found in case of 1-MCP @ 1 ppm + shrink wrap followed by 1-MCP alone (16.24%) and the maximum soluble solid content of 17.64 per cent was reported in untreated fruits after 105 days of refrigerated storage. There was increase in soluble solid content with the increase in storage period. Minimum soluble solid content of 15.75 per cent was found at 0 day and maximum of 17.99 per cent was found at 105 days of refrigerated storage. Application of 1-MCP on pear fruit showed decrease in ethylene production and respiration which resulted in little increase in soluble solids as compared to the untreated pear fruit. Similar findings were found in Mandarin fruit (Laamim *et al.*, 2005) and Papaya (Rasori *et al.*, 2002) [9, 13].

Table 1: Effect of Post-harvest treatments on physico-chemical quality attributes of William's Bartlett pear during 49 and 105 days of ambient and refrigerated storage

	Ambient storage conditions					Refrigerated Storage conditions		
Treatments	**Reducing sugars (%)**	**Total solids (%)**	**pH (%)**	**Treatments**	**Reducing sugars (%)**	**Total solids (%)**	**pH (%)**	
Control		9.24	17.94	4.52	Control	8.65	17.64	4.52
Shrink Wrap		9.18	17.87	4.49	Shrink Wrap	8.61	17.57	4.49
1-MCP @1 PPM		7.65	16.33	4.31	1-MCP @1 PPM	7.52	16.24	4.29
1-MCP @1 PPM + Shrink Wrap		7.61	16.26	4.29	1-MCP @1 PPM + Shrink Wrap	7.49	16.17	4.27
Carbendazim @ 500 PPM		8.84	17.68	4.44	Carbendazim @ 500 PPM	8.45	17.46	4.46
Calcium Chloride @ 4 %		8.51	17.00	4.39	Calcium Chloride @ 4 %	8.18	16.90	4.41
Calcium Chloride @ 4 % + Shrink Wrap		8.46	16.93	4.37	Calcium Chloride @ 4 % + Shrink Wrap	8.13	16.83	4.38
Wax (SHOO2) @ 10%		8.10	16.78	4.35	Wax (SHOO2) @ 10%	7.97	16.56	4.36
Wax (SHOO2) @ 10% + Shrink Wrap		8.05	16.71	4.33	Wax (SHOO2) @ 10% + Shrink Wrap	7.92	16.49	4.33
CD(p≤0.05)	0.02		0.02	0.01	CD(p≤0.05)	0.02	0.02	0.01
Storage Period (Days)					Storage Period (Days)			
0	7.15		15.75	4.13	0	7.15	15.75	4.13
7	7.55		16.29	4.20	15	7.44	16.15	4.18
14	7.99		16.62	4.27	30	7.67	16.48	4.25
21	8.36		16.97	4.35	45	7.99	16.78	4.33
28	8.66		17.33	4.42	60	8.23	17.13	4.42
35	9.59		17.64	4.51	75	9.16	17.41	4.52
42	9.27		18.00	4.58	90	8.88	17.69	4.61
49	8.99		18.29	4.67	105	8.55	17.99	4.72
CD(p≤0.05)	0.02		0.02	0.01	CD(p≤0.05)	0.02	0.01	0.01

pH

The pH percent of pear during storage exhibited a significant incline with increase in storage period during both ambient and refrigerated storage (Table-1). Among all treatments 1-MCP @ 1ppm + shrink-wrap fruit exhibited minimum pH percent (4.29%) followed by 4.31% in 1-MCP@ 1ppm treated fruit. Other treatment showed higher values of pH and higher percent of 4.52% pH was recorded in control fruits during 49 days of ambient storage. In case of refrigerated storage treatments 1-MCP @ 1ppm + shrink-wrap fruit exhibited minimum pH percent (4.27%) followed by 4.29% in 1-MCP@ 1ppm treated fruit. Significant increase in pH has also been reported by Miani *et al*; 1985, Gupta *et al*; 1987, Sud *et al*; 1992, Wojick; 2001 [8, 17, 18]. The increase in pH is ascribed to its utilization as a partial substrate for respiration.

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