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Physico-chemical study of seed oil of *Prunus armeniaca* L. grown in Garhwal region (India) and its comparison with some conventional food oils

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Abstract: The seeds of the wild *Prunus armeniaca* L. (wild Apricot) from the Garhwal Region of Uttarakhand (India) was analysed for its proximate compositions and the physico-chemical characteristics of the oil. The elements present in seed oil were also determined which reflected that apricot is rich in Phosphorous, Calcium, Magnesium, Iron and Copper which makes it suitable for edible and commercial oil. Gas chromatography (GC) of seed oil revealed that it contains oleic acid (73.58%), linoleic acid (19.26%), palmitic acid (3.31%), myristic acid (1.18%) and stearic acid (2.68%). Proximate values of the protein, fiber, oil and carbohydrate content of the wild apricot seed oil and their comparison with other food grade oil suggests that wild apricot oil from this region may be used for edible purposes.

Keywords: *Prunus armeniaca* L., Garhwal, wild apricot, seeds, fatty acid, oil, mineral composition, oleic acid

Introduction

Wild Apricoat (*Prunus armeniaca* L.) is an important fruit tree species found in temperate regions of Himachal Pradesh and Uttarakhand states of India at an altitude up to 2500 msl. It is a moderate-sized tree, about 10 m tall, with a reddish bark. Leaves are ovate round-ovate or up-cordate, approximately 5-9 cms. Flowers are, pinkish white, borne singly and appearing much in advance of the foliage. Fruits are round about 5 cms, across, hairy when young, but nearly smooth skinned at maturity with a yellow skin overlaid with red, the flesh is yellow or yellowish orange, firm and sweet. Fruits are harvested from May to July.

Fats and oils are an important food source for man, and are supplying essential fatty acids such as linoleic and arachidonic acids. Fats and oils are also used for producing drug dispersants in therapeutics (Rauken and Kill, 1993). Oils from seeds are both edible and non-edible depending on the type. These oils are often available as raw materials for chemical and industrial applications. Because of the high demand and economic importance of these oil seeds to the chemical industry, attention has therefore been focused on underutilized *Prunus armeniaca* L. seeds for possible development and use.

The objective of this study was therefore to extract oil from *Prunus armeniaca* L. seeds, assess the physical and chemical characteristics and suggest possible uses for the oil as a prelude to an investigation into the scientific basis for its use for edible purposes. Comparisons between *Prunus armeniaca* L. seed oil and other well known edible oils from other plant sources that are already enjoying a degree of utilization popularity and acceptability are also made.

Materials and Methods

Collection of seeds

The fruits of *Prunus armeniaca* L. were collected from village Kandai, (Pauri Garhwal), Uttarakhand, India in the month of June, 2010. The village is situated at a height of 1650 msl, between 29°45' to 30°15' E and 78°24' to 79°23'E. The average annual rainfall in the area is 218 cm. and means monthly temperature is 25-30°C. The fruits and tree were identified by the Systematic Botany Division, Forest Research Institute, Dehradun. Seeds were obtained by breaking the fruit manually into two parts. These seed samples were stored in airtight coloured glass bottles and kept in a refrigerator prior to analysis.

Extraction of seed oil

A known weight of the seeds were grounded into powder form with high speed blender and dried in an air circulating oven at 50°C for 1 h. thereafter oil was extracted from this powder with petroleum ether (boiling point 60-80°C) using a Soxhlet extractor.

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The solvent was distilled off at 80°C. Oil content was estimated on the basis of dry seed weight and expressed in g/100 g.

Analysis of seed oil

Oil density was determined picnometrically, whereas refractive index was determined at 25°C with Abbey Refractometer. The oil viscosity was determined by Ostwald method (Standard Base, 2010). The seed oil was assessed for various chemical properties. Standard methods described by Association of Official Analytical Chemists (AOAC, 1990) were used for the determination of moisture, crude fibre and free fatty acids (FFA) contents of the oil sample. Physical and chemical analyses of the extracted oil were carried out by using AOAC methods (AOAC, 1990). Iodine value was determined using Wij's method as reported in AOAC methods (AOAC, 1990). The procedures of Egan *et al*. (1981) were adopted for the estimation of Saponification values, unsaponifiable matter content and acid value of the oil sample. Protein was determined using micro-Kjeldhal method as described by Allen and Quarmby (1989). A factor of 6.25 was adopted for protein content estimation. Carbohydrate content was determined by colorimetric method (Allen and Quarmby, 1989).

The metal composition Zinc, Iron, Copper of the seeds were determined by using an Atomic Absorption Spectrophotometer (Model Varian 240FS+GTA120), after acid digestion. Calcium and magnesium was determined by complexometric titration with 0.1M EDTA, by using Erichome black T indicator and calculated. Phosphorus was determined by the precipitation of phosphorus in the form of phospho molybdate by using the reagent ammonium molybdate. Precipitate was filtered from asbestos, then residue obtained was taken in conical Flask and dissolved in 0.1M NaOH and titrate with 0.1M HCl by using indicator Phenolphthalein. Sodium and potassium was determined by flame photometer model No. ESICO 1381 by using the reference standard (Merck) and calculated on the basis of reading and dilution of the sample.

The fatty acids were derivatized by using the boron trifluoride method as described by Hisil (1988). Samples were injected as 2 µl into a Nucon model 5700 equipped with 10% DEGS (Diethylene Glycol Succinate) + 1% H_3PO_4 constant phase, a flame ionization detector (FID) and chromosorb G (100/120 mesh) support matter, internal diameter (2mm) and stainless steel (190 cm) column. Column temperature was programmed from 70°C to 200°C with the increasing rate of temperature 6°C/Minute. Injector and detector temperatures were set at 225°C. Nitrogen (N_2) (25 ml/min) was used as the carrier gas. Hydrogen (40 ml/min) and Air (60 ml/min) were used as burnt and dry gas respectively. Fatty acid methyl esters were identified by comparison with fatty acid internal standards, Individual fatty acid concentration was expressed as percent.

Results and Discussion

Oil extracted from *Prunus armeniaca* L. seeds is light yellow, tasteless and free of sediments. It is liquid at room temperature (at 27±2°C). It contains 31.18% protein, 1.94% fiber and 15.61% carbohydrate. The level of phosphorous, calcium and magnesium are quit high while those of copper, potassium and sodium are much lower (Table 2). GC examination of fatty acids of the Apricot oil showed that it contains myristic, palmitic, stearic, oleic and linoleic acids. Oleic and linoleic acids were present in significant amounts (Table 3).

Table 1. Physico-chemical Properties of *Prunus armeniaca* L. seed oil from Garhwal region

Characteristics	Values
Colour	Pale yellow, clear and transparent
Taste	Neutral, free of bitter taste, free of after taste
Smell	Neutral, free of smell coming from plant material
Sediments	Free of sediments
State at room temperature	Liquid
Refractive Index (at 40°C)	1.4638
Specific Gravity (at 25°C)	0.9172
Yield (%)	44.3
Moisture (%)	6.86
Protein (%)	31.18
Fiber (%)	1.94
Carbohydrate (%)	15.61
Acid Value (mgKOH/g)	4.05
Iodine value	102.0
Saponification value (mgKOH/g)	190
Unsaponifiable matter (%w/w)	0.71
Free fatty acid (%)	2.01
Total saturated (%)	7.17
Total unsaturated (%)	93.13

Table 2. Mineral content (mg/100 g) of *Prunus armeniaca* L. seed oil from Garhwal region

Mineral	Content
Phosphorous	472
Zinc	3.79
Calcium	330.0
Magnesium	370.0
Potassium	0.017
Sodium	0.034
Iron	3.6
Copper	1.56

Table 3. Fatty acid composition (mg/g) of *Prunus armeniaca* L. seed oil from Garhwal region

Fatty acid	Amount
Myristic acid	1.18
Palmitic acid	3.37
Stearic acid	2.68
Oleic acid	73.58
Linoleic acid	19.26

A comparison of Apricot oil properties was also done with the previously reported (Gopalan *et al*., 1971; Anonymous, 2001) properties of some

conventionally used oils (CUOs), for food purposes and other applications. Apricot oil is existing in liquid state at room temperatures as all other CUOs (except coconut oil which is semi- solid). The yellow colour of the Apricot oil is also in the colour range of CUOs, which varies from colourless, yellow to dark brown. The proximate chemical composition of the seven different CUOs and wild Apricot oil are given in Tables 4 and 5. Among these oils the moisture content is in the range 3.0-9.9%. The moisture content of the sample seed oils in this study are generally low indicating that the seed oils could be stored for a long period.

index for light unsaturated fatty acids content.

Saponification value of apricot oil is 190. Saponification value is used in checking adulteration. The low saponification value suggests that the oil may not be industrially, useful. The high saponification values recorded for the seed oils suggest that the oils contain high molecular weight fatty acids and low level of impurities. This is evidence that the oil could be used in soap making industry (Kirsehenbauer, 1965; Amoo *et al.*, 2004).

Table 4. Proximate composition of some conventional oils and wild apricot seed oil (g/100 g)

Plant	Moisture (%)	Yield (%)	Protein (%)	Fiber (%)	Carbohydrate (%)
Soybean Seed Oil (*Sojamax*)	8.1	19.5	43.2	3.7	20.9
Mustard Seed Oil (*Brassica Compestris*)	8.5	39.7	20.0	1.8	23.8
Ground Nut Seed Oil (*Arachis hypogoes*)	3.0	40.1	25.3	3.1	26.1
Cotton Seed Oil (Genus *Gossypium*)	9.9	19.5	19.4	22.6	23.9
Linseed Oil (*Linum usitatissium*)	6.5	37.1	20.3	4.8	28.9
Sunflower Seed Oil (*Helianthus Annus*)	5.5	52.1	19.8	1.0	17.9
Coconut Oil (*Cocos mucifera*)	4.2	39.0	23.9	10.9	17.1
Almond Seed Oil (*Prunus arnygdalys*)	5.2	58.9	20.8	1.7	10.5
Wild Apricot Seed Oil (Prunus armeniaca L.*)*	*6.86*	*44.3*	*31.18*	*1.94*	*15.61*

Table 5. Physical attributes of some common edible seed oils and wild apricot seed oil

Plant	State at room temperature	Colour	Refractive Index (at 40°C)	Specific gravity at 25°C
Soybean Seed Oil (*Sojamax*)	Liquid	Yellow	1.4658	0.9172
Mustard Seed Oil (*Brassica Compestris*)	Liquid	Brownish Yellow	1.4655	0.9072
Ground Nut Seed Oil (*Arachis hypogoes*)	Semi solid	Colourless	1.4638	0.9136
Cotton Seed Oil (Genus *Gossypium*)	Liquid	Yellow colour	1.4642	0.9190
Linseed Oil (*Linum usitatissium*)	Liquid	Colourless	1.4736	0.9323
Sunflower Seed Oil (*Helianthus Annus*)	Liquid	Pale Yellow	1.4672	0.9182
Coconut Oil (*Cocos mucifera*)	Semi solid	Colourless	1.4486	0.9186
Almond Seed Oil (*Prunus arnygdalys*)	Liquid	Pale Yellow	1.4632	0.9176
Wild Apricot Seed Oil (Prunus armeniaca L.*)*	*Liquid*	*Pale Yellow*	*1.4638*	*0.9172*

The oil yield of *Prunus armeniaca* L. is 44.3% which is in comparable range to those of CUOs as reported in Nutritive value of Indian foods (Gopalan *et al*., 1971). This shows that seed oil of *Prunus armeniaca* L. may be used economically and commercially. In Table 6, a comparison is made among the chemical properties of CUOs with wild apricot oil. Acid value is an indicator for edibility of oil and suitability for industrial use. *Prunus armeniaca* L. has the acid value of 4.05 is nearest to almond seed oil, which is` already in use for edible purpose and this falls within the recommended codex of 0.6 and 10 for virgin and non-virgin edible fats and oil respectively (Dawodu, 2009). This essence suggests that the wild Apricot oil is suitable for edible purposes and also in the manufacture of paints and varnishes (William, 1966). The Iodine value of apricot oil is 102. Hence wild Apricot oil can be used in the manufacture of cosmetics oil paints and varnishes and also serve edible purposes because the iodine value is also an Apricot oil have approximately same ratio of saturated and unsaturated fatty acid as compared to CUOs e.g. mustard oil, cotton seed oil, soybean oil, linseed oil, almond oil , except coconut oil which contain high amount of saturated fatty acids (Table 6).

The results of comparison, in between different CUOs and wild apricot seed oil, clearly indicate that the values of chemical properties like acid value, iodine value, unsaponifiable matter, sapinifiable matter, free fatty acid, total saturated and total unsaturated are highly comparable in case of almond seed oil (*Prunus arnygdalys*) and wild apricot seed oil (*Prunus armeniaca* L.). Hence with these chemical values, the wild apricot seed oil may also be suggested as a good alternative for almond seed oil in industries and food purposes.

On comparison of wild Apricot oil with other conventional seed oils in Table 7 for their mineral composition, it is found that wild Apricot oils is almost having same mineral composition as in all the

Table 6. Chemical properties of some common edible seed oils and wild apricot seed oil

Plant	A.V[a].	I. V[b].	U. M[c].	S. V[d].	F.F.A[e] %	T. S[f]. (%)	T. U[g]. (%)
Soybean Seed Oil (*Sojamax*)	1.08	132.0	0.33	192	0.56	14.39	85.66
Mustard Seed Oil (*Brassica Compestris*)	1.21	108.0	0.35	174	0.59	8.79	91.21
Ground Nut Seed Oil (*Arachis hypogoes*)	3.98	88.0	0.62	193	1.74	13.11	81.89
Cotton Seed Oil (Genus *Gossypium*)	0.26	108.0	0.86	195	0.10	22.55	77.4
Linseed Oil (*Linum usitatissium*)	3.42	174.0	1.09	189	1.61	10.54	89.46
Sunflower Seed Oil (*Helianthus Annus*)	3.89	128.0	0.96	188	1.68	9.63	90.37
Coconut Oil (*Cocos mucifera*)	3.62	8.4	0.43	261	1.79	92.68	8.92
Almond Seed Oil (*Prunus arnygdalys*)	3.42	96.0	0.49	191	1.72	9.0	86.0
Wild Apricot Seed Oil (Prunus armeniaca L.)	*4.05*	*102.0*	*0.71*	*190*	*2.01*	*7.17*	*93.13*

a: Acid Value (mgKOH/g); b: Iodine Value; c:Unsaponifiable Matter (%w/w); d:Sapinifiable Matter (mgKOH/g); e: Free Fatty Acid (%); f: Total Saturated (%); g: Total Unsaturated (%)

Table 7. Mineral contents (mg/100 g) of common oils and wild apricot oil

Plant	P	Zn	Ca	Mg	K	Na	Fe	Cu
Soybean Seed Oil (*Sojamax*)	690.2	3.41	242.6	178.9	0.009	0.011	11.1	1.14
Mustard Seed Oil (*Brassica Compestris*)	694.3	4.86	492.1	0.034	0.019	0.007	8.11	0.84
Ground Nut Seed Oil (*Arachis hypogoes*)	349	3.91	86.4	0.048	0.007	0.011	2.62	0.92
Cotton Seed Oil (Genus *Gossypium*)	256	1.25	135.6	1.23	-	-	2.89	0.86
Linseed Oil (*Linum usitatissium*)	374	3.68	168.9	0.021	0.09	0.026	2.76	1.92
Sunflower Seed Oil (*Helianthus Annus*)	671.0	5.31	280.0	0.096	0.042	0.011	4.84	1.61
Coconut Oil (*Cocos mucifera*)	208	4.96	402.8	0.084	0.86	0.41	7.89	1.33
Almond Seed Oil (*Prunus arnygdalys*)	484	3.61	239.2	374.6	0.019	0.054	4.26	0.98
Wild Apricot Seed Oil (Prunus armeniaca L.*)*	*472*	*3.79*	*330.0*	*370.0*	*0.017*	*0.034*	*3.6*	*1.56*

Table 8. Fatty acid composition of some conventional seed oil and wild apricot oil

Fatty acid	Plants								
	Soybean Seed oil	**Mustard Seed oil**	**Ground Nut Seed Oil**	**Cotton Seed Oil**	**Linseed Oil**	**Sunflower Seed Oil**	**Coconut Oil**	**Almond Seed Oil**	***Wild Apricot* seed oil**
Caproic	-	-	-	-	-	-	-	0.28	-
Caprylic	-	-	-	-	-	-	-	7.64	-
Capric	-	-	-	-	-	-	-	8.12	-
Lauric	-	-	-	-	-	-	-	48.92	-
Myristic	0.51	-	-	0.38	-	-	16.08		*1.18*
Palmitic	8.41	1.52	7.28	20.01	6.12	4.61	9.96	7.0	*3.31*
Stearic	5.42	0.48	4.16	2.16	3.96	1.94	1.68	2.0	*2.68*
Oleic	26.54	22.3	58.2	35.1	19.22	27.22	6.56	69	*73.58*
Linolenic	8.12	6.8	-	-	48.1	7.22	-	-	-
Linoleic	51.0	14.11	23.69	4.23	22.14	55.93	0.76	17	*19.26*
Arachidic	-	4.37	3.22	-	0.46	2.26	-	-	-
Any Special fatty acid	-	Eurcic -48.5 Behenic -2.42	Ligocenic -1.61 Behenic -1.84	-	-	Behemic -0.82	Palmioleic-1.6	-	-

oils. It is rich in phosphorous, calcium, magnesium, iron and copper, which make it suitable for edible and commercial purpose. In oils fatty acids are the main constituents, fatty acids are merely carboxylic acids with long hydrocarbon chains. The hydrocarbon chain length may vary from 10-30 carbons. In fatty acids with only a few carbons, the acid functional group dominates and gives the whole molecule a polar character. In fatty acids, the non polar hydrocarbon chain gives the molecule a non polar character. There are two groups of fatty acids-saturated and unsaturated. The physico-chemical properties of oil are depends on these fatty acids. Fatty acid composition of Apricot oil is almost similar to almond seed oil (Table 8). This similarity of wild apricot oil with almond oil further support the high values of this oil.

Conclusion

The present study envisage that wild apricot seed oil (*Prunus armeniaca* L.) from the Garhwal region of India have almost same physico-chemical properties as in Almond (*Prunus arnygdalys*). Wild apricot seed have higher yield of oil over 40%, which is comparable to the oil yield of some commercial seed oils such as groundnut, mustard, linseed, Almond, Sunflower and coconut oil. Many of the physico-chemical properties of the seed oil studied have close similarity with other commercial seed oils. The results obtained from this study could be used as baseline data to develop wild apricot oil (*Prunus armeniaca*) for both domestic and industrial purposes and also for promotion and cultivation of this tree with a sustainable manner in the Garhwal region for large scale production of oil.

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