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Standardization of Technology for Osmotic Dehydration of Wild Apricot (Chulu)

[1]Suneeta Singh, [2]Anil Kumar Saxena and [3]Satish Kumar Sharma
[1]*Department of Horticulture, School of Agricultural Sciences,*
[2]*Department of Soil Science, School of Agricultural Sciences, SGRR University, Dehradun 248 001, Uttarakhand, India*
[3]*Department of Food Science and Technology, G.B. Pant University of Agriculture and Technology, Pantnagar 263 145, (Uttarakhand), India*

Key words: Osmotically dehydrated, wild apricot, dipping time, sensory quality, overall acceptability

Corresponding Author:
Suneeta Singh
Department of Horticulture, School of Agricultural Sciences, SGRR University, Dehradun 248 001, Uttarakhand, India

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Abstract: Present study was undertaken with a view to standardize the technology for the preparation of osmotically dehydrated wild apricots. For this, an experiment was conducted in which apricot fruits of three cultivars namely New Castle, Ranichauri (V_1) wild apricot, Ranichauri (V_2) and wild apricot, Kanatal (V_3) were harvested at optimum maturity, brought to the Post Harvest Technology Lab of the Department, washed and shade dried. The fruits after lye peeling (1.0% NaOH solution in boiling water for 30 sec) were dipped in 70° Brix sugar syrup containing 0.05% KMS for 0-8 h followed by drying in mechanical dehydrator at 55±2°C for 6 h. Result shows that during 8 h of osmotic dipping, about -0.53 to 48.33% weight loss was recorded in different apricot varieties which rose to about 51.33- 78.67% after 6 h of further drying in a mechanical dehydrator. Therefore, 8 h dipping time was found to be the best for effective drying of apricots. Among varieties, the average drying time was minimum (6 h) for wild apricot, Kanatal, i.e., (V_3) and the maximum average dried fruit yield of 24.87% was also observed in wild apricot, Kanatal (V_3). Also on the basis of sensory evaluation, the product prepared from wild apricot, Kanatal (V_3) dipped for 8 h followed by drying in mechanical dehydrator for 6 h was found to be superior over the rest of the products for its overall acceptability.

INTRODUCTION

Apricot (*Prunus armeniaca* L.), a member of family Rosaceae, is one of the most important and delicious fruits of temperate region grown throughout the world. The total apricot production in India is about 1,00,000 metric tonnes covering approximately an area of 24,000 ha. On an average the productivity is about 4.19 tonnes/ha[1]. The major apricot growing states in India are Jammu and Kashmir, Himachal Pradesh and Uttarakhand. Apricots are grown over an area of 9.054 ha in Uttarakhand state producing 30.375 tonnes of fruits annually[2]. The fresh fruits of apricot are attractive, delicious and highly nutritious. They contain adequate

amounts of vitamins, carbohydrates, phosphorous and niacin[3]. Among the various cultivated varieties of apricot, Charmagz, Shakarpara, Moorpark and New Castle are important and show promise for table purpose. Being rich in sugar content, they are also highly suitable for processing. In contrast to the table purpose varieties, the plants of wild apricot (Chulu) are drought resistant, salt tolerant, prolific bearers and less susceptible to insects, pests and diseases. Wild apricot is most common in mid hills of Uttarakhand, Himachal Pradesh and Jammu and Kashmir.

But, the high acidity, low sugar content and poor quality of wild apricot fruits as such, makes them unsuitable for fresh consumption and drying purpose. High acidity and low sugar contents in fruits of wild type apricot cultivars are the major limitations for their utilization as dried fruits in sharp contrast to Charmagz, Shakarpara and New Castle cultivars which possess high sugar content, therefore are highly suitable or drying purposes.

Fruit dehydration industry has not shown a satisfactory growth in India due to a variety of reasons like non-availability of promising varieties in adequate quantity, location disadvantage and lack of up-gradation and innovation in the area of product technology[4]. Osmotic dehydration is a technique where moisture is partially removed and the sweetness is increased by dipping the fruits in concentrated sugar solution, followed by final drying in hot air. In this method, fruits are washed and halved to remove the stones and dipped in hypertonic solution containing 70° Brix sugar syrup for 6-8 h[5]. Potassium metabisulphite is added in sugar solution as preservative and to improve colour of the finished product. After draining the syrup, the fruits are dried in a mechanical dehydrator to a constant weight[6].

The osmotic dipping of wild apricot was presumed to reduce the fruit acidity (due to leaching effect) and increase the sweetness (due to osmosis), so as to make them acceptable. The successful transfer of the developed technology may open new avenues for the industry through efficient utilization of fruits. Realizing the importance of the problem, the present experiment was therefore, done to standardize the technology for osmotic dehydration of wild apricot.

MATERIALS AND METHODS

The present investigation entitled "standardization of technology for osmotic dehydration of wild apricot." was conducted in the Post harvest laboratory, Department of Horticulture, Govind Ballabh Pant University of Agriculture and Technology, Hill Campus, Ranichauri, Tehri Garhwal, Uttarakhand. For the experiment fruits of apricot cultivar New Castle (V_1) were harvested at optimum maturity, from the trees planted in the experimental Block of Horticulture Department, Hill Campus, Ranichauri, located at an altitude of 1975 m above m.s.l. while that of wild apricot (chulu) were harvested from two different places, i.e., from the experimental orchards of Horticulture Department , Hill Campus, Ranichauri (V_2) and Research sub-station, Kanatal, district Tehri Garhwal Uttarakhand (V_3) which is located at an altitude of 2250 m above msl. The fruits were brought to the laboratory and after thorough sorting and grading are used for conducting further experiment.

Standardization of osmotic dipping time: Fruits were washed thoroughly in cold water and cut into halves to remove the stones. The fruits were lye-peeled (1.0% NaOH solution in boiling water for 30 sec) followed by immediate cooling and washing in running tap water to remove excess alkali. A 70° Brix sugar syrup containing 0.05% potassium metabisulphite (KMS) with temperature maintained at 50°C was used as osmotic dehydration solution for immersing the lye-peeled fruits of New Castle and wild apricots for 0 h (T_1), 2 h (T_2), ,4 h (T_3), 6 h (T_4) and 8 h (T_5) in 1:3 ratio (fruit: syrup). During dipping time, the product was agitated periodically at 1 h interval with a wooden laddle.

The dipped fruits were removed from sugar solution and dried in a mechanical dehydrator at 55±2°C temperature up to an almost constant weight. The osmotically dried products were evaluated for rate of drying, drying time, yield and sensory quality based on colour, texture, taste and overall acceptability.

Estimation of drying time: The drying time was recorded by dehydrating the osmo-dipped samples to an almost constant weight in a mechanical dehydrator at 55±2°C temperature. It was expressed in hour.

Estimation of drying rate: The rate of drying per unit time was calculated by dipping weighed quantity of fruits (1500 g) in 70° Brix sugar syrup, in 1:3 (fruit:syrup) ratio for 8 h followed by drying in mechanical dehydrator (55±2°C) for 6 h up to a moisture content of 10-12%. The loss in weight during dipping and drying was recorded at periodic intervals. The drying rate was then calculated by plotting the weight in g against time in hour[7].

Estimation of yield: The yield of osmotically dehydrated fruits was expressed in percentage and determined by using the following formula:

$$\text{Yield (\%)} = \frac{\text{Weight of dried fruit}}{\text{Weight of fresh fruit}} \times 100$$

Evaluation of sensory quality: The fruits, under each treatment were evaluated for sensory characteristics (colour, texture, taste and overall acceptability) by a panel of 7 semi-trained members using on a 9-point Hedonic Scale, i.e., like extremely 9, like very much 8, like moderately 7, like slightly 6, neither like nor dislike 5, dislike slightly 4, dislike moderately 3, dislike very much 2, dislike extremely 1 as described by Amerine *et al*.[8]. The osmotically dehydrated products were coded before serving to the taste panelists and plain water was also served for rinsing mouth during the evaluation.

Statistical analysis: The data pertaining to the physico-chemical characteristics evaluation were analysed by Factorial Completely Randomized Design (CRD) as described by Cochron and Cox[9] and the values were compared at 5% level of significance. While, that of sensory evaluation of osmotically dehydrated fruits were analysed according to Factorial Randomized Block Design (RBD) as described by O'Mahony[10].

RESULTS AND DISCUSSION

Drying rate: As revealed in Table 1 there was a sharp decrease in fruit weight during initial stages of osmotic dipping, i.e., upto 4 h. About 34.33-39.67% weight loss was observed after 4 h of dipping with minimum values recorded in wild apricot, Ranichauri (V_2) and maximum in wild apricot, Kanatal (V_3). Gradual decrease in weight was observed in all the three varieties during 4-6 h of osmotic dip which further stabilized towards the end of dipping time, i.e., 8 h. The maximum (48.33%) weight loss was observed in wild apricot, Kanatal (V_3) while minimum (42.33%) was recorded in wild apricot, Ranichauri (V_2) at the end of 8 h of dipping. After osmotic dipping, the products were transferred to the dehydrator for drying. The drying rates again speeded up for about 4 h when the samples were shifted to mechanical dehydrator. Infact, all the three varieties followed similar trend for weight loss during osmotic dipping as well as in drying period. However, maximum (72.67%) and minimum (65%) weight loss were observed in wild apricot, Kanatal (V_3) and wild apricot, Ranichauri (V_2), respectively, at the end of 4 h of drying in dehydrator, whereas, New Castle (V_1) showed 68.33% weight loss in 4 h of drying. At later stage of drying, the drying rate fell drastically in all the varieties. The highest overall weight loss was found in wild apricot, Kanatal (V_3), i.e., 78.67% after 6 h of drying, while, V_1 and V_2 showed 74.67 and 72.33% weight loss, respectively. It was observed that the drying rate was a little faster in wild apricot, Kanatal (V_3) than the other two varieties. The increase in weight loss per cent during 8 h of osmotic dipping period in all the three varieties (Table 1) might be due to the moisture loss during osmosis. Similar results have been reported in osmotic dehydration of many fruits including aonla cv. Chakaiya and Pineapple cv. Gaint Kew[11, 12]. After osmotic dipping, during air drying in dehydrator, the faster drying rate was observed in wild apricot, Ranichauri (V_2) as compared to other two varieties with the maximum weight loss of 78.67% after 6 h of drying. This might be attributed to minimum moisture content in fresh fruit and also due to more porous nature of fruit. Similar kind of findings has been reported by Sharma *et al*.[13] in apricot and Kanthakumari and Maheswari[14] in grapes. The increased moisture loss on shifting the fruits to mechanical dehydrator might be attributed to the faster rate of evaporation achieved at a temperature of 55°C with forced air circulation in a dehydrator.

Drying time: Data presented in Table 2 reveal that increase in dipping time of fruits in osmotic solution reduced the mechanical dehydration time significantly, irrespective of a variety. Drying time in mechanical dehydrator declined from an average of 10.05 h in control to 6.17 h in osmotically dipped fruits (for 8 h). The fruits of apricot cv. New Castle (V_1) had faster drying

Table 1: Effect of osmotic dipping and drying on weight changes in different varieties of apricot

	Varieties								
	V_1			V_2			V_3		
Time (h)	Weight (g)	Weight loss (%)	Weight loss difference (%)	Weight (g)	Weight loss (%)	Weight loss difference (%)	Weight (g)	Weight loss (%)	Weight loss difference (%)
Osmotic dipping									
0	1508	-0.53	-	1560	-4.00	-	1495	0.33	-
2	1190	20.67	21.20	1225	18.33	22.33	1175	21.67	21.34
4	930	38.00	17.33	985	34.33	16.00	905	39.67	18.00
6	850	43.33	5.33	910	39.33	5.00	815	45.67	6.00
8	800	46.67	3.34	865	42.33	3.00	775	48.33	2.66
Drying in dehydrator									
10	680	54.67	8.00	730	51.33	9.00	630	58.0	9.67
12	475	68.33	13.66	525	65.00	13.67	410	72.67	14.67
14	380	74.67	6.34	415	72.33	7.33	320	78.67	6.00

V_1: New Castle, V_2: Wild Apricot (Ranichauri), V_3: Wild Apricot (Kanatal)

Table 2: Effect of osmotic dip on drying time (h) of dehydrated apricot

	Duration of osmotic dip (h)					
Varieties	0 (T_1)	2 (T_2)	4 (T_3)	6 (T_4)	8 (T_5)	Mean
V_1	10.00	8.03	6.30	6.21	6.00	7.31
V_2	10.15	8.50	7.30	7.00	6.50	7.89
V_3	10.00	8.30	7.00	6.50	6.00	7.56
Mean	10.05	8.28	6.87	6.57	6.17	

$CD_{0.05}$; Variety (V) 0.013; Dip period (T) 0.016; V×T 0.28; V_1: New Castle, V_2: Wild Apricot (Ranichauri), V_3: Wild Apricot (Kanatal)

Table 3: Effect of osmotic dip on dried fruit yield (%) of dehydrated apricot

	Duration of osmotic dip (h)					
Varieties	0 (T_1)	2 (T_2)	4 (T_3)	6 (T_4)	8 (T_5)	Mean
V_1	18.66	22.00	23.67	24.35	25.00	22.74
V_2	20.67	21.47	22.68	25.11	28.05	23.59
V_3	21.62	22.82	24.35	26.37	29.19	24.87
Mean	20.32	22.10	23.56	25.28	27.41	

$CD_{0.05}$; Variety (V) 0.056; Dip period (T) 0.073; V×T 1.267; V_1: New Castle; V_2: Wild Apricot (Ranichauri); V_3: Wild Apricot (Kanatal)

rate whereas, it was slowest in wild apricot, Ranichauri (V_2). The drying time for V_1 reduced from 10-6 h during 0-8 h of osmotic dip period while for V_2 and V_3 it reduced from 10.15-6.50 h and 10-6 h, respectively. The average drying time was maximum (7.89 h) for wild apricot, Ranichauri (V_2) and minimum for V_1 (7.31 h). Therefore, 8 h dipping time was found to be the best for effective drying of apricots. The varieties apricot cv. New Castle (V_1) and wild apricot, Kanatal (V_3) were also adjudged good for osmotic dehydration. The reduction in total drying time with the progressive increase in dipping time from 0-8 h (Table 2) might be due to removal of a considerable amount of water during osmotic dipping and also due to the maintenance of the porous structure of the fruits during osmotic treatment. The reduction in total drying time after osmotic dip has also been reported earlier during preparation of various dehydrated products of grapes, banana, mango, aonla, fig etc. in a mechanical dehydrator[15]. A little higher mean value for drying time in wild apricot, Ranichauri (V_2) might be attributed to the differences in porosity of mesocarp as well as the variable initial moisture contents of the fruits.

Dried fruit yield: The data presented in Table 3 indicate that the highest average dried fruit yield of 27.41% was obtained with 8 h dipping time and lowest (20.32%) in T_1. The dried fruit yield for apricot cv. New Castle (V_1) varied from 18.66-25.0% whereas for wild apricot, Ranichauri (V_2) and wild apricot, Kanatal (V_3) it varied from 20.67-28.05 and 21.62-29.19%, respectively. Among varieties, maximum average yield of 24.87% was observed in wild apricot, Kanatal (V_3) and minimum in apricot cv. New Castle (22.74%). The best treatment combination recorded was 8 h osmotic dip of wild apricot, Kanatal (V_3) resulting in 29.19% dried fruit yield. The increase in mean dried fruit yield from 20.32-27.41% during 8 h of osmotic dipping of apricots (Table 3) was probably due to the increased sugar penetration into the fruits by osmosis. Similar findings have also been reported by Adambounon and Costaigne[16] in Banana. The increase in dried fruit yield with the advancement in osmotic dipping period has also been reported in many fruits including mango and apple[17, 18].

Among varieties, the higher mean dried fruit yield of wild apricot, Kanatal (V_3) was probably due to the lower final moisture content and higher total solids (constituted of sugars, acids and fibrous material). The present findings are in confirmation with the studies of Winkler *et al*.[19] who reported that with an increase in the content of TSS, total sugars and reducing sugars and decrease in moisture and non-reducing sugars, an increase in the yield of raisins was observed. Bhatia[20] has reported a drying yield of 30-35 and 15-22% for whole and halved fruits, respectively, in few superior apricot varieties of Ladakh region.

Sensory evaluation

Colour: The perusal of the data in Table 4 shows that the mean sensory scores for colour of dehydrated products on 9 point hedonic scale in apricot fruits varied from 6.48 to 7.53 in various osmotic dip periods. However, the highest score was recorded in T_5, which was at par with T_4, while, the lowest mean colour score was recorded in T_1. Among varieties, wild apricot, Kanatal (V_3) gave the best colour of dehydrated products with the mean score of 7.35, whereas apricot cv. New Castle (V_1) and wild apricot, Ranichauri (V_2) had average colour scores of 6.06 and 6.96, respectively. The colour of dehydrated wild apricot, Kanatal (V_3) was found to be superior as compared to apricot cv. New Castle (V_1) and wild apricot, Ranichauri (V_2).

Texture: Data presented in Table 4 indicate that the mean sensory scores for texture were highest (8.12) in T_5, being statistically at par with T_4, while, the lowest mean texture score (4.52) was obtained in T_1. The texture of dehydrated apricots increased with the increase in dipping time. The average sensory score for texture was highest for V_3 (6.63) and lowest for V_1 (5.75). The best texture score was recorded in was 8 hour osmotic dip of wild apricot, Kanatal (V_3).

Taste: The average sensory score for taste of osmotically dehydrated apricot fruits under various dipping periods on 9 period hedonic scale varied from 4.87 to 7.26 with highest score in T_5 and lowest in T_1 (Table 4). Among varieties, the highest sensory (7.01) score was recorded for wild apricot, Kanatal (V_3), whereas, lowest score (5.47) for wild apricot, Ranichauri (V_2). The taste of dehydrated apricot was found to increase with the concomitant increase in dipping time.

Table 4: Effect of osmotic dip on colour, taste, texture, flavour and overall acceptability of osmotically dehydrated apricot fruits

Duration of osmotic dip (h)	V_1	V_2	V_3	Mean
		Colour		
0	6.00	6.35	6.80	6.48
2	6.08	6.55	6.85	6.50
4	6.12	6.55	7.60	6.55
6	6.30	7.20	7.80	7.10
8	7.00	7.70	7.88	7.53
Mean	6.06	6.96	7.35	
$CD_{0.05}$	Variety = 0.005	Dipping period = 0.006	Variety×Dipping period = 0.011	
		Taste		
0	5.40	4.00	5.20	4.87
2	5.88	5.20	6.40	5.83
4	6.67	5.66	6.86	6.40
6	7.77	6.20	7.80	7.26
8	7.88	6.30	8.62	7.60
Mean	6.72	5.47	7.01	
$CD_{0.05}$	Variety = 0.008	Dipping period = 0.011	Variety×Dipping period = 0.019	
		Texture		
0	4.60	4.47	4.50	4.52
2	4.88	4.60	5.20	4.89
4	5.20	5.86	6.82	5.96
6	6.85	7.20	7.80	7.28
8	7.20	8.30	8.85	8.12
Mean	5.75	6.08	8.12	
$CD_{0.05}$	Variety = 0.089	Dipping period = 0.115	Variety×Dipping period = 0.119	
		Overall acceptability		
0	4.45	4.08	4.82	4.45
2	5.30	4.80	5.87	5.32
4	6.60	6.10	6.85	6.52
6	7.50	6.15	7.88	7.18
8	7.77	6.22	8.86	7.62
Mean	6.32	5.47	6.86	
$CD_{0.05}$	Variety = 0.005	Dipping period = 0.007	Variety×Dipping period = 0.012	

V_1: New Castle, V_2: Wild Apricot (Ranichauri), V_3: Wild Apricot (Kanatal)

Overall acceptability: The data presented in Table 4 show that overall acceptability of dehydrated apricots on the basis of colour, texture and taste was found to be maximum in T_5 (7.62) followed by T_4 (7.18). The average overall acceptability scores for different varieties ranged between 5.47 and 6.86 while, for osmotic dip time (0-8 h), the scores ranged from 4.45-7.62. The best result (overall acceptability score 7.62) was obtained with 8 h osmotic dip time irrespective of variety. Overall, the best treatment combination observed was 8 h dip for wild apricot, Kanatal i.e., V_3.

During the 8 h of osmotic dipping period of apricot fruits, there was an increase in the mean sensory scores of all the attributes including colour, texture, taste and overall acceptability (Table 4). The increase in sensory scores with increase in osmotic dipping period might be attributed to more water loss, acid leaching, sugar penetration and higher drying rate during mechanical dehydration. A significant difference in colour among all the three varieties was observed. The higher mean sensory score for colour was observed for wild apricot, Kanatal (V_3) might be due to the presence of higher amount of total carotenoids in fresh fruit which is in conformity with the results of Jasim and Choudhary[21]. The higher mean sensory score for texture in wild apricot, Kanatal (V_3) was observed which might be due to higher pulp: stone ratio of the fresh fruits. Similar findings have also been reported in different varieties of apricot by Sharma *et al.*[13]. As far as the dipping periods are concerned, the maximum mean sensory scores were obtained in fruits dipped in T_5 which might be due to more loss in moisture. Similar findings have also been reported earlier[22].

Present finding confirm that during 8 h of dipping about -0.53 to 48.33% weight loss was recorded in different apricot varieties which rose to about 51.33-78.67% after 6 h of further drying in a mechanical dehydrator. Therefore, 8 h dipping time was found to be the best for effective drying of apricots. Among varieties, the average drying time was minimum (6 h) for wild apricot, Kanatal i.e., (V_3) and the maximum average dried fruit yield of 24.87% was also observed in wild apricot, Kanatal (V_3). More over on the basis of sensory evaluation, the product prepared from wild apricot, Kanatal (V_3) dipped for 8 h followed by drying in mechanical dehydrator for 6 h was found to be superior over the rest of the products for its overall acceptability adjudged on the basis of colour, texture and taste.

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