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REVIEW

Value addition of wild apricot fruits grown in North–West Himalayan regions-a review

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Abstract Wild apricot (*Prunus armeniaca* L.) commonly known as *chulli* is a potential fruit widely distributed in North-West Himalayan regions of the world. The fruits are good source of carbohydrates, vitamins, minerals besides having attractive colour and typical flavour. Unlike table purpose varieties of apricots like New Castle, the fruits of wild apricot are unsuitable for fresh consumption because of its high acid and low sugar content. However, the fruits are traditionally utilized for open sun drying, pulping to prepare different products such as jams, chutney and naturally fermented and distilled liquor. But, scientific literature on processing and value addition of wild apricot is scanty. Preparation of jam with 25 % wild apricot +75 % apple showed maximum score for organoleptic characteristics due to better taste and colour. Osmotic dehydration has been found as a suitable method for drying of wild type acidic apricots. A good quality sauce using wild apricot pulp and tomato pulp in the ratio of 1:1 has been prepared, while chutney of good acceptability prepared from wild apricot pulp (100 %) has also been documented. Preparation of apricot-soy protein enriched products like apricot-soya leather, toffee and fruit bars has been reported, which are reported to meet the protein requirements of adult and children as per the recommendations of ICMR. Besides these processed products, preparation of alcoholic beverages like wine, vermouth and brandy from wild apricot fruits has also been reported by various researchers. Further, after utilization of pulp for preparation of value added products, the stones left over have been successfully utilized for oil extraction which has medicinal and cosmetic value. The traditional method of oil extraction has been reported to be unhygienic and result in low oil yield with poor quality, whereas improved mechanical method of oil extraction has been found to produce good quality oil. The apricot kernel oil and press cake have successfully been utilized for preparation of various value added products such as facial cream, lip balm, essential oil and protein isolate with good quality attributes and consumer acceptability. However, no scientific information on utilization of shells remained after kernel separation is available, but the shells are traditionally utilized for burning purpose during winters by the farmers. Therefore, it seems that every part of wild apricot can be utilized for conversion into value-added products and commercial utilization of this fruit will certainly add value to this underutilized fruit and also increase the economy of farmers.

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Introduction

Wild apricot (*Prunus armeniaca* L.) is an important stone fruit widely grown in the temperate regions of the world. Turkey, Italy, Greece, Spain, USA and France are the major producers of this fruit (Ghorpade et al. 1995). In North–Western Himalayan regions, it is found growing wild in cold desert region of Tibet, southern part of China and northern India comprising temperate regions of Jammu & Kashmir, Himachal Pradesh and Uttarakhand ranging between 2000 and 2500 m above mean sea level (Parmar and Kaushal 1982; Parmar and Sharma 1992; Sharma 2000). Wild apricot fruits popularly known as *chulli* are round to oblong, hairy when young but smooth yellow or reddish yellow when ripe, sour in taste; ripens in May–August as per altitude and full bearing tree can yield 35–75 kg fruits (Parmar and Kaushal 1982; Sharma 1994). The fruits are anti-diarrhoeal, anti-pyretic, emetic, allaying thirst whereas; the seeds are tonic used in liver troubles, piles, earache and deafness (Parmar and Kaushal 1982). In contrast to table purpose varieties of apricot like Charmagaz, New Castle and Shakarpara, the fruits of wild apricot are unsuitable for fresh consumption due to high acid, low sugar contents and poor sensory acceptability (Lal et al. 1989; Gandhi et al. 1997; Sharma et al. 2011). The major portion of this crop is utilized to express oil used locally for cooking and burning and for preparation of distilled alcoholic liquor at home levels by the tribal peoples, especially in northern India (Parmar and Sharma 1992; Sharma et al. 2002; Sharma et al. 2004b). The pulp of this fruit is sometimes mixed with those of cultivated types for producing a number of products like jam, chutney and nectar; however, it is not processed commercially into any profitable value added product so far. In this article, efforts have been made to present the information available in the literature on various aspects like physico-chemical characteristics of fruit, processing and value addition, by-product utilization of wild apricot growing in North–West Himalayan regions.

Physico-chemical characteristics of wild apricot

Physico-chemical characteristics of fruit, pulp/fleshy part and kernel of wild apricot recorded by various workers are given in Table 1. Wild apricot fruit is a drupe, velvety when young, but nearly smooth at maturity, round to oblong. Among various physical characteristics; the fruit weight ranged between 8.0 to 15.1 g, diameter from 2.3 to 2.5 cm and pulp ranged between 77.8 to 87.3 %, whereas the pulp to stone ratio varied between 3.5 to 6.9:1 (Sharma 1994; Gupta et al. 2009). The total soluble solid contents in wild apricot fruit pulp ranged from 6.5–18.0°B. The acidity ranged between 1.6–3.4 percent, contains total sugars contents 6.30 percent and 9.95 mg per 100 g of pulp is the vitamin C contents (Parmar and Kaushal 1982). The Stone recovery in wild apricot is 12.7 to 22.2 percent, kernel recovery of 30.7–33.7 percent which gives 45.6 to 46.3 percent of oil (Gupta et al. 2009; Gupta and Sharma 2009). Whereas, range of stone length, breadth and thickness from 14.64–26.48, 12.26–21.49 and 8.63–14.65 mm, respectively has been reported by Kumar and Bhan (2010) with oil content to vary between 50.05 to 57.97 %.

Table 1 Physico-chemical characteristics of fruit, pulp and kernel of wild apricot

Parameters	Values	Reference
Fruit		
Weight of fruit, g	8.0–15.1	Parmar and Sharma (1992), Sharma (1994), Gupta et al. (2009)
Size of fruits		
(i) Horizontal diameter, mm	24.0–26.7	
(ii) Vertical diameter, mm	22.4–25.0	
Pulp recovery, %	77.8–87.3	
Stone recovery, %	12.7–22.2	
Pulp/Stone ratio	3.5–6.9	
Edible portion (per 100 g Pulp)		
TSS, °B	6.5–18.0	Parmar and Kaushal (1982), Parmar and Sharma (1992), Sharma (1994), Karadeniz and Islam (1995)
Acidity, %	1.6–3.4	
pH	3.26–5.74	
Total sugars, %	6.30–8.50	
Pectin, %	2.52–5.0	
Vitamin C, mg	9.95–11.20	
Riboflavin, mg	0.53–1.02	
Nicotinic acid, mg	1.89–2.96	
Protein, %	0.67–1.32	
Fat, g	0.2–0.5	
Ash, g	0.6–0.9	
Fiber, g	0.8–1.6	
Carbohydrates, g	33.1–45.7	
Stone, Kernel and Oil		
Kernel weight, g	0.58–0.60	Aggarwal et al. (1974), Gandhi et al. (1997), Dwivedi and Ram (2008), Gupta et al. (2009), Gupta and Sharma (2009), Kumar and Bhan (2010)
Kernel recovery, %	27.0–57.97	
Size of stone:		
(i) Length., mm	12.9–26.48	
(ii) Breadth, mm	10.1–21.49	
(iii) Thickness, mm	8.63–14.65	
Moisture in kernel, %	4.0–4.1	
Oil recovery, %	45.6–57.97 %	
Presence of HCN in kernels	Yes	

TSS Total soluble solids; *HCN* Hydro-cyanic acid

Processing of wild apricot fruit into different value added products

The fresh fruits of wild apricots are not generally eaten because of their high acid content than those of the cultivated types. Traditionally, the fruits are however sun-dried to make *chalori*, which is used as a souring agent in many food preparations like '*chaat*' by the local tribal in Himachal Pradesh (Parmar and Kaushal 1982). Drying is one of the commonly used methods for apricot preservation. Osmotic dehydration applied for food dewatering can be used as a pre-treatment in the drying process (Lenart 1996). Though, osmotic dehydration is used for drying of commercial apricots (Forni et al. 1997; Riva et al. 2005; Khoyi and Hesai 2007), but can also be used for drying of low quality as well as wild type of apricots (Sharma et al. 2004a). Sharma et al. (2000) has reported that osmotic dehydration of apricot fruits in hypertonic solution enhanced the quality of dried fruits to a great extent by increasing the sugar content, reducing acidity and preventing the loss of natural flavour. Sharma et al. (2004a) standardized the unit operations for osmotic dehydration of wild apricots which include lye peeling of fruits followed by immersion in 70°B sugar syrup containing 0.05 % citric acid for 6 h then dehydration in a cabinet drier (60±2 °C).

Bhardwaj (2000) has prepared a palatable jam by cooking wild apricot fruit pulp and sugar in 1:1 ratio without addition of acid because of the high acidity of fruits. Hussain and Shakir (2010) made efforts to utilize wild apricot by converting into jam in combination with apple. Different formulations viz. F1 (100 % apple), F2 (75 % apricot +25 % apple), F3 (50 % apricot +50 % apple) and F4 (25 % apricot +75 % apple) were attempted and analyzed for physico-chemical and sensory quality attributes. It was found that jam prepared with 25 % apricot +75 % apple showed maximum score for organoleptic characteristics due to better taste and colour.

Preparation of sauces and chutney from *chulli* has also been attempted by Lal et al. (1989). They found that *chulli* sauce prepared by using *chulli* fruit pulp and tomato pulp in the ratio of 1:1 rated best (Table 2). They further reported good quality wild apricot chutney (100 % pulp) which was indistinguishable from that prepared from cultivated apricot (New Castle). Sharma et al. (2002) developed instant chutney powder from wild apricot. The wild apricot powder (250 g), onion powder (200 g), garlic powder (50 g), sugar 250 g), salt (100 g) and mint powder (50 g) along with grounded spices (100 g) were mixed properly and a fine powder was prepared which was then packed in PE pouches to use it as instant chutney powder after adding boiled water in 1:3 ratio.

Chauhan et al. (1993) reported apricot-soy slurry enriched bars using different combinations viz; 80:20, 70:30, 60:40 and 50:50 with total soluble solids raised to 30°Brix by using sugar syrup. The mixture after adding SO_2 @ 50 ppm was spread on trays (45×30 cm) for dehydration at 65±1 °C in a mechanical drier for 14 h. The acceptability of these bars was assessed by a panel of 10 judges and it was concluded that the apricot pulp + soya slurry in ratio of 70:30 resulted in ideal product meeting the protein requirements of adult (0.7–2.0 g protein/kg) and children (1.2–2.0 g protein/kg) as per the recommendations of ICMR. However, Thakur et al. (2008) reported a method for preparation of protein enriched apricot-soya leather by using apricot pulp: soy slurry in 85:15 ratio. Sharma et al. (2011) optimized a recipe consisting of wild apricot pulp +60 % sugar +0.30 % pectin for preparing good quality fruit bar by drying in a mechanical dehydrator at 55±2 °C for 6 h. They reported least quality loss in fruit bars (only 3 % moisture gain) packed in aluminium laminated pouches during six months storage (Table 3). Whereas, Thakur et al. (2007) optimized a method for preparation of apricot-soya toffee and reported decrease in total sugars during storage.

Canning is another method of preservation and for canning of apricot; the fruits may be peeled before canning or canned with the skins. Though, this method of preservation is largely used for canning of commercial apricots, but can be used for low quality wild apricots. According to USDA (1988), dipping of apricots in boiling water for 30–60 s remove the skin. However, at least 4 % lye concentration is required for a satisfactory peeling of low sugar apricots prior to canning (Manolopoulou and Mallidis 1999). Singh et al. (1992) studied the suitability of apricots grown in Ladakh for canning and found that the fruits which were rich in TSS retained higher TSS in syrup of canned product while those fruits containing high acid contents retained soft texture after canning.

Further, alcoholic beverages like wine, vermouth and brandy etc. can also be prepared from wild apricot fruits even having high acidity (Joshi et al. 1990; Joshi and Sharma 2004). Amerine et al. (1982) reported that a wine can be prepared from any fruit having fermentable sugar and

Table 2 Sensory evaluation of sauces and chutney prepared from wild apricot fruits

Products	Colour (20)	Consistency (20)	Flavour (40)	Acid/Sugar/ Salt bend (20)	Overall score (100)
Sauces					
Wild apricot pulp (100 %)	12.94	17.00	24.81	13.50	68.25
Wild apricot pulp (75 %) + Tomato pulp (25 %)	14.50	17.00	25.50	14.50	71.50
Wild apricot pulp (50 %) + Tomato pulp (50 %)	16.50	17.75	28.50	16.63	79.38
Tomato pulp (100 %)	16.00	17.50	28.50	15.50	77.50
Chutney					
Wild apricot pulp (100 %)	17.00	21.25	22.00	16.75	77.00
Apricot (New Castle) pulp (100 %)	16.50	19.75	22.50	16.75	75.50

Lal et al. (1989)

Table 3 Effect of packaging material and storage atmosphere on quality characteristics of wild apricot fruit bars during storage

Characteristics	Packaging material			Storage atmosphere		
	PP	ALP	$CD_{0.05}$	Normal	Vacuum	$CD_{0.05}$
Moisture, %	20.4	20.1	NS	20.9	20.0	NS
Reducing sugars	47.5	45.9	0.9	48.4	45.1	0.9
Total sugars	70.0	70.5	0.4	70.0	70.8	0.4
Titratable acidity, %	2.5	2.5	NS	2.5	2.5	NS
Ascorbic acid, mg/100 g	8.9	9.1	NS	8.7	9.3	0.3
Overall sensory quality	7.4	7.5	0.1	7.4	7.6	0.1

PP Polythene pouches; *ALP* Aluminium laminated pouches

Sharma et al. (2011)

nutrients required for fermentation. Abrol and Joshi (2011) have developed a method for the preparation of wine and mead from wild apricot, which consists of diluting the pulp in the ratios of 1:2, addition of 0.1 % di-ammonium hydrogen phosphate (DAHP) and 0.5 % pectinol, total soluble solids of 24°B (26°B in case of mead) followed by fermentation with *Saccharomyces cerevisiae* var *ellipsoideus*. In case of wine, TSS was raised by using cane sugar, whereas for apricot-honey wine (apricot mead), honey was used as source of sugar. Further, maturation of wild apricot wine and mead with different wood chips (*Quercus, Bombax* and *Acacia*) was also reported (Abrol et al. 2011). A sensory comparison of two sources of fermentable sugars is shown in Fig. 1. Brandy can also be prepared from wild apricot (Joshi et al. 1990). The pulp is diluted in 1:1 ratio with water fortified with 0.1 % DAHP and fermented to completion with TSS of 25°B. The wine is then, distilled to make brandy. The brandy made from 1:1 diluted pulp was superior to that from 1:2 dilutions. Attempts were also made to prepare vermouth from wild apricot fruits with respect to alcohol content, sugar level and spices quantity (Panesar et al. 2011). For preparation of vermouth, herbs and spices are added to a fortified wine with 15–21 % alcohol to impart an aromatic flavour (Amerine et al. 1982). Whereas, according to Joshi (1997) spices have to be immersed and gently heated for 10 min for 10 days continuously so as to get a good flavour. A comparison of physico-chemical characteristics of wild apricot wine, mead and vermouth is made in Table 4.

By-product utilization

During processing of these wild apricot fruits, a huge quantity of stones left after utilization of edible portion is thrown as a waste. However, these stones can be utilized for extraction of kernel oil for meeting the demand of edible oil and for its further use in various edible and industrial preparations (Sharma et al. 2004b; Gupta and Sharma 2009). The oil can be extracted by physical means or by solvent extraction. Physical means consisted of different unit operations like crushing of stones, separation of kernels from crushed mass, expression of oil, filtration or decantation and packing. Breaking of stones of apricots is the most time-

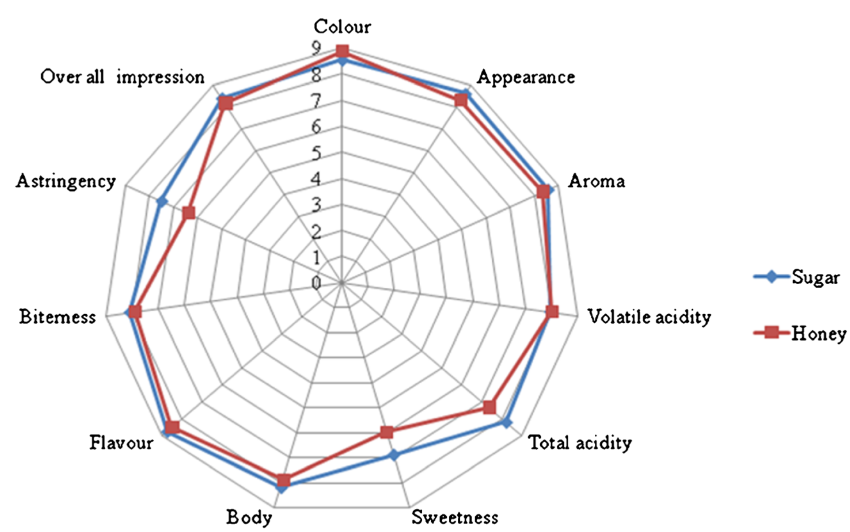

Fig. 1 Sensory quality of wild apricot wine of different sources of sugars. Source: Abrol and Joshi (2011)

Table 4 Physico-chemical characteristics of wild apricot wine, mead and vermouth

Characteristics	Wine	Mead	Vermouth
Total soluble solids, °B	8.57	8.37	17.23
Reducing sugars, %	0.35	0.44	5.46
Total sugars, %	1.28	1.18	10.16
Titratable acidity, %	0.80	0.81	0.78
Ethanol, %v/v	11.70	9.86	17.10
Total esters, mg/l	124.7	117.7	262.7
Total phenols, mg/l	264.0	255.0	451.6
Total carotenoids, mg/l	0.78	0.73	1.120

Abrol and Joshi (2011); Abrol et al. (2011); Panesar et al. (2011)

consuming and difficult unit operation. Traditionally, in some parts of J & K, Uttrakhand and Himachal Pradesh, the stones of *chulli* are crushed manually during the lean season (snowy winters) for removal of kernels. The oil from these kernels is extracted manually by grinding in pestle and mortar (made of wood and stone) followed by pressing the paste in between hands (Sharma et al. 2004b; Dwivedi and Dwivedi 2007; Targais et al. 2011). Besides, low oil yield, this method is quite cumbersome and time consuming (Sharma et al. 2004b). Reddy and Azeemoddin (1995) have developed a hand-operated decorticator for stone decortication. It is a type of roller crusher, consists of two rollers moving in inward opposite directions with help of 3HP motor, provided with a hopper and feeder assembly. The clearance between rollers is adjusted on basis of stone size. Sharma et al. (2004b) has reported 71–85 % breaking of stones of apricot fruits using mechanical decorticator, whereas; Gupta and Sharma (2009) reported 85.4–86.5 % breaking of wild apricot stones.

After decortication, the kernels are required to be separated from the mixture which is again a tedious and time consuming operation. Schab and Yannai (1973) reported that the apricot kernels can be separated from crushed mass using a salt solution having specific gravity of 1.158 (20 % salt solution), whereas Sharma et al. (2004b) with 1.036, 1.078, 1.115, 1.158 specific gravities noticed the separation of 5.27, 43.76, 91.38, 100.0 % kernels, respectively. Further, Gupta et al. (2009) also found that the dipping of crushed mass in 25 % salt solution results in maximum kernel separation.

The oil yield from apricot kernels by using oil press is reported to be to be 40.42 % (Aggarwal et al. 1974) against the oil recovery of 50.90 % through solvent extraction method. While, Sharma et al. (2004b) recorded wild apricot oil yield of 34.5 % by using oil press against the value of 45.03 % in solvent extraction. Gupta et al. (2009) compared different methods for extraction of *chulli* oil and reported an oil yield of 28.5–29.0 percent (oil press), 31.5–32 percent (baby oil expeller) and 42–44.5 percent (table oil expeller) against 46–48.5 percent oil obtained from solvent extraction using petroleum ether as solvent. Naude et al. (1998) also found the solvent extraction as a better technique for extracting lipids, but the method is costly and can not be used for commercial extraction of oil.

Various physico-chemical characteristics of wild apricot kernel oil reported by different researchers is given in Table 5. The wild apricot kernel oil has a typical apricot odour and visual appearance is usually light pale yellow to deep yellow (Sharma et al. 2004b; Gupta and Sharma 2009). The specific gravity of oil ranged from 0.914 (at 25 °C) to 0.960 (at 20 °C). The iodine value which is the measure of degree of unsaturation of oil ranged from 87.2 to 123.0 in kernel oils of wild and low quality apricots grown in different regions of North–Western Himayala (Table 5). However, iodine value of the almond oil specified under Indian Food Laws is reported to range between 90 and 109 (Anonymous 1996). Further, acid value determines the amount of free fatty acids present in the oil and is the indicator of hydrolytic rancidity (Nawar 1985). According to Prevention of Food Adulteration Act 1954, the acid value in kernel oil should not be more than 6.0 mg KOH/g oil; however it varied from 1.07 to 10.0 as reported by different workers (Table 5).

Further, the wild apricot kernel oil has been found to be rich in polyunsaturated fatty acids comprising of linoleic acid (18.43–27.76 %) besides the presence of oleic acid as mono-unsaturated (62.07–70.93 %). The predominant saturated fatty acid was palmitic acid representing 7.5–8.5 % of the total fatty acid composition (Sharma et al. 2004b). Further, Dwivedi and Ram (2008) has also reported that oil of wild apricot grown in Ladakh region is predominated by oleic acid which varied from 70.52 to 75.99 % followed by linoleic acid (14.3–22.83 %), palmitic acid (3.50–5.04 %), palmitoleic acid acid (0.56–0.91 %), stearic acid (0.34–1.22 %) and arachidic acid (0.08–0.39 %).

The kernel oil obtained from wild apricot has been traditionally used by the tribe of Himachal Pradesh as oil for cooking to replace ghee. It is also used as baby oil, hair oil and is used as cosmetic oil due to its softening and moisturizing effect on skin and massaging oil for relieving joint pain etc (Sharma et al. 2004b). Dwivedi and Dwivedi (2007) have reported that wild apricot (*Chulli*) oil is used for cooking, lighting prayer lamps and also for cosmetic uses in the remote villages of Ladakh. However, Targais et al. (2011) reported that oil of wild apricot grown in Ladakh region is popularly known as body oil to relieve backache and joint ache. It has also been found that applying warm apricot oil mixed with a pinch of common salt on chest give relief to patients with acidity. Further, Ullah et al. (2009) has also highlighted the potential of wild apricot kernel oil for biodiesel production with fuel properties comparable to those of mineral diesel.

Owing to presence of poly unsaturated fatty acids (PUFA), the wild apricot kernel oil has been found

Table 5 Physico-chemical composition of wild apricot kernel oil

Characteristic	Values	References
Visual appearance/colour	Yellowish	Sharma et al. (2004b)
	Light yellow to deep yellow	Gupta and Sharma (2009)
Refractive index, 40 °C	1.465	Aggarwal et al. (1974)
	1.4672–1.4689 (Ladakh)	Kapoor et al. (1987)
	1.460–1.475	AOCS (1998)
	1.472	Sharma et al. (2004b)
Specific Gravity at 25 °C, g/cm^3	0.917	Aggarwal et al. (1974)
	0.915	Anonymous (1976)
	0.914	Sharma et al. (2004b)
	0.910	Ullah et al. (2009)
Iodine value, g I_2/100 g oil	87.2	Dhar and Chauhan (1963)
	109.9–99.58	Dang et al. (1964)
	80.82–123.0	Kapoor et al. (1987)
	98–110	Chakarborty and Talapatra (1965)
	100.2–100.4	Gupta and Sharma (2009)
	103.0	Ullah et al. (2009)
Saponification value, mg KOH/g oil	188.8	Aggarwal et al. (1974)
	190.2–194.4	Sharma et al. (2004b)
	189.8–191.3	Gupta et al. (2009)
	185.0	Ullah et al. (2009)
Acid value, mg KOH/g oil	3.6	Aggarwal et al. (1974)
	Not more than 6.0	Anonymous (1996)
	2.26–4.31	Sharma et al. (2004b)
	5.12–5.27	Gupta et al. (2009)
	1.70	Ullah et al. (2009)
Peroxide value, meq/kg oil	Not more than 10.0	Anonymous (1996)
	5.39	Sharma et al. (2004b)
	5.12–5.27	Gupta et al. (2009)

susceptible to spoilage during storage generally called rancidity, which reduces its shelf-life (Nawar 1985; Sharma et al. 2004b). Among different factors affecting the quality of apricot kernel oil during storage include packaging material, storage condition, headspace, exposure to light and other factors (Nawar 1985; Sharma et al. 2004b; Sharma et al. 2006). Various authors have found good improvement in quality of wild apricot kernel oils by packing in amber coloured glass bottles (ACGB) during storage up to six months (Sharma et al. 2004b; Sharma et al. 2006; Gupta et al. 2009). Further, Gupta and Sharma (2009) have reported that the storage of apricot kernel oil up to 6 months did not exhibit any adverse changes in its chemical constituents when packed in coloured glass bottles and polyethylene pouches after adding tert-butylhydroquinone (TBHQ) @ 0.02 % and remained well within the specifications for almond oil as per Prevention of Food Adulteration (PFA) Act.

On the other hand, the press cake, left after oil extraction is considered unfit for human consumption and as cattle feed due to presence of hydro-cyanic acid, however can be utilized as fuel and fertilizer. The press cake from bitter apricot kernels yield 1.6 % essential oil as compare to 0.5 % from kernels, the essence is identical to that of almond essential oil (Anonymous 1976). Sharma et al. (2010a) reported that the bitter apricot kernel press cake yields about 1.6 per cent of essential oil, which can be used for flavouring different food products. The treatment consists of diluting press cake with water (1:10) followed by distillation and re-distillation to remove HCN (Sharma et al. 2010a). According to Singh (1951), the apricot cake from which the essential oil has been removed is free of hydro-cyanic acid and can be used as feed stuff for livestock. The left over press cake is also high in proteins, vitamins, minerals etc. and can be utilized for preparation of protein isolates/protein concentrates after detoxification. Sharma et al. (2010b) reported that the dilution of press cake with water in 1:20 ration (w/v) followed by boiling for 60 min resulted in free flowing slurry with better yield and is recommended for detoxification of press cake. The maximum solubility (87 %) was observed during solubilization at pH 8 followed by coagulation of filtrate at pH 4 which gave highest protein isolate yield (24.3 %) with 71.3 % extraction efficiency. The protein isolate can be utilized for the improvement of nutritional status of many food formulations.

The shells of wild apricot fruit stones which still remained after kernel separation as waste has been reported to be utilized for burning purposes during winters by the local farmers (Dwivedi and Dwivedi 2007; Targais et al. 2011). However, no scientific information on utilization of these shells for preparation of value added products like scrub etc. is lacking. Therefore, it seems that every part of wild apricot can be utilized for conversion into value-added products and hence, commercial utilization of this fruit certainly will add value to this underutilized fruit crop besides increasing the economy of farmers.

Conclusion

Conclusively, it emerges that wild apricot commonly known as *Chulli* is a potential stone fruit of North–West Himalayan regions. The fruits are said to possess many nutritional and medicinal properties. However, these are not put to any profitable use at present and most of it is wasted, although studies for preparation of jam, sauces, chutney and fruit bars from this fruit has given quite encouraging results. Its stones left after processing, can be utilized successfully for extraction of oil with modern technologies in a profitable manner. The oil can be used for cooking, lighting prayer lamps and for cosmetic uses like hair oil, body oil, production of biodiesel etc. The wild apricot oil can also be used as a substitute for almond oil. The left over press cake which contain good amount of proteins, vitamins and minerals can be utilized for preparation of protein isolates/protein concentrates after detoxification. Therefore, complete utilization of this wild fruit for preparation of different value added products can help economically the rural people of the regions while providing nutritious products to the consumers. Further, whatever the efforts have been made by various researchers for utilization of this valuable crop for preparation of various value added products, its potential still has not been harnessed to a considerable level. The panorama of research and development on utilization of *chulli* fruits compiled here reflects that sporadic and inconsistent work has been carried out and efforts are still need to uplift this crop to a commercial level.

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