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Influence of packaging and storage on the quality of osmodehydrated apricots (*Prunus armeniaca* L.)

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Abstract

To find out the suitable packaging material for storage of osmodehydrated apricot (Var. CITH-2), prepared by using 60 °brix syrup containing 2000 PPM KMS, followed by cabinet drier at 58 ±2°C till 8% moisture content, then packaged in pouches of ALPE (250 g), HDPE (200 g), LDPE (200 g) and Shrink wrapping (150 g), prior to storage for six months at ambient conditions. During storage significant decrease in physicochemical and functional quality in term of antioxidants capacity (61%), total phenolics (50%), total flavonoids (38%), total carotenoids (30%), β-carotene (29%), ascorbic acid (64%), and titratable acidity (33%) was observed, while moisture content, total sugars and reducing sugars observed to slightly increase during storage. Among the packaging materials, ALPE (250 g) was found to be good for retention of better quality, better color and higher sensory score of the osmodehydrated apricot.

Keywords: Apricots, osmodehydration, antioxidants activity, polyphenolics, sugars, beta carotene.

Introduction

Apricot (*Prunus* sp.) is a stone fruit belongs to family Rosaceae. It is 3rd most popular temperate fruit species after peach and plum, having a total world production of about 3.8 million tons, with Turkey (750,000 tons) as the leading country, followed by Uzbekistan (490,000 tons) and Iran (340,000 tons) as other main producers (Faostat, 2020)^[8]. In India, apricots are commercially cultivated in northern region specifically in Jammu and Kashmir, Uttar Pradesh, and Himachal Pradesh. Apricot is a climacteric fruit and is an excellent source of antioxidants, β-carotene, polyphenols, minerals and vitamins (C, A, niacin, thiamine, riboflavin and pantothenic acid) (Leccese *et al.* 2012)^[11]. The perishable nature of apricots makes it vulnerable to deterioration factors, and it can deteriorate within 4 – 5 days under ambient conditions, the shelf life could be extended to 2–3 weeks in cold storage (1°C) with high relative humidity of 90–95% (Wani *et al.*, 2018)^[21].

Dehydration is the best method for preservation of apricots. Among drying techniques, sun drying is commonly used, in which fruits are spread on large surface such as rooftops or rocks with no washing or any pre-treatment. This method has many disadvantages such as long duration and exposing of fruit to open environment, where dust / dirt, flies, and micro-organisms can contaminate the fruits, this result in unhygienic and inferior quality product. Thus, to improve product quality, decrease spoilage reaction effect and to facilitate the drying process, sulphur dioxide is widely used for protect form browning and oxidation of fruit during drying and storage (Türkyılmaz *et al.*, 2013)^[20].

Osmodehydrated apricots are light in weight and can be eaten directly without any preparation. Osmodehydration could reduce the high cost of transportation and storage without affecting fruit quality. However, storage at high temperature and high humidity conditions cause quality changes of osmodehydrated products. Moisture exchange between a product and its surrounding atmosphere as well as other biochemical changes can be controlled by providing adequate packaging, therefore, investigation was undertaken to develop the method of osmodehydrated apricot and to find suitable low cost packaging of osmodehydrated apricots.

Materials and Methods

Raw Materials - Apricots (*P. armeniaca* L. viz., CITH-2) were procured from Regional Horticultural Research Station, Bajaura, Himachal Pradesh. The fruits were harvested at full maturity and brought to Division of Food Science and Postharvest Technology, ICAR-IARI, New Delhi for experimentation.

Treatments – the fruits were subjected to ultrasound- and microwave- assisted osmotic dehydration prior to convective drying. The fruits were washed and deseeded, then blanched for 50 sec in boiling syrup, followed by immediate cooling and subsequent dipping in 60°B sugar syrup (sucrose) containing 2000 ppm potassium meta-bisulphite with fruit to syrup ratio of 1:4, microwaved at 900W for three minutes, and subsequently sonicated in ultrasonic bath (40 kHz; 70 W) for 20 minutes. The fruits remained in the same syrup for 12 hours, then drained, and again washed under running tap water to remove adhered syrup and spread on tissue paper to remove excess surface water.

Dehydration - The osmotically treated fruits were loaded on an aluminium tray (76 x 56 cm) with a load of 2 kg per tray and dehydrated in cabinet tray drier (Kilburn make, model-0248) with airflow 0.12 to 0.16 m/sec of at 58 ± 2 °C to a constant moisture content ranging from 8 to 10 percent, the fruits were turned periodically at 2 hours interval to achieve uniform drying of fruits.

Packaging – The dehydrated fruits were packed in HDPE (200 gauge), LDPE (200 gauge), ALPE (250 gauge) and shrink wrapping (150 gauge) for storage. The osmodehydrated fruits were stored at ambient conditions for six months and withdrawn monthly for analysis.

Analysis - Moisture content was determined by drying the samples till constant weight in a hot air oven at 60°C for 48 h. Titratable acidity was estimated by titration method and reported as malic acid percentage (Ranganna, 1986) [14]. Ascorbic acid content was determined by titration method using standard 2,6-dichlorophenol indophenol dye solution (AOAC, 2000) [1]. Sugars (reducing and total) were estimated by Lane and Eynon's volumetric method (Ranganna, 1986) [14]. Total carotenoids content was determined by measuring the optical density at 452 nm of sample's petroleum ether extract using spectrophotometer (Spectra Max® M2, Molecular Devices, San Jose, CA) as per method described by Ranganna, (1986) [14].

β-carotene content – The extraction and HPLC estimation of β-carotene in stored samples was performed as described by Huang *et al.* (2013) [9]. Previous carotenoids extract was evaporated to dryness and reconstituted with TBME (tert-Butyl methyl ether). Carotenoids were separated on a YMC C30 column (250 × 4.6 mm i.d., 5 μm; Water co., Milford, MA, USA) at 20 °C using an DionexRSLC Ultimate 3000 UPLC, consisting of 500 G pump and S-3210 PDA detector (Schambeck SFDGmbH, Bad Honnef, Germany). The chromatography was conducted with buffer A (methanol/acetonitrile/distilled water (70/20/10, v/v/v), and buffer B (100% TBME), with a linear gradient from 20 to 55% B over 18 min at 1 mL/min flow rate, with detection at 450 nm. Aliquot of 20 μL of apricot carotenoid extract was injected onto the HPLC column. Stock β-carotene (Sigma) was prepared in TBME, injected onto HPLC for obtaining of

standard curve. β-carotene was identified in HPLC based on retention time and quantified with help of the standard curve. Results were expressed as mg carotene per 100g apricot.

Polyphenols, flavonoids and antioxidant capacity – the sample was extracted with 80% ethanol and centrifuged at 4 ± 1 °C for 20 min at 10000 rpm. The supernatants was collected and kept at 4 ± 1 °C for further analysis. Total phenolic content was determined according to the method of Singleton *et al.* (1999) [19] using the Folin–Ciocalteu (FC) reagent and the results were expressed as mg GAE/100 g on fresh weigh basis. Total flavonoids content (TFC) was estimated according to method of Zhishen *et al.* (1999) [22] and the results were expressed as mg QE/100 g on fresh weigh basis. DPPH radical scavenging activity was measured according to the method of Brand-Williams *et al.* (1995) [4]. Cupric reducing antioxidant power assay (CUPRAC) was determined according to Apak *et al.*, (2004) [2]. FRAP assay was determined according to the procedure described by Benzie and Strain (1996) [3].

Sensory evaluation - The sensory evaluation of osmodehydrated fruits was carried out using a nine-point Hedonic scale, the product was evaluated by a panel of 7 semi - trained judges for scoring of colour, flavour and texture attributes (Meilgaard *et al.*, 1999) [12].

Statistical Analysis - All measurements were carried out in triplicates and reported as mean value. Randomized Block Design experiment (RBD) was used. Data were subjected to ANOVA using IBM SPSS Statistics 20.0 software. The means were subjected to pairwise comparison by Duncan's Multiple Range Test ($P \leq 0.05$).

Results and Discussion

Physicochemical properties

The moisture content increased with increase in storage period, and it increased from 8.26 to 14.22% (Table 1). Significant increase in moisture content might be due to vapour pressure differential between dehydrated apricots and the storage environment. Among packaging materials, highest moisture content was recorded in Shrink wrapped samples followed by LDPE pouches, however ALPE packed samples recorded the lowest moisture content throughout the storage. Similar results have been reported by (Singh *et al.*, 2019; Wani *et al.*, 2018; Sharma 2000) [18, 21, 16] during storage of osmodehydrated apricot. Siddiq *et al.*, (2012) [17] reported that 23 -26% MC is the highest acceptable limit for moisture content in osmodehydrated apricot, above which the activity of deterioration reaction and spoilage organisms would be accelerated to unacceptable level.

There was significant decrease in titratable acidity irrespective of packaging during storage of 6 months from 0.33 to 0.22% (Table 1). Shrink Wrapped samples recorded the lowest titratable acidity throughout the storage, while acidity content was higher in ALPE and HDPE pouches. TA decrease could be attributed to moisture gain and decomposition of organic acids during storage. Similar findings has been reported by (Wani *et al.*, 2018; Sharma, 2000) [21, 16] during storage of osmodehydrated apricots.

Data pertaining to reducing and total sugars is presented in Table 1. The content of reducing and total sugars was increased with increase in storage period, which could be attributed to the hydrolysis of sugars by acids, leading to degradation of disaccharides to monosaccharides. With regard

to packaging material, the highest sugar content was recorded in the samples packed in ALPE followed by HDPE pouches, this might be due to differential in conversion of the non-reducing sugars to reducing sugars (Kumar and Sagar, 2016; Mir *et al.*, 2009) ^[10, 13]. Similarly, increase of sugar content was reported during storage of osmodehydrated guava slices (Kumar and Sagar, 2016) ^[10] and dried apricots (Mir *et al.*, 2009) ^[13].

Ascorbic acid content - Considerable reduction of ascorbic acid was observed during 6 months storage from 8.04 to 2.86mg/100g (Table 2). There was significant variation in ascorbic acid content with respect to packaging and storage period. ALPE packed samples retain higher ascorbic acid content followed by HDPE ones, this might be due to difference in permeability of packaging materials and degradation of ascorbic acid due to oxidation by light and oxygen which was amplified due to MC increase (Kumar and Sagar 2016) ^[10].

Total carotenoids varied significantly with respect to packaging and storage intervals (Table 2). The mean content of total carotenoids significantly decreased from 7.77 to 5.44 mg/100g during six months storage, indicating 30% loss. ALPE packaged samples showed highest retention of carotenoids throughout the storage while the least retention

was in Shrink wrapped ones. The decrease may be attributed to photosensitive and thermo-labile nature of carotenoids that made them prone to oxidation and loss during storage. Carotenoids degradation could lead to loss of product attractive orange color as the browning will advance. Similar results were reported by (Türkyılmaz *et al.*, 2013; Mir *et al.*, 2009; Sharma 2000) ^[20, 13, 16] during storage of dried apricots. Similar trend in β -carotene content in respect of packaging and storage period has been recorded (Table 2). β -carotene is major carotenoids present in apricot forming more than 50% of total carotenoids (Akin *et al.*, 2008), and it is prone to oxidation during processing and storage. β -carotene content significantly decreased from 4.04 to 2.83 mg/100g). ALPE packaged samples had highest retention of β -carotene than other packaging materials. Better retention of carotenoids could be achieved by sulphite treatments which help in retarding its break down during storage; SO₂ concentration over 791 mg/kg can effectively protect carotenoids in dried apricots (Türkyılmaz *et al.*, 2013) ^[20]. Several workers had also reported significant loss in β -carotene content in dried apricots when stored for longer periods at higher temperatures (Elmaci *et al.*, 2008; Coskun *et al.*, 2013) ^[7, 6]. Similarly, Türkyılmaz *et al.* (2013) ^[20] reported 24 -26% loss of β -carotene during 12 months storage of dried apricot.

Table 1: Physicochemical properties of osmodehydrated apricot as affected by packaging and storage period

Attribute	Packaging	Storage (month)								CV		
		0	1	2	3	4	5	6	Mean	S	P	S*P
Moisture (%)	ALPE	8.26	8.81	9.48	10.06	10.65	11.95	12.85	10.29d	0.41	0.31	0.82
	HDPE	8.26	9.39	10.35	11.40	12.07	12.67	13.89	11.18c			
	LDPE	8.26	9.56	10.41	11.86	12.85	13.99	14.84	11.69a			
	SW	8.26	9.63	10.64	12.01	12.90	14.40	15.30	11.83a			
	Mean	8.26g	9.34f	10.22e	11.33d	12.11c	13.25b	14.22a				
Titratable acid (%)	ALPE	0.33	0.31	0.30	0.28	0.27	0.26	0.24	0.28a	0.005	0.004	NS
	HDPE	0.33	0.31	0.29	0.27	0.26	0.24	0.23	0.27a,b			
	LDPE	0.33	0.31	0.28	0.27	0.25	0.23	0.22	0.27b,c			
	SW	0.33	0.30	0.28	0.26	0.24	0.22	0.20	0.26c			
	Mean	0.33a	0.31b	0.29c	0.27d	0.25e	0.23f	0.22g				
Reducing sugars (g/100g)	ALPE	37.10	37.70	38.30	38.91	39.53	40.17	40.81	38.93a	0.34	0.25	NS
	HDPE	37.10	37.62	38.15	38.68	39.22	39.77	40.33	38.69a,b			
	LDPE	37.10	37.55	38.00	38.45	38.91	39.38	39.91	38.47a,b			
	SW	37.10	37.47	37.85	38.22	38.61	38.99	39.39	38.23b			
	Mean	37.10f	37.58e,f	38.07d,e	38.57c,d	39.07b,c	39.58a,b	40.11a				
Total sugars (g/100g)	ALPE	66.94	68.01	69.10	70.20	71.33	72.47	73.63	70.24	0.26	0.20	NS
	HDPE	66.94	67.88	68.83	69.79	70.77	71.76	72.76	69.82			
	LDPE	66.94	67.74	68.55	69.38	70.21	71.05	72.01	69.41			
	SW	66.94	67.61	68.28	68.97	69.66	70.35	71.06	68.98			
	Mean	66.94g	67.81f	68.69e	69.58d	70.49c	71.41b	72.36a				

Values are a mean of three replicates \pm standard deviation. All values are expressed on fresh weight basis.

Same letter in the same row or column represent no significant differences between values ($p < 0.05$).

ALPE= Aluminum laminated polyethylene (260 gauge). HDPE= High density polyethylene (200 gauge). LDPE= Low density polyethylene (200 gauge). SW= shrink wrapping (150 gauge). S= Storage period. P= Packaging. S*P= interaction between storage and packaging. NS= not significant at 5% level ($P < 0.05$)

Table 2: Effect of packaging on carotenoids and ascorbic acid content in osmodehydrated apricots during storage

Attribute	Packaging	Storage (month)								CV _{0.05}		
		0	1	2	3	4	5	6	Mean	S	P	P*S
Ascorbic acid (mg/100g)	ALPE	8.04	7.35	6.25	5.49	5.03	4.41	3.64	5.71a	0.24	0.18	0.48
	HDPE	8.04	6.84	6.23	5.25	4.82	3.81	3.20	5.49b			
	LDPE	8.04	6.58	5.80	4.82	4.02	3.45	2.80	5.07c			
	SW	8.04	6.33	5.59	4.46	3.60	2.31	1.82	4.62d			
	Mean	8.04a	6.77b	5.97c	5.05d	4.36e	3.49f	2.86g				
Total carotene (mg/100g)	ALPE	7.77	7.56	7.33	7.10	6.83	6.35	6.00	6.99a	0.15	0.12	0.31
	HDPE	7.77	7.32	7.06	6.54	6.07	5.92	5.61	6.61b			
	LDPE	7.77	7.02	6.46	6.07	5.67	5.51	5.28p	6.21c			
	SW	7.77	6.72	6.28	6.00	5.55	5.18	4.88	6.09d			
	Mean	7.77a	7.15b	6.78c	6.43d	6.03e	5.74f	5.44g				
Beta carotene (mg/100g)	ALPE	4.04	3.93	3.81	3.69	3.55	3.30	3.12	3.63a	0.08	0.06	0.16
	HDPE	4.04	3.81	3.67	3.40	3.16	3.08	2.92	3.44b			
	LDPE	4.04	3.65	3.36	3.16	2.95	2.86	2.74	3.23c			
	SW	4.04	3.50	3.26	3.12	2.89	2.70	2.54	3.17d			
	Mean	4.04a	3.72b	3.52c	3.34d	3.13e	2.98f	2.83g				

Values are a mean of three replicates \pm standard deviation. All values are expressed on fresh weight basis.

Same letter in the same row or column represent no significant differences between values ($p < 0.05$).

ALPE= Aluminum laminated polyethylene (260 gauge). HDPE= High density polyethylene (200 gauge). LDPE= Low density polyethylene (200 gauge). SW= shrink wrapping (150 gauge). S= Storage period. P= Packaging. S*P= interaction between storage and packaging. NS= not significant at 5% level ($P > 0.05$).

Polyphenols, flavonoids and antioxidants

AOX in sample extracts was determined using three assays namely, CUPRAC, FRAP and DPPH, these assays are widely used among researchers as they are consistent, cheap and do not require any sophisticated instruments. DPPH assay measure the ability of the antioxidants in a sample to scavenge pre-formed radicals (DPPH[•] to DPPH²) by accepting a hydrogen (H) atom. FRAP and CUPRAC are based on single electron transfer; involving reduction of a colored oxidant. The results of the AOX are presented in Table 3. Antioxidants capacity showed significant variation in respect of packaging and storage intervals. ALPE followed by HDPE packed samples showed highest antioxidant capacity values throughout the storage, and the least was in samples packed in Shrink wrapping. DPPH, CUPRAC and FRAP values were decreased from 19.17 to 7.40 ($\mu\text{mol TE/g}$), 54.75 to 21.13 ($\mu\text{mol TE/g}$) and 33.95 to 13.11 ($\mu\text{mol TE/g}$), respectively. The reduction in values might be due to oxidation that leads to reduction of color, nutritional and sensory quality in osmodehydrated apricot, which can be protected by using of SO₂ (Türkyılmaz *et al.*, 2013) [20].

It is a now an established fact that high AOX is largely attributed to high phenolics content which seems to be the case in the present study. Total phenolics content of osmodehydrated apricot was significantly influenced by packaging and storage. The mean TPC values decreased significantly during the period of six months from 478.74 to 239.43 mg GAE/100g, indicating 50% loss (Table 3). Highest TPC retention throughout the storage was recorded in samples packed in ALPE followed by HDPE pouches, while the least in shrink wrapped ones. The decreases in TPC value could be due result of dilution effect of moisture gain and to phenolics degradation, Degradation of phenolic compounds is primary caused by oxidation, cleavage of covalent bonds on enhanced oxidation reactions (Wani *et al.*, 2018) [21]. Our results are in agreement with several workers who reported decreasing of TPC values as effected by storage period and packaging materials (Campbell *et al.*, 2013; Wani *et al.*, 2018) [5, 21]. Similar trend was observed for total flavonoids content which showed significant variation with respect to packaging materials and storage intervals.

Table 3: Effect of packaging on antioxidants, polyphenols and flavonoids content in osmodehydrated apricots during storage

Attribute	Packaging	Storage (month)								CV _{0.05}		
		0	1	2	3	4	5	6	Mean	S	P	P*S
DPPH ($\mu\text{mol TE/g}$)	ALPE	19.17	18.22	17.01	15.03	13.50	10.99	9.55	14.78a	0.88	0.67	NS
	HDPE	19.17	18.02	16.21	14.23	11.62	9.87	7.94	13.86b			
	LDPE	19.17	17.85	15.28	13.24	11.81	9.00	6.67	13.29b,c			
	SW	19.17	17.05	14.73	13.14	11.18	8.14	5.45	12.69c			
	Mean	19.17a	17.78b	15.81c	13.91d	12.03e	9.50f	7.40g				
CUPRAC ($\mu\text{mol TE/g}$)	ALPE	54.75	52.02	48.57	42.94	38.55	31.37	27.25	42.21a	1.13	0.85	2.25
	HDPE	54.75	51.47	46.32	40.62	33.18	28.18	22.67	39.60b			
	LDPE	54.75	51.01	43.65	37.77	33.71	25.69	19.05	37.94c			
	SW	54.75	48.74	42.07	37.56	31.91	23.29	15.56	36.27d			
	Mean	54.75a	50.81b	45.15c	39.72d	34.34e	27.13f	21.13g				
FRAP ($\mu\text{mol TE/g}$)	ALPE	33.95	32.26	30.12	26.62	23.91	19.46	16.91	26.17a	1.15	0.87	NS
	HDPE	33.95	31.92	28.71	25.20	20.58	17.48	14.06	24.55b			
	LDPE	33.95	31.62	27.07	23.44	20.91	15.94	11.82	23.53c			
	SW	33.95	30.22	26.09	23.28	19.79	14.44	9.65	22.48d			
	Mean	33.95a	31.50b	28.00c	24.63d	21.30e	16.83f	13.11g				
TPC (mg GAE/100g)	ALPE	478.74	456.14	421.83	378.68	360.28	321.83	292.15	387.09a	13.75	10.39	27.39
	HDPE	478.74	434.06	403.58	365.92	321.30	280.47	249.03	361.87b			

	LDPE	478.74	407.43	350.52	306.61	286.39	242.44	221.23	327.62c			
	SW	478.74	378.05	329.41	277.84	240.88	214.26	195.30	302.07d			
	Mean	478.74a	418.92b	376.34c	332.26d	302.21e	264.75f	239.43g				
TFC (mg QE/100g)	ALPE	58.60	56.00	54.14	52.20	47.99	43.12	38.53	50.08a	1.16	0.88	2.32
	HDPE	58.60	55.74	52.92	48.17	43.77	40.93	37.05	48.16b			
	LDPE	58.60	54.54	50.38	46.20	41.25	38.15	36.04	45.87c			
	SW	58.60	53.20	48.27	45.60	40.04	35.84	33.27	45.55c			
	Mean	58.60a	54.87b	51.43c	48.04d	43.26e	39.51f	36.22g				

Values are a mean of three replicates \pm standard deviation. All values are expressed on fresh weight basis.

Same letter in the same row or column represent no significant differences between values ($p < 0.05$).

ALPE= Aluminum laminated polyethylene (260 gauge). HDPE= High density polyethylene (200 gauge). LDPE= Low density polyethylene (200 gauge). SW= shrink wrapping (150 gauge). S= Storage period. P= Packaging. S*P= interaction between storage and packaging. NS= not significant at 5% level ($P > 0.05$). CUPRAC — cupric ion antioxidant reducing capacity. DPPH — 2, 2-diphenyl-1-picrylhydrazyl. GAE= Gallic acid equivalents; QE= Quercetin equivalent; TE= Trolox equivalent.

Table 4: Sensory evaluation scores of osmodehydrated apricot as affected by packaging and storage period

Attribute	Packaging	Storage (month)								CV		
		0	1	2	3	4	5	6	Mean	S	P	P*S
Color	ALPE	7.67	7.00	6.89	6.89	6.67	6.56	5.33	6.71a	0.67	0.51	NS
	HDPE	7.67	7.00	6.72	6.44	6.39	6.33	6.00	6.65a			
	LDPE	7.67	6.89	6.44	6.33	6.00	5.67	5.33	6.33a,b			
	SW	7.67	6.56	6.44	5.89	5.78	5.33	4.78	6.06b			
	Mean	7.67a	6.86b	6.63b,c	6.39b,c	6.21b,c	5.97c,d	5.36d				
Flavour	ALPE	7.33	7.22	7.00	6.89	6.67	6.44	6.33	6.84	0.57	NS	NS
	HDPE	7.33	6.89	6.78	6.67	6.56	6.33	6.22	6.68			
	LDPE	7.33	6.99	6.78	6.67	6.56	6.33	6.11	6.68			
	SW	7.33	6.89	6.56	6.44	6.33	6.00	5.78	6.48			
	Mean	7.33a	7.00a,b	6.78a,b,c	6.67b,c,d	6.53b,c,d	6.28c,d	6.11d				
Texture	ALPE	7.67	6.89	6.78	6.56	6.33	6.22	6.22	6.67	0.58	NS	NS
	HDPE	7.67	7.00	6.89	6.67	6.33	6.22	5.89	6.67			
	LDPE	7.67	6.89	6.67	6.44	6.33	6.00	5.78	6.54			
	SW	7.67	6.89	6.89	6.11	6.00	5.67	5.33	6.37			
	Mean	7.67a	6.92b	6.81b,c	6.44b,c,d	6.25c,d,e	6.03d,e	5.81e				

Values are a mean of 10 replicates \pm standard deviation. Same letter in the same row or column represent no significant differences between values ($p < 0.05$). ALPE= Aluminum laminated polyethylene (260 gauge). HDPE= High density polyethylene (200 gauge). LDPE= Low density polyethylene (200 gauge). SW= shrink wrapping (150 gauge). S= Storage period. P= Packaging. S*P= interaction between storage and packaging. NS= not significant at 5% level ($P < 0.05$)

Sensory Evaluation

The sensory quality of osmodehydrated apricots decreased during storage (Table 4). The samples stored in ALPE and HDPE pouches showed highest sensory score and it was low in the shrink wrapped ones. Color was the most affected variable during storage and it was significantly varied with respect to packaging and storage interval. The color score decreased from 7.67 to 5.36. However, flavor and texture scores were only affected by storage period, while packaging didn't show significant effect. Their score was decreased from 7.33 to 6.11 and 7.67 to 5.81, respectively. However natural apricot flavor was retained and was detectable by many panel members throughout the storage period. Several workers had also reported decrease in sensory quality of dried apricot during storage (Wani *et al.*, 2018; Singh *et al.*, 2019; Sharma *et al.*, 2000) [21, 18, 16]. Such decrease could be due to SO₂ reduction and moisture increase in the sample which led to increase in non-enzymatic browning, oxidation and changes in other chemical components of product (Kumar and Sagar 2016) [10].

Conclusion

Treatment of mature and fully ripe apricots with ultrasound- and microwave- assisted osmotic dehydration using 60 °brix syrup containing 2000 PPM KMS prior to convective drying found to improve and maintain the quality of dehydrated apricot beyond 6 months of storage. Processed osmodehydrated apricot can be utilized by the industry as raw material during one year period when fresh apricots are not

available. Packaging of osmodehydrated apricot in ALPE found to be good for retention of functional components such as antioxidants, phenols, flavonoids, carotenoids and ascorbic acid, and sensory scores followed by HDPE. The product can retain its quality character when stored in these pouches beyond 6 months.

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Conflict of Interest

None

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