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Full Research Article

Studies on Preparation and Storage of Osmotic Dehydrated Wild Pear (*Pyrus serotina*)

Anju Kumari Dhiman, Lucky Devi, Surekha Attri and Anshu Sharma*

[1]Dept. of Food Science and Technology (FST), Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh (173 230), India

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Correspondence to

**E-mail*: anshufst1989@gmail.com

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Abstract

Studies were conducted during the months of October–December in 2011 and January-April in 2012 at the Department of Food Science and Technology, Dr. Yashwant Singh Parmar, University of Horticulture and Forestry, Nauni, Solan (HP). Process for preparation of wild pear halves using osmotic dehydration was standardized. Fully ripe wild fruits of pear were peeled and cut into halves. The halves were soaked in 50 °Brix (Recipe 1), 60 °Brix (Recipe 2), 70 °Brix (Recipe 3) and 80 °Brix (Recipe 4) sugar solutions, respectively. After 24 h soaking in sugar solutions, quick washing, blotting and then cabinet drying at 55–60 °C for 5−6 h was done. The dried products were packed in polyethylene pouches and stored at ambient condition for six months. The physico-chemical, microbial and sensory changes were analyzed at an interval of 0, 3 and 6 months. The osmo-dried wild pear halves prepared after using water blanching for 5 minutes+1.0% citric acid dip for 30 minutes was found better in respect to colour, texture, taste and overall acceptability among various treatments. Storage studies indicated that there was significant decrease in moisture content, titratable acidity, ascorbic acid, total phenols, sensory quality scores and increase in TSS and TSS: acid ratio of wild pear halves. The stored osmo-dried wild pear halves were found microbiologically safe and sensorily acceptable up to six months of storage at ambient condition.

1. Introduction

Pear is an important pome fruit belongs to the family Pomaceae, sub-family Pomaideae and genus *Pyrus*. There are large number of species under this genus out of which some are cultivated and some are found in wild profusion of mid-hill regions. The important cultivated specie of pear is *Pyrus communis*. Among the all, two important species which are wild in nature are *Pyrus pashia* Buch and Ham and another is *Pyrus serotina* Rehd. *Pyrus serotina* and *Pyrus pyrifolia* (Burm) *nak* are synonymous for Asian or Japanese pear (Lombard and Westwood, 1987). Asian pear or wild pear is known as *Nashi* in Australia and New Zealand (Singh et al., 1963) and it is also designated as oriental pear, Chinese pear and salad pear. Asian pears are often referred to as apple pears because of their crisp and juicy texture and apple like flavour. China is the largest producer of Asian pears, whereas, it is grown as a minor crop in New Zealand, Australia and Thailand (White, 2002; Li, 2002; Subhadrabandhu et al., 2002). In India, *Pyrus pashia* bearing small size fruit is known as *Soh-Shur*, *Kainth*, *Chotia*, *Shegal*, *Mahal-Mol* while *Pyrus serotina* bearing large size fruits is known as *Bada-kainth*, *Shiara* and *Zarenth* in Himachal Pradesh (Parmar and Kaushal, 1982).

The fruits of *Pyrus serotina* attain a fairly large size in the end of September and can be eaten at this stage. The ripe fruits are yellowish brown with rusty white spots on the outer surface (Parmar and Kaushal, 1982). The skin colour of fruits changes from yellowish green to golden brown. The quality of fruits of *Pyrus serotina* is better than those of *Pyrus pashia* (Parmar and Kaushal, 1982). It is relished for its soft and sweet taste (Rathore, 1991). The fruit has somewhat astringent taste and gritty texture but are juicy and edible. The pulp of the fruit is yellowish white in colour (Parmar and Kaushal, 1982).

The wild pear fruit possesses many nutritional and medicinal properties. It is a delicious fruit, rich in carbohydrates and minerals (Saini and Jain, 1995). The fruit contains pectin, protein, phosphorus, iron, calcium, magnesium, phenols etc. besides having antioxidant properties. Asian pears are also excellent source of folate, vitamin B-complex, riboflavin, niacin, thiamine, vitamin E and vitamin K (Anonymous, 2016). Tillotson et al. (1997) reported that pear fruit is also a good source of dietary fibre. Kumar and Ghuman (2007) revealed that one hundred grams of edible portion of sand pear provides about 52 k Cal of energy in addition to various minerals and vitamins. Tillotson et al. (1997) also reported that the pear fruit are cholesterol free and low in calories. Asian pears contain necessary element of a healthy diet which helps in sustaining blood sugar level. Pear juice contains phytochemicals and these phytochemicals with other nutrients reduces the risk of many diseases including cancer, heart diseases, stroke, high blood pressure etc (Ding et al., 2007).

Short shelf life of fresh fruits after harvest is one of the major factors that give the necessity of developing a cheap and efficient preservation process for growers of this fruit. Moreover, this fruit is not liked as much as cultivated pear by consumers for fresh consumption. One of the techniques being widely used for preservation is osmotic dehydration. The process involves removal of moisture from fruits by immersing them in concentrated aqueous solutions of sugar. This process also changes the organoleptic properties of the fruit. No attempts so far have been made to utilize wild pear for processing into osmotically dehydrated value added product and disposed as a source of income for the farmers. Looking upon the nutritional, medicinal and edible characteristics of this fruit, the present study has been done to standardize the recipe for preparation of osmotically dehydrated fruit along with storage study of the prepared product.

2. Materials and Methods

2.1. Preparation of osmotically dehydrated wild pear halves

The fully matured fruits of uniform size were selected for preparation of product. The fruits were washed, peeled, cut into halves and core was removed. The prepared fruit halves were immediately dipped in common salt solution (2%) to avoid browning. The fruits were then subjected to different pre-treatments prior to pricking and osmotic dehydration. Four different treatments were given for preparation of wild pear halves for osmotic dehydration were as T_1: without blanching, T_2: water blanching for 5 minutes, T_3: water blanching for 5 minutes+1.0% citric acid dip for 30 minutes and T_4: water blanching for 5 minutes+1.0% calcium chloride dip for 2 hours. The pretreated fruit halves were used to prepare osmotically dehydrated product. The pricking on the surface of halves was done by the use of stain less steel fork. The halves were soaked in sugar syrup of four different concentrations viz., 50 °Brix, 60 °Brix, 70 °Brix and 80 °Brix using citric acid @ 0.75 g kg^{-1} for 24 hours. Then the halves were removed from syrup after draining and dried in cabinet drier at 55–60 °C for 5–6 h. The samples were subjected to sensory evaluation and the best method was selected. The method for preparation of osmotically dehydrated fruit halves was also standardized (Figure 1).

2.2. Physico-chemical, sensory and statistical analysis

The excess water was taken out and drained weight was recorded by using a physical balance and ratio was calculated. Water loss (WL) was the net loss at time T on an initial mass basis and calculated in percentage as suggested by Rahman and Lamb (1990). The mass reduction (MR) was the net mass loss of the sample on an initial mass basis and also calculated in percentage as suggested by Rahman and Lamb (1990). The solid gain was the net sugar transported into the fruits on an initial mass basis and expressed in %. It was calculated by taking difference between % water loss and % mass reduction. The TSS was determined with the help

Selection of fruits
↓
Washing
↓
Peeling, halving and coring
↓
Dipping in common salt solution (2%)
↓
Pre- treatments
↓
Pricking
↓
Dipping fruit halves in sugar syrup for 24 hours
↓
Draining syrup
↓
Drying fruit halves in cabinet drier
(55–60 °C for 5–6 h)
↓
Osmotically dehydrated wild pear halves
↓
Packing in polyethylene bags and sealing
↓
Labelling
↓
Storage (Ambient temperature)

Figure 1: Flow sheet for preparation of osmotically dehydrated wild pear halves

of hand refractometer and expressed as °Brix at 20 °C using reference table for temperature correction (Ranganna, 2009). Moisture was estimated by drying the weighed sample (20 g) to a constant weight in a hot air oven. The titratable acidity was expressed as % citric acid (AOAC, 2004) and estimated by using phenolphthalein as an indicator to give pink colour (end point). Ascorbic acid content was determined as per AOAC (2004) method using 2, 6-dichlorophenol-indophonol dye. TSS: acid ratio was calculated by dividing the TSS value with acidity and total sugars were determined as per the method described by Ranganna (2009). The ratio between the initial weight of material (before drying) to that of final weight (after drying) represent the dehydration ratio of given samples. Method given by Ranganna (2009) was followed to determine the rehydration ratio of wild pear halves. The amount of total phenols (Bray and Thorpe, 1954) in the wild pear sample was determined with the Folin-Ciocalteu reagent using catechol as a standard. Total plate count (TPC) was made as per the standard method (Ranganna, 2009) using nutrient agar medium. The different parameters such as colour, taste, texture and overall acceptability were used for sensory evaluation on 9 point hedonic scale by panel of ten judges. The data for quantitative analysis of various physico-chemical attributes were analyzed by Completely Randomized Design (CRD) while the data on sensory analysis were analyzed by Randomized Block Design (RBD).

3. Results and Discussion

The results (Figure 2) clearly indicated that the highest overall acceptability score was awarded to Recipe 3 (8.65) followed by Recipe 4 (8.00), Recipe 2 (7.50) and Recipe 1 (7.00). Therefore, Recipe 3 (soaking in 70 °Brix sugar syrup) was selected for further studies.

The water loss (%), weight loss (%) and solid gain (%) were calculated during the osmotic process and it was observed (Table 1) that the highest (69.00%) and lowest (65.00%)

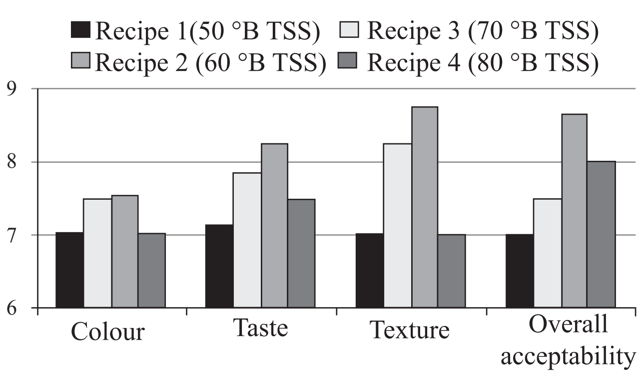


Figure 2: Standardization of recipe for the preparation of osmotically dehydrated wild pear halves

water loss was in T_2 and T_1, respectively. The weight loss was found to be maximum (58.50%) and minimum (57.00%) in T_3 and T_1, respectively, whereas, the maximum (11.00%) and minimum (8.00%) solid gain was recorded in T_2 and T_1, respectively.

The investigation showed that there was a significant increase in TSS (Table 2) during storage of osmotically dehydrated

Table 1: Effect of different treatments on water loss (%), weight loss (%) and solid gain (%) during osmotic process of wild pear halves

Treatments	Water loss (%)	Weight loss (%)	Solid gain (%)
T_1	65.00	57.00	8.00
T_2	69.00	58.00	11.00
T_3	68.80	58.50	10.30
T_4	68.60	58.01	10.06
Mean	67.85	58.54	7.13
CD (p=0.05)	0.09	0.08	0.06

T_1: without blanching, T_2: water blanching for 5 minutes, T_3: water blanching for 5 minutes+1.0% citric acid dip for 30 minutes and T_4: water blanching for 5 minutes+1.0% calcium chloride dip for 2 hours

wild pear halves for a period of six months. The reason for increase in TSS during storage might be due to the decrease in moisture content and inhibition of sugar by the process of osmosis. Among the different treatments, T_3 (73.13 °Brix) had significantly higher TSS as compared to rest of the treatments. The minimum TSS of 72.24 °Brix was recorded in treatment T_1. Similar results of increase of TSS was reported by Rani and Bhatia (1985) in pear candy, Sharma et al. (1998) in apple candy, Muzzaffer (2006) in pumpkin candy, Chavan et al. (2010) in osmotically dried banana slices but the results were contradictory to those of Kumar (2013) in osmotically dried plum and Pritika (2015) in osmotically dried pumpkin cubes. The data regarding changes in moisture content of osmotically dehydrated wild pear halves during storage is also presented in (Table 2). The data reveal a decrease (17.37 to 16.64%) in moisture content of the products during storage of six months. Among different treatments the highest moisture content was recorded in T_3 (17.09%) while the lowest in T_1 (16.77%). The decrease in moisture content during storage has also been reported by Chavan et al. (2010) in osmo-dried banana slices but the results are contradictory to the findings of Kumar (2013) in osmo-dried plum and Pritika (2015) in osmotically dried pumpkin cubes.

An appraisal of data revealed that there was a decrease in % titratable acidity of osmotically dehydrated wild pear halves

Table 2: Effect of different treatments and storage on total soluble solids (°B) and moisture content (%) of osmotically dehydrate wild pear halves

Treatments (T)	TSS (°B)			Mean	Moisture (%)			Mean
	Storage interval (I)				Storage interval (I)			
	0 month	3 months	6 months		0 month	3 months	6 months	
T_1	71.03	72.63	73.05	72.24	17.25	16.54	16.52	16.77
T_2	71.82	72.75	73.25	72.61	17.34	16.77	16.65	16.92
T_3	72.25	73.25	73.90	73.13	17.56	16.97	16.74	17.09
T_4	72.04	73.12	73.75	72.97	17.35	16.93	16.66	16.98
Mean	71.79	72.94	73.49		17.37	16.80	16.64	
CD (p=0.05)	T=0.009; I=0.008; T×I=0.010				T=0.010; I=0.009; T×I=0.013			

during the storage period of six months. The maximum mean value was found in T_3 (1.172%) and minimum in T_1 (1.134%). The mean value was observed to increase significantly from 1.228 to 1.115% during storage and the interaction between storage intervals and treatments was also found to be significant. The maximum titratable acidity was recorded in T_3 (1.236%) at 0 month and minimum in T_1 (1.063%) at 6 months of storage. The acid content of osmotically dehydrated wild pear halves showed a decreasing trend during storage (Table 3), which could be due to the neutralization of acid by internal reaction between acids and other constituents of fruit. The results are in conformity with those of Mehta and Bajaj (1984); Rani and Bhatia (1985); Kumar and Ghuman (1989) in citrus peel candy, pear candy and date palm candy, respectively. Different authors viz., Amitabh et al. (2000), Kumar and Ghuman (2007); Naikwadi et al. (2010); Pritika (2015) had also obtained a decreasing trend of acidity in various products like osmotically dehydrated mango slices, processed sand pear slices, dehydrated figs and osmotically dehydrated pumpkin cubes, respectively. Data of (Table 3) also indicate that the ascorbic acid content in osmotically dehydrated wild pear halves decreased significantly during storage. The average ascorbic acid content was found to decrease from 11.21 to 6.34 mg 100 g^{-1} during six months of storage. Among the treatments the highest ascorbic acid content was recorded in T_1 followed by T_3, T_2 and T_4 with

Table 3: Effect of different treatments and storage on titrable acidity (%) and ascorbic acid (mg100 g^{-1}) of osmotically dehydrate wild pear halves

Treatments (T)	Titratable acidity (%)			Mean	Ascorbic acid (mg 100 g^{-1})			Mean
	Storage interval (I)				Storage interval (I)			
	0 month	3 months	6 months		0 month	3 months	6 months	
T_1	1.222	1.117	1.063	1.134	12.55	9.62	6.52	9.56
T_2	1.225	1.119	1.082	1.142	10.84	8.84	6.04	8.57
T_3	1.236	1.125	1.155	1.172	10.90	9.18	6.44	8.84
T_4	1.227	1.121	1.160	1.170	10.54	8.80	6.35	8.56
Mean	1.228	1.120	1.115		11.21	9.12	6.34	
CD (p=0.05)	T=0.002, I=0.002, T×I=0.002				T=0.016, I=0.014, T×I=0.028			

value of 9.56, 8.84, 8.57 and 8.56, mg 100 g^{-1}, respectively. The reduction in ascorbic acid content might be due to its oxidation by light and air (Rani and Bhatia, 1985; Ragab, 1987; Sandhu, 1994). The decrease in ascorbic acid content during storage has also been observed by Rani and Bhatia (1985) in pear candy, Sharma et al. (2000) in osmo-dried apricots and Pritika (2015) in osmo-dried pumpkin cubes.

Data in (Table 4) represents the dehydration ratio of osmotically dehydrated wild pear halves. The data reflect that there was an increase in the dehydration ratio of osmotically dehydrated wild pear halves during storage. The mean dehydration ratio increased from 1.056 to 1.098 during storage period of six months. The mean maximum dehydration ratio was recorded in treatment T_4 (1.072) and minimum in T_1 (1.009). The rehydration ratio of osmotically dehydrated wild pear halves was observed to decrease from 2.353 to 2.223 during storage (Table 4). The mean maximum (2.359) and minimum (2.218) value was noticed in treatment

T_3 and T_1, respectively. Similar trend of results was observed by Tomar et al. (2001) in dehydrated mixed vegetable pickle after 12 months of storage, Sagar and Khurdiya (1999) in mango slices, Pritika (2015) in osmo-dried pumpkin cubes but the results are contradictory to the observations of Sharma et al. (1998) in dried apple slices.

Table 4: Effect of different treatments and storage on dehydration and rehydration ratio of osmotically dehydrated wild pear halves

Treatments (T)	Dehydration ratio			Mean	Rehydration ratio			Mean
	Storage interval (I)				Storage interval (I)			
	0 month	3 months	6 months		0 month	3 months	6 months	
T_1	1.002	1.010	1.014	1.009	2.223	2.220	2.210	2.218
T_2	1.005	1.120	1.130	1.052	2.250	2.240	2.230	2.240
T_3	1.115	1.123	1.127	1.122	2.587	2.250	2.240	2.359
T_4	1.103	1.120	1.122	1.148	2.353	2.213	2.210	2.305
Mean	1.056	1.093	1.098		2.353	2.230	2.223	
CD (p=0.05)	T=0.001, I=0.001, T×I=0.001				T = 0.018, I = 0.016, T×I = 0.032			

The results (Table 5) revealed that there was an increase in TSS: acid ratio during storage of osmotically dehydrated wild pear halves. The reason for increase in TSS: acid ratio during storage might be due to the significant increase in TSS content, decrease in moisture and inhibition of sugar by the process of osmosis. Among different treatments, T_1 had significantly higher mean value of TSS: acid ratio (63.97) as compared to other treatments during six months of storage. The minimum increase in TSS: acid ratio (62.51) was observed in treatment T_3. Similar results regarding increase in TSS: acid ratio was observed by Nath et al. (2012) in pear, Islam et al. (2015) in ber and Rokoya et al. (2016) in mandarin citrus fruits during storage. While screening the data in the same table for total sugars content, it is clear that there was significant changes in different treatments during storage. The mean maximum value was recorded in T_3 (46.43%) and mean minimum in T_1 (41.45%). The increase in total sugar content could be attributed to the decrease in moisture content. The results are in accordance with those obtained by Rani and Bhatia (1985) in pear candy, Sharma et al. (1998) in apple candy, Naikwadi et al. (2010) in dehydrated fig, Muzzaffer (2006) in pumpkin candy and Chavan et al. (2010) in osmotically dehydrated banana slices.

Table 5: Effect of different treatments and storage on TSS:acid ratio and total sugars (%) of osmotically dehydrated wild pear halves

Treatments (T)	TSS:acid ratio			Mean	Total sugars (%)			Mean
	Storage interval (I)				Storage interval (I)			
	0 month	3 months	6 months		0 month	3 months	6 months	
T_1	58.16	65.02	68.72	63.97	40.23	41.52	42.59	41.45
T_2	58.63	65.01	67.70	63.78	42.40	43.53	44.87	43.60
T_3	58.45	65.11	63.98	62.51	44.68	46.85	47.76	46.43
T_4	58.71	65.23	63.58	62.50	43.15	44.05	45.30	44.17
Mean	58.49	65.09	65.99	63.19	42.61	43.99	45.13	
CD (p=0.05)	T=0.009; I=0.008; T×I=0.010				T=0.102; I=0.088; T×I=0.125			

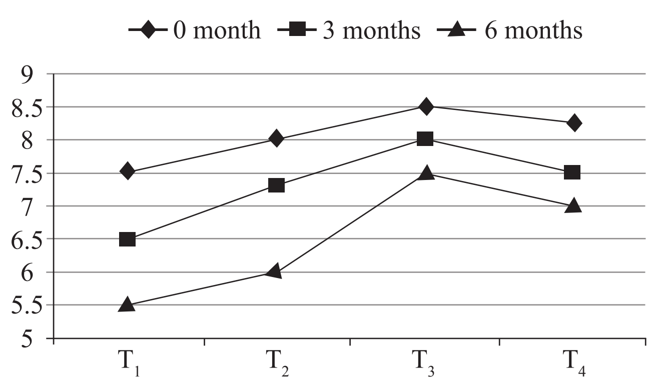
It was clearly observed from the data (Table 6) that the total phenol content of osmotically dehydrated wild pear halves decreased significantly (270.17 to 224.67 mg 100 g^{-1}) with the advancement of storage. The maximum and minimum phenols were recorded, respectively in T_1 (257.55 mg 100 g^{-1}) and T_3 (216.16 mg 100 g^{-1}) during storage. It might be due to the use of phenolic compounds in non-enzymatic browning reactions. Similar decreasing trend during storage has been revealed by Kumar (2013); Sharma and Thakur (2016) in osmotically dried plum and cabinet dried wild pomegranate arils, respectively. It is also clear from the data of same table that treatment T_1 had maximum microbial count of 2.01 log cfu and minimum of 1.72 log cfu was recorded in T_4 during

Table 6: Effect of different treatments and storage on total phenols (mg100 g^{-1}) and microbial population (log cfu) of osmotically dehydrated wild pear halves

Treatments (T)	Total phenols (mg100 g^{-1})			Mean	Microbial population (log cfu)			Mean
	Storage interval (I)				Storage interval (I)			
	0 month	3 months	6 months		0 month	3 months	6 months	
T_1	212.79	292.74	267.02	257.55	0.00	2.77	3.00	1.92
T_2	259.70	239.20	213.95	237.62	0.00	2.60	2.84	1.81
T_3	270.38	250.35	224.90	248.54	0.00	2.00	2.07	1.36
T_4	237.83	217.82	192.82	216.16	0.00	2.47	2.69	1.72
Mean	270.17	250.03	224.67		0.00	2.46	2.65	
CD (p=0.05)	T=0.009; I=0.010; T×I=0.011							

storage. There was an increase of microbial count from 0.00 to 2.90 log cfu which is considered as significantly low and microbially safe for consumption. The reason for increase in microbial count might be due to the contamination during handling instead of contaminated product as reported earlier by Labuza et al., (1972) in intermediate moisture foods, Muzzaffer (2006) in pumpkin candy and Synrem (2013) in bamboo candy.

The storage period had a significant effect on the average score for colour, taste, texture and overall acceptability of osmotically dehydrated wild pear halves as is evident from the results shown in (Figures 3 to 6). The results clearly indicated that mean maximum score for colour (8.00), taste (7.35), texture (7.57) and overall acceptability (8.08) were awarded to treatment T_3 (water blanching for 5 minutes+1.0% citric acid dip for 30 minutes). The scores for different sensory parameters of all the treatments were found to decrease with



T_1: without blanching; T_2: water blanching for 5 minutes; T_3: water blanching for 5 minutes+1.0% citric acid dip for 30 minutes and T_4: water blanching for 5 minutes+1.0% calcium chloride dip for 2 hours

Figure 3: Effect of different treatments and storage on colour (on 9 point hedonic scale) of osmotically dehydrated wild pear halves

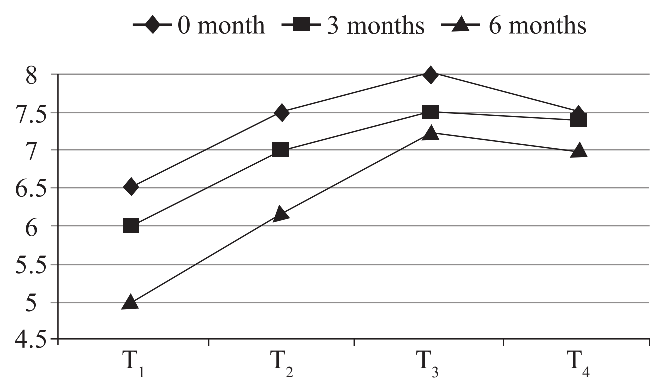


Figure 4: Effect of different treatments and storage on taste (on 9 point hedonic scale) of osmotically dehydrated wild pear halves

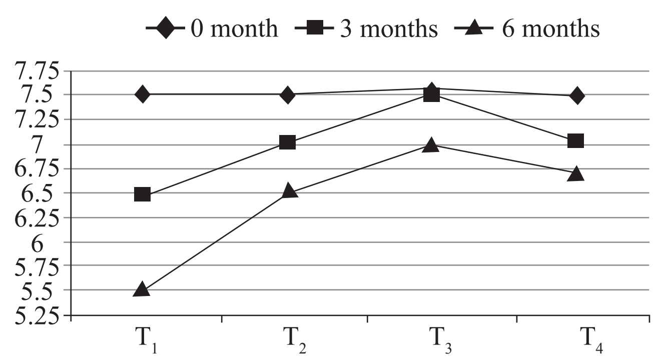


Figure 5: Effect of different treatments and storage on texture (on 9 point hedonic scale) of osmotically dehydrated wild pear halves

the advancement of storage and the mean score decreased from 8.06 to 6.51 for colour, 7.51 to 6.44 for taste, 7.37 to 6.35 for texture and 7.68 to 6.76 for overall acceptability. However, a significant decrease was noticed during storage but the scores for all the treatments were within the acceptable limits. Trend of above results for various sensory attributes are in confirmity with Kumar (2013) in osmo-dried plum, Pritika

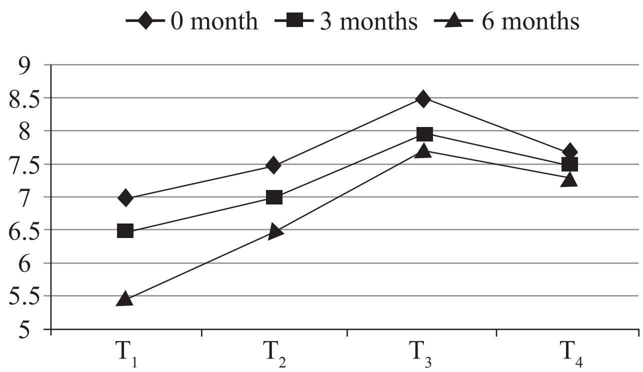


Figure 6: Effect of different treatments and storage on overall acceptability (on 9 point hedonic scale) of osmotically dehydrated wild pear halves

(2015) in osmotically dried pumpkin cubes and Sharma and Thakur (2016) in cabinet dried wild pomegranate arils.

4. Conclusion

Among different recipes, recipe of 70 °Brix was found to be the best for osmotic dehydration of wild pear halves and selected for further studies. Among different treatments prior to drying, water blanching for 5 minutes with 1.0% citric acid dip for 20 minutes was adjudged as the best. The osmo-dried product of wild pear can be preserved safely for a minimum period of six months under ambient condition with minimal changes in chemical, sensory and microbial attributes.

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