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ORIGINAL ARTICLE

Studies on Osmo-air dehydration of different Indian apricot (*Prunus armeniaca* L.) cultivars

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Abstract Suitability of seven cultivars of apricot viz. New Castle, Kaisha, Royal, Suffaida, Nari, Kullu (Local) and Chulli (wild apricot) was evaluated for dehydration. Osmotic dehydration of fruits consisting of dipping prepared fruits in 70° Brix sucrose syrup containing 2,000 ppm potassium metabisulphite (KMS) for 24 h followed by cabinet air drying (55 °C) to desired moisture (20±0.5 %) gave better dried product with good colour and appeal. Dried whole or halved fruits after removal of stones were preferred over whole fruits with stones with respect to appearance, texture and overall acceptability. Among different cultivars of apricot; cv. Kaisha followed by New Castle were found better with respect to yield as well as quality of dried product. Further, the quality of the osmo-air dried wild apricot fruits was found statistically at par with the quality of the osmo-air dried product obtained from cultivated apricots. Therefore, wild apricot fruits can also be utilized for preparation of acceptable quality of dried product.

Keywords Apricot fruits · Cultivars · Fruit type · Standardization · Dehydration

Apricot (*Prunus armeniaca* L.) is an important stone fruit grown in the temperate regions of the world (Ghorpade et al. 1995). The production of apricots in India is estimated to be about 16739 MT (FAO 2011). In India, these are grown in Jammu & Kashmir, Himachal Pradesh, sub-mountainous tracts of Punjab, Uttrakhand, and North Eastern states and to a limited extent in the Nilgiris. In Himachal Pradesh, it occurs in the cold and dry areas of high hills of Kinnaur, Lahaul Spiti, Kullu, Solan, Shimla, Mandi and Pangi (Anonymous 2006). Fresh fruits of apricots are a particularly rich source of Vitamin A and also contain good amounts of carbohydrates, phosphorus and niacin (Teskey and Shoemaker 1972). The apricot fruits are mostly used for table purposes or processing to prepare various types of value added products (Lal et al. 1989). However, due to difficult terrain in the growing areas, poor condition of the roads, insufficient communication facilities and lack of proper infrastructure for post harvest handling, the produce rarely reach terminal market in fresh form due to its perishable nature. Thus, drying of such produce in growing areas is one of the best alternatives for efficient utilization of this produce, as dried fruits are a very good source of minerals and nutrients in comparison to any other processed product (Cruess 1958). At present, apricots are dried either in the open sun or artificially after pitting and sulphuring which are not of a very good quality. Osmotic dehydration of fruits in hypertonic solution can enhance the quality of dried apricot to a great extent by increasing the sugar contents, reducing sourness, preventing the loss of natural flavor along with better retention of nutrients (Ponting et al. 1966). Therefore, the present investigation was undertaken to evaluate different cultivars of apricot and standardization of method for dehydration.

Material and methods

Apricot cultivars viz. New Castle, Kaisha, Royal, Suffaida, Nari, Kullu (Local) and Chulli (wild apricot) were procured from Distt Kinnaur, Solan, and Kullu HP and brought to the Department of Food Science and Technology (FST), Dr YS

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Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh - India for further immediate processing (within 24 h after harvest). Fruits after sorting and washing were dipped in boiling 0.5 % NaOH for 4–5 s. Dipping in lye solution (0.5 % NaOH) helped to remove the bloom from the surface of fruits and eased water removal during dehydration. Fruit halves (FH), destoned whole fruit (DWF) and whole fruit with stone (WF) were prepared after bloom removal and then used for dehydration by following five different dehydration treatments/methods viz. i) M_1-AD (air dehydration of fruits in mechanical dehydrator without sulphuring or sulphitation, i.e. control), ii) M_2-AD_K (air dehydration of sulphited fruits), M_3-AD_S (air dehydration of sulphured fruits), iv) M_4-OAD (osmotic dehydration of unsulphured/unsulphited fruits for overnight in 70°Brix sucrose syrup with a weight ratio of fruit to syrup of 1:2 followed by air dehydration), v) M_5-OAD_K (osmotic dehydration of fruits for overnight in 70°Brix sucrose syrup (1:2) containing 2,000 ppm KMS (potassium metabisulphite) followed by air dehydration). The sulphuring of the prepared fruits prior to dehydration was done by burning sulphur powder (0.3 % SO_2) for 1 h in sulphur fumigation chamber while sulphitation was carried out by dipping prepared fruits in 2,000 ppm KMS solution for 30 min at 35 °C. The osmotic dip was carried out for 12 h at an initial dipping temperature of 50 °C. Air dehydration was carried out in a mechanical dehydrator (WISWO Dehydrator, 12 T, Delhi, India) at 55 °C to a moisture content of 20±0.5 %. The final moisture content of the samples were maintained at 20±0.5 % by measuring the moisture content of the samples during dehydration process. The mechanical dehydrator had a tray load of 6 trays containing 3 kg samples per tray. Fruits treated osmotically were rinsed with water prior to dehydration in to mechanical dehydrator. The dried apricots were cured for equalization of moisture followed by packing, storage and analysis.

The size parameters of the apricot fruits in terms of length and breadth were recorded with the help of electronic vernier caliper (OEM, 0-300 mm, Shandong, China). The average weight of 10 fruits was determined gravimetrically. The weight of stones, shell and kernels were recorded and calculated on % as is basis. Yield of dehydrated apricots was calculated by drying known weight of samples in a dehydrator and expressed as % yield on fresh weight basis. The dry matter content, moisture and ash contents were determined as per AOAC (1995). The total soluble solids (TSS) were determined with the help of hand held refractometer (Unicom Optics, RHB/ATC008, Tsingtao, China) and expressed as °Brix (Ranganna 1986). The TSS of dried apricots was determined by diluting the known quantity of sample with known volume of distilled water following masceration. Reducing sugars, total sugars of fresh as well as processed apricots were determined by the method described by Sadasivam and Manikam (1996). The titratable acidity of fresh as well as processed apricots were determined by method as detailed by Ranganna (1986) and expressed as per cent maliec acid. The dehydrated apricots were evaluated for sensory qualities on the basis of colour (appearance), texture, taste, aroma and overall acceptability by a skilled panel of 10 judges (Research scholars and Scientists from Department of FST, Solan HP - INDIA between age group of 30–40 years) on a 9 - point Hedonic scale (Amerine et al. 1965).

The data on sensory evaluation of dehydrated apricot were analyzed according to Randomized Complete Block Design (RBD) as described by Mahony (1985). While the data on physico-chemical characteristics of fresh apricots as well as dehydrated apricots were analyzed statistically by following

Table 1 Physico-chemical characteristics of fresh fruits of apricot (*Prunus armeniaca*) cultivars used for dehydration

Parameters	Cultivars*							$CD_{0.05}$
	V_1	V_2	V_3	V_4	V_5	V_6	V_7	
Wt. of fruits, g	17.6	28.5	20.5	50.7	9.7	18.0	17.0	0.43
Length, cm	3.1	3.5	3.2	4.6	2.6	3.4	3.1	0.25
Breadth, cm	3.1	3.8	3.5	4.7	2.4	3.1	2.8	0.19
Moisture, %	81.6	80.3	85.1	83.8	83.7	82.0	79.5	0.38
TSS, °Brix	17.5	18.1	13.5	14.5	14.0	15.0	17	0.36
Titrable acidity, %	1.5	1.2	1.8	1.4	1.4	1.0	1.0	0.21
Reducing sugars, %	7.8	7.1	4.7	4.8	5.4	5.0	6.2	0.22
Total sugars, %	15.1	16.3	10.6	11.8	12.2	9.4	9.9	0.21
Dry matter, %	18.5	19.7	15.0	16.2	16.3	18.0	20.5	0.27

*V_1: New Castle, V_2: Kaisha (Solan), V_3: Kullu local, V_4: Royal, V_5: Wild apricot (chulli), V_6: Nari, V_7: Suffaida

TSS means "total soluble solids"; $n=3$

Table 2 Effect of different cultivars and dehydration treatments on yield (%) of dried apricots

Treatments[#] (T)	Fruit type[$] (FT)	Cultivars (CV)*							Mean (T)	Mean (FT)
		V_1	**V_2**	**V_3**	**V_4**	**V_5**	**V_6**	**V_7**		
M_1-AD (Control)	FH	22.1	23.6	17.4	19.5	19.6	21.6	24.6	21.3	**24.8**
	DWF	22.2	23.6	18.1	19.5	19.6	21.7	24.7	21.3	**26.9**
	WF	29.3	33.8	23.3	24.8	30.3	31.2	31.5	29.2	**32.5**
	Mean	24.6	27.0	19.8	21.3	23.2	24.8	26.9	**23.9**	
M_2-AD_K	FH	22.1	23.3	17.9	19.5	19.5	21.5	24.6	21.2	
	DWF	22.2	23.4	18.0	19.5	19.5	21.6	24.6	21.3	
	WF	29.2	33.8	23.2	24.9	30.3	31.1	31.4	29.1	
	Mean	24.5	26.8	19.7	21.3	23.1	24.7	26.9	**23.9**	
M_3-AD_S	FH	22.1	23.6	17.9	19.5	19.5	21.6	24.6	21.3	
	DWF	22.2	23.6	18.1	19.6	19.6	21.6	24.7	21.3	
	WF	29.3	33.8	23.3	24.9	30.3	31.1	31.5	29.1	
	Mean	24.5	27.0	19.8	21.3	23.1	24.8	26.9	**23.9**	
M_4-OAD	FH	31.8	34.6	26.7	28.0	28.1	29.8	31.9	30.1	
	DWF	31.8	35.1	26.9	28.1	28.2	29.9	31.9	30.3	
	WF	37.6	44.2	31.2	32.1	39.6	39.3	38.3	37.5	
	Mean	33.7	38.0	28.2	29.4	32.0	33.0	34.0	**32.6**	
M_5-OAD_K	FH	31.7	34.6	26.7	27.9	28.1	29.8	31.9	30.1	
	DWF	31.9	35.3	26.9	28.0	28.1	29.9	31.9	30.3	
	WF	38.1	43.6	31.5	31.9	29.6	39.3	38.3	37.5	
	Mean	33.9	37.8	28.4	29.3	31.9	33.0	34.1	**32.6**	
Mean (CV)		**28.2**	**31.3**	**23.2**	**24.5**	**26.7**	**28.1**	**29.8**	**27.4**	

CD 0.05

Treatment (T) 0.009

Cultivars (CV) 0.01

Fruit type (FT) 0.007

*$\mathbf{V_1}$: New Castle, $\mathbf{V_2}$: Kaisha (Solan), $\mathbf{V_3}$: Kullu local, $\mathbf{V_4}$: Royal, $\mathbf{V_5}$: Wild apricot (chulli), $\mathbf{V_6}$: Nari, $\mathbf{V_7}$: Suffaida

$ *FH* Fruit halves, *DWF* Destoned whole fruit, *WF* Whole fruit, No of replications per treatment (*n*) =3

AD (air dehydration - control), AD_K (air dehydration of sulphited fruits), AD_S (air dehydration of sulphured fruits), *OAD* (osmotic dehydration followed by air dehydration), OAD_K (osmotic dehydration in sugar syrup containing 2,000 ppm KMS followed by air dehydration)

Table 3 Effect of different cultivars and dehydration treatments on TSS (°Brix) of dried apricots

Treatments[#] (T)	Fruit type[$] (FT)	Cultivars (CV)*							Mean (T)	Mean (FT)
		V_1	V_2	V_3	V_4	V_5	V_6	V_7		
M_1-AD (Control)	FH	66.8	65.7	65.2	62.2	64.8	61.3	62.6	64.1	**66.9**
	DWF	66.7	65.7	65.2	62.1	64.8	61.3	62.6	64.0	**66.9**
	WF	66.8	65.7	65.2	62.1	64.8	61.3	62.6	64.1	**66.9**
	Mean	66.7	65.7	65.2	62.1	64.8	61.3	62.6	**64.1**	
M_2-AD_K	FH	66.7	65.6	65.2	62.1	64.7	61.2	62.5	64.0	
	DWF	66.7	65.7	65.2	62.1	64.7	61.0	62.5	64.0	
	WF	66.8	65.7	65.2	62.1	64.8	61.2	62.5	64.1	
	Mean	66.7	65.6	65.2	62.1	64.7	61.2	62.5	**64.0**	
M_3-AD_S	FH	66.8	65.7	65.3	62.2	64.8	61.3	62.6	63.9	
	DWF	66.8	65.7	65.2	62.1	64.8	61.3	62.6	64.1	
	WF	66.8	65.8	65.2	62.1	64.8	61.2	62.6	64.1	
	Mean	66.8	65.7	65.2	62.1	64.8	61.3	62.6	**64.1**	
M_4-OAD	FH	74.2	74.3	73.6	70.0	71.3	67.1	68.5	71.3	
	DWF	74.1	74.2	73.5	69.9	71.3	67.1	68.5	71.2	
	WF	74.2	74.3	73.5	69.9	71.3	67.1	68.5	71.2	
	Mean	74.1	74.2	73.5	69.9	71.3	67.1	68.5	**71.2**	
M_5-OAD_K	FH	74.2	74.3	73.5	70.1	71.4	67.4	68.6	71.4	
	DWF	74.2	74.3	73.6	70.0	71.4	67.3	68.6	71.3	
	WF	74.2	74.3	73.6	70.0	71.4	67.3	68.6	71.3	
	Mean	74.2	74.3	73.6	70.0	71.4	67.3	68.6	**71.3**	
Mean (CV)		**69.7**	**69.1**	**68.5**	**65.3**	**67.4**	**63.6**	**64.9**	**66.9**	

CD 0.05

Treatment—0.21

Cultivar—0.14

Fruit type—NS

*$\mathbf{V_1}$: New Castle, $\mathbf{V_2}$: Kaisha (Solan), $\mathbf{V_3}$: Kullu local, $\mathbf{V_4}$: Royal, $\mathbf{V_5}$: Wild apricot (chulli), $\mathbf{V_6}$: Nari, $\mathbf{V_7}$: Suffaida

$ *FH* Fruit halves, *DWF* Destoned whole fruit, *WF* Whole fruit, No of replications per treatment (*n*) =3

AD (air dehydration - control), AD_K (air dehydration of sulphited fruits), AD_S (air dehydration of sulphured fruits), *OAD* (osmotic dehydration followed by air dehydration), OAD_K (osmotic dehydration in sugar syrup containing 2,000 ppm KMS followed by air dehydration)

Table 4 Effect of different cultivars and dehydration treatments on total sugars (%) of dried apricots

Treatments[#] (T)	Fruit type[$] (FT)	Cultivars (CV)*							Mean (T)	Mean (FT)
		V_1	V_2	V_3	V_4	V_5	V_6	V_7		
M_1-AD (Control)	FH	56.3	57.4	53.6	52.2	54.8	54.2	56.3	55.0	**59.8**
	DWF	56.2	57.3	53.6	52.1	54.7	54.2	56.3	54.9	**59.8**
	WF	56.2	57.3	53.6	52.1	54.7	54.2	56.3	54.9	**59.8**
	Mean	56.2	57.3	53.6	52.1	54.7	54.2	56.3	**54.9**	
M_2-AD_K	FH	56.3	57.5	53.7	52.2	54.9	54.3	56.5	55.1	
	DWF	56.3	57.5	53.7	52.2	54.8	54.3	56.4	55.0	
	WF	56.3	57.5	53.7	55.2	54.9	54.3	56.4	55.0	
	Mean	56.3	57.5	53.7	52.2	54.9	54.3	56.4	**55.0**	
M_3-AD_S	FH	56.3	57.5	53.7	52.2	54.8	54.3	56.4	55.0	
	DWF	56.3	57.4	53.7	52.2	54.8	54.3	56.4	55.0	
	WF	56.3	57.4	53.7	52.2	54.8	54.3	56.4	55.0	
	Mean	56.3	57.4	53.7	52.2	54.8	54.3	56.4	**55.0**	
M_4-OAD	FH	69.0	69.5	69.3	65.6	67.2	62.5	64.7	66.8	
	DWF	68.9	69.4	69.3	65.6	67.2	62.5	64.6	66.7	
	WF	68.9	69.4	69.3	65.5	67.2	62.4	64.6	66.7	
	Mean	68.9	69.4	69.3	65.6	67.2	62.5	64.6	**66.7**	
M_5-OAD_K	FH	69.1	69.5	69.4	69.7	67.3	62.6	64.7	67.5	
	DWF	69.0	69.5	69.4	69.7	67.3	62.5	64.7	67.4	
	WF	69.0	69.4	69.3	69.6	67.3	62.5	64.6	67.4	
	Mean	69.0	69.4	69.4	69.7	67.3	62.5	64.7	**67.4**	
Mean (CV)		**61.3**	**62.2**	**59.9**	**58.3**	**59.8**	**57.5**	**59.7**	**59.8**	

CD 0.05

Treatment—0.6

Cultivar—0.7

Fruit type—NS

*$\mathbf{V_1}$: New Castle, $\mathbf{V_2}$: Kaisha (Solan), $\mathbf{V_3}$: Kullu local, $\mathbf{V_4}$: Royal, $\mathbf{V_5}$: Wild apricot (chulli), $\mathbf{V_6}$: Nari, $\mathbf{V_7}$: Suffaida

$ *FH* Fruit halves, *DWF* Destoned whole fruit, *WF* Whole fruit, No of replications per treatment (*n*) =3

AD (air dehydration - control), AD_K (air dehydration of sulphited fruits), AD_S (air dehydration of sulphured fruits), *OAD* (osmotic dehydration followed by air dehydration), OAD_K (osmotic dehydration in sugar syrup containing 2,000 ppm KMS followed by air dehydration)

Table 5 Effect of different cultivars and dehydration treatments on titratable acidity (%) of dried apricots

Treatments[#] (T)	Fruit type[$] (FT)	Cultivars (CV)*							Mean (T)	Mean (FT)
		V_1	V_2	V_3	V_4	V_5	V_6	V_7		
M_1-AD (Control)	FH	7.8	6.4	9.5	8.1	8.3	5.1	4.5	7.1	**5.9**
	DWF	7.8	6.3	9.5	8.1	8.2	5.1	4.5	7.1	**5.9**
	WF	7.8	6.3	9.5	8.1	8.2	5.2	4.5	7.1	**5.9**
	Mean	7.8	6.3	9.5	8.1	8.2	5.1	4.5	**7.1**	
M_2-AD_K	FH	8.0	6.5	9.7	8.2	8.5	5.3	4.7	7.2	
	DWF	7.9	6.5	9.7	8.2	8.4	5.3	4.6	7.2	
	WF	7.9	6.5	9.7	8.2	8.4	5.3	4.6	7.2	
	Mean	7.9	6.5	9.7	8.2	8.4	5.3	4.6	**7.2**	
M_3-AD_S	FH	8.0	6.5	9.7	8.2	8.5	5.3	4.7	7.3	
	DWF	8.0	6.4	9.7	8.2	8.5	5.3	4.7	7.2	
	WF	8.0	6.5	9.7	8.2	8.5	5.3	4.6	7.3	
	Mean	8.0	6.5	9.7	8.2	8.5	5.3	4.7	**7.3**	
M_4-OAD	FH	4.2	3.7	4.7	4.4	4.3	3.6	2.8	3.9	
	DWF	4.1	3.7	4.6	4.4	4.3	3.6	2.8	3.9	
	WF	4.1	3.7	4.6	4.4	4.3	3.6	2.8	3.9	
	Mean	4.1	3.7	4.6	4.4	4.3	3.6	2.8	**3.9**	
M_5-OAD_K	FH	4.2	3.8	4.8	4.4	4.4	3.7	2.9	4.0	
	DWF	4.2	3.8	4.7	4.4	4.4	3.6	2.8	3.9	
	WF	4.2	3.8	4.7	4.4	4.4	3.6	2.8	4.0	
	Mean	4.2	3.8	4.7	4.4	4.4	3.6	2.8	**4.0**	
Mean (CV)		**6.4**	**5.3**	**7.6**	**6.6**	**6.8**	**4.6**	**3.9**	**5.9**	

CD 0.05

Treatment—0.01

Cultivar—0.01

Fruit type—NS

*$\mathbf{V_1}$: New Castle, $\mathbf{V_2}$: Kaisha (Solan), $\mathbf{V_3}$: Kullu local, $\mathbf{V_4}$: Royal, $\mathbf{V_5}$: Wild apricot (chulli), $\mathbf{V_6}$: Nari, $\mathbf{V_7}$: Suffaida

$ *FH* Fruit halves, *DWF* Destoned whole fruit, *WF* Whole fruit, No of replications per treatment (*n*) =3

AD (air dehydration - control), AD_K (air dehydration of sulphited fruits), AD_S (air dehydration of sulphured fruits), *OAD* (osmotic dehydration followed by air dehydration), OAD_K (osmotic dehydration in sugar syrup containing 2,000 ppm KMS followed by air dehydration)

Table 6 Effect of different cultivars and dehydration treatments on sensory colour of dried apricots

Treatments[#] (T)	Fruit type[$] (FT)	Cultivars (CV)*							Mean (T)	Mean (FT)
		V_1	V_2	V_3	V_4	V_5	V_6	V_7		
M_1-AD (Control)	FH	5.3	5.4	5.4	5.5	5.7	5.4	5.5	5.4	**7.1**
	DWF	5.2	5.8	5.3	5.5	5.6	5.3	5.4	5.4	**7.2**
	WF	5.0	5.2	5.0	5.0	5.0	5.0	5.0	5.0	**6.4**
	Mean	5.1	5.4	5.2	5.3	5.4	5.2	5.3	**5.3**	
M_2-AD_K	FH	7.5	7.5	7.2	7.3	7.3	7.2	7.2	7.3	
	DWF	7.6	7.5	7.1	7.2	7.3	7.3	7.2	7.3	
	WF	6.9	6.8	6.5	6.5	6.7	6.5	6.8	6.7	
	Mean	7.3	7.2	6.9	7.0	7.1	7.0	7.0	**7.1**	
M_3-AD_S	FH	7.1	7.3	7.0	7.1	7.1	7.0	7.1	7.1	
	DWF	7.2	7.4	7.0	7.1	7.2	6.8	7.0	7.1	
	WF	6.8	6.7	6.0	6.0	6.5	6.5	6.5	6.4	
	Mean	7.0	7.1	6.6	6.7	6.9	6.7	6.8	**6.8**	
M_4-OAD	FH	7.8	8.0	7.6	7.3	7.7	7.4	7.6	7.6	
	DWF	7.9	8.0	7.7	7.4	7.9	7.6	7.8	7.7	
	WF	7.0	7.0	6.5	6.5	6.8	7.0	6.5	6.7	
	Mean	7.5	7.6	7.2	7.0	7.4	7.3	7.3	**7.3**	
M_5-OAD_K	FH	8.2	8.5	8.0	8.0	8.1	8.0	8.1	8.1	
	DWF	8.4	8.7	8.2	8.3	8.8	8.1	8.3	8.4	
	WF	7.3	7.5	7.0	7.0	7.2	7.0	7.0	7.1	
	Mean	7.9	8.2	7.7	7.7	8.0	7.7	7.8	**7.9**	
Mean (CV)		**7.0**	**7.1**	**6.7**	**6.7**	**7.0**	**6.8**	**6.8**	**6.9**	

CD 0.05

Treatment—0.05

Cultivar—0.06

Fruit type—0.04

*$\mathbf{V_1}$: New Castle, $\mathbf{V_2}$: Kaisha (Solan), $\mathbf{V_3}$: Kullu local, $\mathbf{V_4}$: Royal, $\mathbf{V_5}$: Wild apricot (chulli), $\mathbf{V_6}$: Nari, $\mathbf{V_7}$: Suffaida

$ *FH* Fruit halves, *DWF* Destoned whole fruit, *WF* Whole fruit, No of replications per treatment (*n*) =3

AD (air dehydration - control), AD_K (air dehydration of sulphited fruits), AD_S (air dehydration of sulphured fruits), *OAD* (osmotic dehydration followed by air dehydration), OAD_K (osmotic dehydration in sugar syrup containing 2,000 ppm KMS followed by air dehydration)

Complete Randomized Design (CRD) (Cochran and Cox 1967). Each treatment was replicated thrice.

Results and discussion

Physico-chemical characteristics of fresh apricots

The data on physico-chemical characteristics of fresh fruits of apricot of different cultivars is presented in Table 1. Data revealed that the fruit of Royal variety were larger in size (4.6x4.7 cm) and weight (50.7 g). The moisture and TSS content of the different varieties of apricots ranged from 79.5 to 85.1 % and 13.5 to 18.1°B, respectively. The titratable acidity was recorded maximum for Kullu local (1.8 %) following New Castle (1.5 %) and minimum for Suffaida and Nari (1.0 %). The reducing sugars contents of apricots ranged from 4.7 to 7.8 %, with highest reducing sugars in New castle and lowest in local variety of Kullu local (4.7 %). The total sugars content among different cultivars ranged from 9.4 to 16.3 %, maximum sugars content in cultivar Kaisha. Dry matter content among different cultivars of apricots ranged from 15.0 to 20.5 % and recorded maximum (20.5 %) in Suffaida and minimum (15.0 %) in Kullu local. Statistically significant differences ($P<0.05$) were observed for moisture, TSS, reducing sugars, total sugars and dry matter content of different Indian cultivars (Table 1). This may be due to the effect of agro-ecological region, as well as varietal characteristics. The results for various attributes in the present investigation for different varieties of apricots are in close agreement with those reported earlier by Deshpande and Salunkhe (1969) and Srivastava et al. (1992).

Table 7 Effect of different cultivars and dehydration treatments on sensory taste of dried apricots

Treatments[#] (T)	Fruit type[$] (FT)	Cultivars (CV)*							Mean (T)	Mean (FT)
		V_1	V_2	V_3	V_4	V_5	V_6	V_7		
M_1-AD (Control)	FH	6.7	6.8	6.7	6.5	6.6	6.7	6.8	6.7	**7.4**
	DWF	6.7	6.8	6.8	6.7	6.7	6.8	6.9	6.8	**7.5**
	WF	6.5	6.5	6.5	6.5	6.0	6.5	6.6	6.4	**7.2**
	Mean	6.6	6.7	6.6	6.5	6.4	6.6	6.7	**6.6**	
M_2-AD_K	FH	6.8	7.0	6.5	6.8	6.7	7.0	7.0	6.8	
	DWF	6.9	7.2	6.6	6.8	6.7	7.0	7.0	6.9	
	WF	6.5	7.0	6.5	6.5	6.5	7.0	6.8	6.7	
	Mean	6.7	7.0	6.5	6.7	6.6	7.0	6.9	**6.8**	
M_3-AD_S	FH	7.0	7.3	6.8	6.7	6.6	7.0	7.0	6.9	
	DWF	7.1	7.4	6.9	6.7	6.7	7.1	7.2	7.0	
	WF	7.0	7.2	6.6	6.4	6.5	6.8	6.9	6.8	
	Mean	7.0	7.3	6.7	6.6	6.6	6.9	7.0	**6.9**	
M_4-OAD	FH	8.2	8.7	8.2	8.3	8.4	7.8	7.7	8.2	
	DWF	8.4	8.5	8.3	8.5	8.5	7.9	7.8	8.3	
	WF	8.0	8.3	8.0	7.9	8.2	7.4	7.5	7.9	
	Mean	8.2	8.5	8.1	8.2	8.3	7.7	7.6	**8.1**	
M_5-OAD_K	FH	8.3	8.8	8.3	8.4	8.5	7.9	7.8	8.3	
	DWF	8.4	8.9	8.4	8.7	8.6	8.0	7.8	8.4	
	WF	8.2	8.5	8.1	8.0	8.2	7.4	7.8	8.0	
	Mean	8.3	8.7	8.2	8.3	8.4	7.7	7.7	**8.2**	
Mean (CV)		**7.4**	**7.6**	**7.2**	**7.2**	**7.3**	**7.2**	**7.2**	**7.3**	

CD 0.05

Treatment—0.15

Cultivar—0.19

Fruit type—0.12

*$\mathbf{V_1}$: New Castle, $\mathbf{V_2}$: Kaisha (Solan), $\mathbf{V_3}$: Kullu local, $\mathbf{V_4}$: Royal, $\mathbf{V_5}$: Wild apricot (chulli), $\mathbf{V_6}$: Nari, $\mathbf{V_7}$: Suffaida

$ *FH* Fruit halves, *DWF* Destoned whole fruit, *WF*: Whole fruit, No of replications per treatment (*n*) =3

Number of sensory panelists used for sensory evaluation=10

AD (air dehydration - control), AD_K (air dehydration of sulphited fruits), AD_S (air dehydration of sulphured fruits), *OAD* (osmotic dehydration followed by air dehydration), OAD_K (osmotic dehydration in sugar syrup containing 2,000 ppm KMS followed by air dehydration)

Physico-chemical characteristics of dehydrated apricots

The yield of dried apricots among different cultivars ranged from 23.2 to 31.3 %, with maximum yield of dehydrated apricots in cultivar Kaisha following Suffaida (Table 2). Yield of the dehydrated apricots when dried with different treatments ranged from 23.9 to 32.6 %. The yield in fruits which were dried osmotically in sucrose syrup followed by air drying in the mechanical dehydrator was maximum and statistically at par with M_4-OAD and M_5-OAD_K while minimum and statistically at par with air dried fruits (M_1-AD, M_2-AD_K and M_3-AD_S). There were significant differences between M_4 and M_1, M_4 and M_3, M_5 and M_1, M_5 and M_2 as well as M_5 and M_3. The increase in yield in osmo-air dried fruits is due to penetration of sugar into the fruits (Togrul and Ispir 2007). Yield of dehydrated products having different fruits types ranged from 24.2 to 32.5 %, with maximum yield in whole fruit (WF) and minimum in halves (FH) (Table 2). The differences among treatments, cultivars and fruit types were found statistically significant in Table 2 ($P<0.05$). Bhatia (1976) reported that dehydration of apricots gave 30-35 % yield for WF and 15-22 % yield for FH in apricot varieties of Ladakh region. Almost similar results with slight variation for yield has been earlier reported (Anonymous 1991). The yield of whole dried apricot fruits (WF) is due to presence of seed inside the fruits. Within cultivars, there is variation in weight of seeds resulting variation in yield of dried apricots in different cultivars. The variation in dry matter content of different apricot cultivars might affect the yield of dried apricot among different cultivars. Even the geometry of the different cultivars

Table 8 Effect of different cultivars and dehydration treatments on sensory texture of dried apricots

Treatments[#] (T)	Fruit type[$] (FT)	Cultivars (CV)*							Mean (T)	Mean (FT)
		V_1	V_2	V_3	V_4	V_5	V_6	V_7		
M_1-AD (Control)	FH	6.5	6.6	6.4	6.5	6.4	6.5	6.4	6.5	**7.5**
	DWF	6.5	6.5	6.5	6.6	6.5	6.5	6.5	6.5	**7.6**
	WF	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	**6.9**
	Mean	6.3	6.3	6.3	6.3	6.3	6.3	6.3	**6.3**	
M_2-AD_K	FH	7.5	7.6	7.3	7.0	7.2	7.1	7.1	7.2	
	DWF	7.7	7.5	7.4	7.0	7.4	7.3	7.4	7.4	
	WF	7.8	7.0	7.0	6.5	7.0	7.0	7.0	7.0	
	Mean	7.6	7.3	7.2	6.8	7.2	7.1	7.1	**7.2**	
M_3-AD_S	FH	7.5	7.5	7.0	7.0	7.1	7.0	7.0	7.1	
	DWF	7.6	7.5	7.0	7.0	7.1	7.0	6.9	7.1	
	WF	6.5	6.8	6.5	6.5	6.6	6.0	6.0	6.4	
	Mean	7.2	7.2	6.8	6.8	6.9	6.6	6.6	**6.9**	
M_4-OAD	FH	8.3	8.5	8.1	8.0	8.1	8.2	8.2	8.2	
	DWF	8.5	8.5	8.2	8.3	8.3	8.2	8.3	8.3	
	WF	7.3	7.8	7.5	7.6	7.6	7.5	7.4	7.5	
	Mean	8.0	8.2	7.9	7.9	8.0	7.9	7.9	**8.0**	
M_5-OAD_K	FH	8.4	8.7	8.3	8.3	8.3	8.3	8.3	8.4	
	DWF	8.5	8.8	8.4	8.5	8.4	8.3	8.4	8.5	
	WF	7.5	7.6	7.4	7.6	7.7	7.5	7.5	7.5	
	Mean	8.1	8.3	8.0	8.1	8.1	8.0	8.0	**8.1**	
Mean (CV)		**7.4**	**7.5**	**7.2**	**7.2**	**7.3**	**7.2**	**7.2**	**7.3**	

CD 0.05

Treatment—0.06

Cultivar—0.07

Fruit type—0.04

*$\mathbf{V_1}$: New Castle, $\mathbf{V_2}$: Kaisha (Solan), $\mathbf{V_3}$: Kullu local, $\mathbf{V_4}$: Royal, $\mathbf{V_5}$: Wild apricot (chulli), $\mathbf{V_6}$: Nari, $\mathbf{V_7}$: Suffaida

$ *FH* Fruit halves, *DWF* Destoned whole fruit, *WF* Whole fruit, No of replications per treatment (*n*) =3

Number of sensory panelists used for sensory evaluation=10

AD (air dehydration - control), AD_K (air dehydration of sulphited fruits), AD_S (air dehydration of sulphured fruits), *OAD* (osmotic dehydration followed by air dehydration), OAD_K (osmotic dehydration in sugar syrup containing 2,000 ppm *KMS* followed by air dehydration)

of apricot fruits may affect the yield of the dehydrated apricots because the geometry of fruits have effect on the sugar gain of fruits, thus may effect the yield (Ispir and Togrul 2009).

Total soluble solids (TSS) of the dehydrated apricots when dried with different methods ranged from 64.0 to 71.3 °B, with maximum TSS in osmo-air dried apricots containing 2,000 ppm KMS in osmotic solution of 70°B (M_5-OAD_K) and lowest in sulphited and air dried fruits (M_2-AD_K) (Table 3). The TSS of dried apricots of different cultivars ranged from 63.6 to 69.7°B, with maximum TSS in cultivar New Castle following Kaisha (69.11) and minimum in Nari. The TSS of the dehydrated apricots having different fruit types found to be non-significant ($P<0.05$). The variation in TSS might be attributed to variation in the dry matter as well as TSS of the fresh fruits of different cultivars. Similarly total sugars content of the dried apricots when dehydrated with different treatments ranged from 54.9 to 67.4 %, with maximum total sugars in osmo-air dried apricots containing 2,000 ppm KMS in sucrose syrup (M_5-OAD_K) (Table 4). Total sugars of dried apricots of different cultivars ranged from 57.5 to 62.2 %, with maximum sugars in cultivar Kaisha and minimum in Nari. The total sugars of the dehydrated apricots having different fruit types found to be non-significant. Variations in total sugars among different cultivars of the apricots were reported earlier by Mehta et al. (1974). Titratable acidity of the dried apricots of different cultivars ranged between 3.9 and 7.6 %, with maximum titratable acidity in Kullu local and minimum in Suffaida. The acidity

Table 9 Effect of different cultivars and dehydration treatments on sensory overall acceptability of dried apricots

Treatments[#] (T)	Fruit type[$] (FT)	Cultivars (CV)*							Mean (T)	Mean (FT)
		V_1	V_2	V_3	V_4	V_5	V_6	V_7		
M_1-AD (Control)	FH	6.2	6.3	6.2	6.2	6.2	6.2	6.2	6.2	**7.3**
	DWF	6.1	6.4	6.2	6.1	6.3	6.2	6.3	6.2	**7.4**
	WF	5.8	6.2	6.0	5.8	5.7	5.8	5.7	5.9	**6.8**
	Mean	6.0	6.3	6.1	5.0	6.1	6.1	6.1	**6.0**	
M_2-AD_K	FH	7.3	7.4	7.0	7.0	7.1	7.1	7.1	7.1	
	DWF	7.4	7.4	6.9	7.0	7.1	7.2	7.1	7.2	
	WF	6.7	6.9	6.7	6.5	6.7	6.8	6.7	6.8	
	Mean	7.1	7.2	6.9	6.8	7.0	7.0	7.0	**7.0**	
M_3-AD_S	FH	7.2	7.4	6.9	6.9	6.9	7.0	7.0	7.1	
	DWF	7.3	7.4	7.0	6.9	7.0	7.0	7.0	7.1	
	WF	6.8	6.9	6.4	6.3	6.5	6.4	6.5	6.5	
	Mean	7.1	7.2	6.8	6.7	6.8	6.8	6.8	**6.9**	
M_4-OAD	FH	8.1	8.3	7.9	7.8	8.0	7.8	7.8	8.0	
	DWF	8.3	8.3	8.0	8.0	8.2	7.9	8.0	8.1	
	WF	7.5	7.6	7.3	7.0	7.5	7.3	7.1	7.4	
	Mean	7.9	8.1	7.7	7.6	7.9	7.7	7.6	**7.8**	
M_5-OAD_K	FH	8.3	8.6	8.2	8.2	8.3	8.1	8.1	8.3	
	DWF	8.4	8.8	8.3	8.5	8.6	8.1	8.2	8.4	
	WF	7.7	7.9	7.5	7.5	7.7	7.3	7.4	7.6	
	Mean	8.1	8.4	8.0	8.1	8.2	7.7	7.9	**8.1**	
Mean (CV)		**7.3**	**7.4**	**7.1**	**7.1**	**7.2**	**7.1**	**7.1**	**7.2**	

CD 0.05

Treatment—0.5

Cultivar—0.6

Fruit type—0.04

*$\mathbf{V_1}$: New Castle, $\mathbf{V_2}$: Kaisha (Solan), $\mathbf{V_3}$: Kullu local, $\mathbf{V_4}$: Royal, $\mathbf{V_5}$: Wild apricot (chulli), $\mathbf{V_6}$: Nari, $\mathbf{V_7}$ Suffaida

$FH: Fruit halves, DWF: Destoned whole fruit, WF: Whole fruit, No of replications per treatment (n) =3

Number of sensory panelists used for sensory evaluation=10

AD (air dehydration - control), AD_K (air dehydration of sulphited fruits), AD_S (air dehydration of sulphured fruits), OAD (osmotic dehydration followed by air dehydration), OAD_K (osmotic dehydration in sugar syrup containing 2,000 ppm KMS followed by air dehydration)

of the dehydrated apricots when dried with different treatments ranged from 3.9 to 7.3 %, with maximum acidity in products which were sulphured and air dried (M_3-AD_S) and minimum in osmo-air dehydrated fruits (M_4-OAD). Acidity of the dried apricots having different fruit types was found statistically non-significant (Table 5). The results of the present investigation are in conformity as reported earlier by Mehta et al. (1974).

Sensory characteristics of dehydrated apricots

The sensory colour/appearance of the dehydrated apricots of different cultivars ranged from 6.7 to 7.1 (9 point Hedonic scale), with maximum score in cultivar Kaisha following New Castle and Wild apricot and minimum in Royal and Kullu local. The sensory score for colour of the dehydrated apricots dried by different methods ranged from 5.3 to 7.9, with maximum colour in fruits dehydrated osmotically in sucrose syrup containing 2,000 ppm KMS for 24 h following air drying (M_5-OAD_K) and minimum in control. The colour score for different fruit types ranged from 6.4 to 7.2, with maximum score in destoned whole fruits (DWF) following halves (FH) and minimum in whole fruits with stones (WF) (Table 6). The score for taste of the dehydrated apricots of different cultivars ranged from 7.2 to 7.6 (9 point Hedonic scale), with maximum score in cultivar Kaisha. The taste score of the dehydrated apricots treated with different methods ranged from 6.6 to 8.2; with maximum sensory taste in fruits dehydrated osmotically in sucrose syrup containing 2,000 ppm KMS for 24 h following air drying (M_5-OAD_K) statistically at par with osmo-air dried fruits (M_4-OAD). The taste score for different fruit types ranged from 7.2 to 7.5, with maximum score in destoned

whole fruits following halves and minimum in whole fruits with stones (Table 7).

The sensory texture of the dehydrated apricots of different cultivars ranged from 7.2 to 7.5 (9 point Hedonic scale), with maximum score in cultivar Kaisha (Table 8). The texture score of the apricots dehydrated by different methods ranged from 6.3 to 8.1, with maximum texture score in osmo-air dried fruits (M_5-OAD_K). Among different fruit types, the texture score were found to be higher in destoned whole fruits and statistically at par with halves (Table 8). The sensory score for overall acceptability of the dehydrated apricots of different cultivars ranged from 7.05 to 7.44 (9 point Hedonic scale), with maximum score in cultivar Kaisha. Apricot fruits dehydrated obtained maximum overall acceptability score (8.07) when dehydrated using osmo-air dehydration method (M_5-OAD_K). The overall acceptability score for different fruit types ranged from 6.8 to 7.4, with maximum score in destoned whole fruits following halves (Table 9).

Conclusion

Osmotic dehydration consisting of dipping prepared fruits in 70 ^{o}Brix sucrose syrup containing 2,000 ppm KMS for 24 h followed by cabinet air drying to desired moisture (20 %) gave better dried product with good colour and appeal. Dried whole or halved fruits after removal of stones (DWF or FH) were preferred over whole fruits with stones (WF) with respect to appearance, texture and overall acceptability. Among different cultivars of apricot; cv. Kaisha followed by New Castle were found better with respect to yield as well as quality of dried product. Furthermore, the quality of the osmo-air dried wild apricot fruits was found to be statistically at par with the quality of the osmo-air dried product obtained from cultivated apricots. Therefore, wild apricot fruits can also be utilized for preparation of acceptable quality of dried product by using osmo-air dehydration methods.

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