

## Studies on physico-chemical characteristics and fatty acid composition of wild apricot (*Prunus armeniaca* Linn.) kernel oil

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Some principle characteristics like fruit, stone and kernel weight and kernel and oil recovery as crude oil and physico-chemical characteristics of apricot (*Prunus armeniaca* Linn.) kernel oils were determined in the stones collected from different locations of Himachal Pradesh. Mean fruit weight of apricot fruits ranged between 8.0-15.1 g with the stone recovery of 12.7-22.2% having stone weight 1.78-1.92 g. Further, the kernel recovery was found ranging between 30.7-33.7% whereas kernels gave oil yield of 45.6-46.3% crude oil. The study further revealed that the colour of apricot kernel oil was yellow whereas acid value; peroxide value; iodine value and saponification value were reported as 2.27-2.78 mg KOH/g; 5.12-5.27 meq/kg; 100.2-100.4 g I<sub>2</sub>/100 g and 189.8-191.3 mg KOH/g oil, respectively. The fatty acid profile of these oils showed that the oleic (62.07-70.6%); linoleic (20.5-27.76%); linolenic (0.4-1.42%); palmitic (5.0-7.79%) acids are present in major quantity, while palmitoleic acid (0.48-0.70%) in small quantities. Vitamin E contents were present in oil to the extent of 72-107 mg/100 g. Apricot oil was characterized by its high contents of oleic and linoleic acid. The apricot oils because of the fatty acid composition indicates that they may be suitable as edible oils and vitamin E rich contents make these oils suitable for use in preparation of cosmetic and moisturizing creams for dry skins, massaging oils and for industrial use.

**Keywords:** Apricot, *Prunus armeniaca*, Kernels, Crude oil, Fatty acid composition, Vitamin E.

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### Introduction

Apricot (*Prunus armeniaca* Linn.), commonly known as chulli, chulu, sarha or zardalu is grown in temperate regions of the world including USA, Spain, France, Italy, Turkey, Morocco, Iran, Africa and Australia. In India, apricots are found growing in Himachal Pradesh, Jammu & Kashmir and Uttarkashi in Uttarakhand. In Himachal Pradesh, it is grown in the districts of Shimla, Mandi, Kullu, Chamba, Sirmour, Kinnaur and Lahaul-Spiti<sup>1</sup>. Owing to their short harvest season and highly perishable nature, apricots are mostly used for preparation of different value-added products, in processing, in drying and in preparation of fermented liquor (*Ghanti*). The stones/pits left after processing is thrown as a waste, which otherwise is a good source of edible oil and considered to be a good source of polyunsaturated

fatty acids like linoleic and linolenic acid and oleic acid as monounsaturate with a good nutritional and pharmaceutical importance. Broadly, it contains 13.7% saturated and 86.0% unsaturated fatty acids<sup>2</sup>. The oil has been used in preparation of many cosmetic products, moisturizing creams for dry skins, baby oil, massaging oil, face scrub, lip balm, etc<sup>3</sup>. It is estimated that Indian varieties are reported to contain 44% oil<sup>4</sup>. Femenia *et al* reported that the apricot kernels contain more oil (53 g/100 g) than of bitter kernels (43g/100 g)<sup>5</sup>. Owing to the presence of unsaturated fatty acids in good proportion, its quality attributes matches with almond oil. After oil extraction from apricot kernels, around 60% of remaining residue called as press cake, contains about 50% of protein thus the press cake can also be utilized as protein source after its treatment for removal of bittering component hydrocyanic acid (HCN).

The level of major fatty acids found in apricot kernel oil range between 3.2-10.7 palmitic, 51.0-83.3

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oleic and 9.6-45.9% linoleic acid<sup>5</sup>. The oil obtained from Indian bitter apricot kernels had the fatty acid composition as 1.1 myristic, 3.5 palmitic, 2.0 stearic, 73.4 oleic and 20.0% linoleic acid, the lipid profile in apricot oil also reported as 3.8 myristic, 4.37 palmitic, 0.12 palmitoleic, 0.46 stearic, 66.29 oleic, 28-64 linoleic and 0.12% linolenic acid<sup>6,7</sup>. A diet rich in palmitoleic and linolenic acid is known to significantly decrease the level of total cholesterol and triacylglycerol concentration in the blood plasma. The essential fatty acids (EFA) are those which are required for growth, maintenance and proper functioning of many physiological processes and are not biosynthesized in the human body. Linoleic, linolenic and arachidonic acids are generally considered to be essential fatty acids for human beings<sup>8</sup>. Tocopherols are important dietary constituents as they are essential in maintaining the stability and integrity of the cell membrane, which is associated with high concentrations of unsaturated fatty acids present in these membranes. The tocopherol content in apricot oil ranged from 268.5-436.0 µg/g, while, in almond oil, the vitamin E is present in fairly large concentration i.e. 4 mg/g of oil<sup>9,10</sup>. However, detailed literature on fatty acid composition with proximate composition of apricot press cake is scarce. Therefore, present investigations were carried out to study the physico-chemical characteristics of apricot fruits, stones, kernels and kernel oil. The fatty acid composition with proximate composition of apricot press cake were undertaken for apricots seeds collected from different areas of Himachal Pradesh.

### Materials and Methods

Apricot stones/pits collected from different locations in Himachal Pradesh were utilized for these studies. The kernels were separated from the mass of stones/pits by using specific gravity separation method after breaking the stones with mechanical decorticator. On semi-pilot scale, the oil was extracted by passing the apricot kernels through table oil expeller and after filtration through a filter press; the oil was analyzed for different physico-chemical characteristics.

### Chemical and statistical analysis

Standard analytical procedures were followed for estimation of iodine value, saponification value, acid value and peroxide value in the extracted oils<sup>11</sup>. The

fatty acid composition of the apricot kernel oil was determined by using standard method and converting them in respective fatty acid methyl esters and by using gas liquid chromatography (GLC)<sup>11,12</sup>. Vitamin E contents were determined by using HPLC<sup>13</sup>. The data on physico-chemical characteristics were statistically analyzed by using CRD-Factorial design<sup>14</sup>. Triplicate determinations were made for each attribute.

### Results and Discussion

#### Physico-chemical characteristics of apricot fruits, stones and kernels

Broadly, mean fruit and stone weight ranged between 8.0-15.1 g and 1.78-1.92 g, respectively with stone recovery of 12.7-22.2% in apricot fruits. Further, the kernel recovery was 30.7-33.7% (on stone basis) and 3.9-7.5% (on fruit basis) having a kernel weight of 0.58-0.60 g (Table 1). Further oil recovery ranged between 45.6-46.3% as crude oil (extracted through Soxhlet apparatus). The moisture contents in kernels ranged between 4.0-4.1% with 2.2-2.4% ash contents, whereas in oils the moisture contents ranged between 0.25-0.26%. The bitter apricot kernels are reported known to contain bittering component HCN (hydrocyanic acid). In confirmation to these results, the kernel recovery in apricot stones was reported as 35-45% and 22-38% in sweet and bitter apricots. Further, the apricot oil yield of 35-45% was reported<sup>6,15</sup>.

#### Quality characteristics of apricot kernel oil

The visual appearance of extracted oil was observed to be yellow in colour (Table 2). The specific gravity of apricot kernel oil was found to range between 0.914-0.915 with the refractive index and butyro- refractometer reading (40°C) of 1.4720-1.4729 and 69.6-70.3, respectively. The kernel oil from apricots exhibited low acid value (2.27-2.78 mg KOH/g); peroxide value (5.12-5.27 meq/kg); iodine value (100.2-100.4 g I<sub>2</sub>/100 g and saponification value of 189.8-191.3 mg KOH/g oil. The quality characteristics of apricot oil extracted from kernels collected from different locations are at par and all the values were found well within the standards specified by PFA for almond oil<sup>16</sup>. Further, the vitamin E contents in oils ranged between 72-93.7 mg/100 g and total carotenoids ranged between 262-267 µg/100 g. Earlier, the vitamin E content in apricot oil was reported in the range of 268.5 to 436.0 µg/g oil<sup>9</sup>.

Table 1—Physico-chemical characteristics of apricot fruits, stones, kernels and kernel oil from different locations in Himachal Pradesh

Location→ Parameters	Mandi	Shimla	Kinnaur	Mean	CD <sub>0.05</sub> (n=3)
Weight of fruit (g)	8.0	15.1	12.8	12.0	0.24
Pulp weight (g)	6.2	13.2	10.9	10.1	0.24
Pulp, %	77.8	87.3	85.6	84.3	-
Stone weight, g	1.78	1.92	1.85	1.88	0.03
Stone recovery, %	22.2	12.7	14.4	16.4	0.23
Pulp/stone ratio	3.5	6.9	5.5	5.1	-
Kernel weight, g	0.60	0.59	0.58	0.59	0.01
Kernel recovery, % (on stone basis)	33.7	30.7	31.4	31.9	0.32
Kernel recovery, % (on fruit basis)	7.5	3.9	4.5	5.3	0.08
Stone/kernel ratio	3.0	3.2	3.1	3.1	-
Kernel moisture, %	4.1	4.0	4.1	4.1	-
Crude oil, %	45.6	46.3	46.3	46.1	0.57
Moisture in oil, %	0.25	0.26	0.26	0.26	-
HCN in kernels*	+	+	+	-	-
Crude ash, %	2.4	2.2	2.4	2.3	-

Karsog, Mandi (930-935 m amsl.); Jubbal, Shimla (1850-2000 m amsl.); Kalpa, Kinnaur, (2190-2250 m amsl.); \*Qualitative test shows presence of HCN in kernels; HCN= Hydrocyanic acid

Table 2—Qualitative characteristics of kernel oil from stones of apricots grown in different locations of Himachal Pradesh

Parameters	Mandi	Shimla	Kinnaur	Mean	CD <sub>0.05</sub> (n=3)	PFA Standards
<b>Tintometer Colour Units</b>						
Yellow	6.9	6.7	6.4	6.7	-	
Red	0.1	0.3	0.1	0.2	-	
Blue	0.0	0.0	0.0	0.0	-	
Specific gravity, g/cc	0.915	0.914	0.914	0.914	-	
Refractive index, 40°C	1.4729	1.4729	1.4720	1.4726	-	
Butyrefractometer reading, 40°C	70.3	70.3	69.6	70.1	0.84	54-57
Acid value, mg KOH/ g oil	2.27	2.78	2.69	2.58	1.02	Not more than 6
Peroxide value, meq/ kg oil	5.26	5.27	5.12	5.22	0.01	Not more than* 125
Iodine value, g I <sub>2</sub> /100 g oil	100.4	100.2	100.2	100.3	2.23	90-109
Saponification value, mg KOH/ g oil	190.8	189.8	191.3	190.6	0.99	186-195
Visual appearance	Yellow	Yellow	Yellow	-	-	Clear, free from rancidity
Vitamin E, mg/100 g	72	93.7	90.7	-	-	
Polar material, % PM	5.6	5.8	5.7	5.7	-	
Total carotenoid , µg/100 g	262	265	267	264		

Karsog, Mandi (930-935 m amsl.); Jubbal, Shimla (1850-2000 m amsl.); Kalpa, Kinnaur, (2190-2250 m amsl.). \*Jacobs, 1958<sup>18</sup>

#### Fatty acid composition of apricot kernel oil

The fatty acids present in apricot kernel oils from Mandi, Kinnaur and Shimla areas are significantly at par, whereas the lower linoleic acid contents and high monounsaturated fatty acid contents present in oils from Mandi and Kinnaur areas helps in longer shelf-life as compared to kernel oil from Shimla (Table 3). Further, it was found that apricot oil possessed an

appreciable proportion of unsaturated fatty acids which comprised of 62.5-71.2% monounsaturates and 21.2-29.2% polyunsaturates. While the saturates were only 6.5-8.7%, thus the ratio between unsaturates and saturates (U/S) were recorded as 10.51-14.24. Among the unsaturated fatty acids, oleic and linoleic were the predominant acids in apricot kernel oil. The oils rich in polyunsaturated fatty acids have been shown to

Table 3—Fatty acid composition of apricot kernel oil

Fatty acid	Per cent composition (% w/w)		
	Mandi	Shimla	Kinnaur
Palmitic acid C <sub>16:0</sub>	5.0	7.8	5.1
Palmitoleic acid C <sub>16:1</sub>	0.6	0.5	0.7
Stearic acid C <sub>18:0</sub>	1.5	0.9	2.0
Oleic acid C <sub>18:1</sub>	70.6	62.1	69.7
Linoleic acid C <sub>18:2</sub>	21.0	27.8	20.5
Linolenic acid C <sub>18:3</sub>	0.4	1.4	0.7
Σ SFA	6.5	8.7	7.1
Σ MUFA	71.2	62.6	70.4
Σ PUFA	21.4	29.2	21.2
Σ UFA	92.6	91.8	91.6
U : S ratio	14.24:1	10.51:1	12.90:1

Σ SFA-Saturated fatty acid; Σ MUFA-Mono unsaturated fatty acid; Σ PUFA-Polyunsaturated fatty acid; Σ UFA-Unsaturated fatty acid; Karsog, Mandi (930-935 m amsl.); Jubbal, Shimla (1850-2000 m amsl); Kalpa, Kinnaur, (2190-2250 m amsl)

Table 4—Proximate composition of bitter apricot kernels and press cake

Parameter	Bitter apricot* kernels	Press cake		
		Mandi	Shimla	Kinnaur
Moisture, %	4.0-4.1	4.9	7.2	7.5
Crude protein, %	24.4	44.5	34.3	40.9
Crude lipids, %	45.6-46.3	5.4	9.7	7.0
Total ash, %	2.2-2.4	4.9	5.1	4.9
Crude fibre, %	5.4	10.2	10.8	7.0
Total CHO, %	8.2	30.1	27.5	32.7
Hydrocyanic acid, mg/100 g	148-173	90.5	92.0	90.5
Calorific value	-	347	324	357

Karsog, Mandi (930-935 m amsl.); Jubbal, Shimla (1850-2000 m amsl); Kalpa, Kinnaur, (2190-2250 m amsl); CHO= Carbohydrates. \*Range of values as given in Table-1

reduce the risk of cardiovascular diseases<sup>17</sup> and linoleic and linolenic acids are essential fatty acids and are important for maintenance of skin, hair growth, regulation of cholesterol metabolism and maintenance of cell membrane integrity<sup>8</sup>. Thus, apricot oil possesses special dietary importance and can be used for both edible and pharmaceutical purposes.

Moisture content of kernels ranged between 4.0-4.1 and 4.9-7.5% in apricot press cake (Table 4). The crude protein contents were found to be 24.4% in kernels and 34.3-44.5% in press cake. The crude lipids were recorded as 45.6-46.3% in apricot kernels

and in range of 5.4-9.7% press cake and crude fibres of 5.4 in kernels and 7.0-10.8% in press cake, whereas calorific value (K cal/100 g) was found in the range of 324-357 in press cake. Further, the bittering toxic compound HCN was found to be 148-173 mg/100 g in kernels and 90.5-92.0 mg/100 g in press cake.

Thus, the preliminary study showed that the stones left after preparation of different value-added products from pulp contained an oil of good nutritional and pharmaceutical properties. The fatty acid profile showed that there is predominance of unsaturated fatty acids comprising of major proportion of oleic and linoleic acids besides vitamin E and carotenoid.

## Conclusion

The apricot kernel oil can be considered as good edible oil and can also be utilize for other industrial purposes. Extraction of such oils may also open an avenue for their utilization in various preparations such as pharmaceutical, cosmetics, facial creams and lip balms besides its use in the food industry. The proximate composition of bitter apricot kernels and press cake showed that the press cake can also be successfully utilized for preparation of protein isolate.

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