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ORIGINAL ARTICLE

Utilization of wild apricot kernel press cake for extraction of protein isolate

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Abstract The kernels of apricot (*Prunus armeniaca*) stones are utilized for extraction of oil. The press cake left after extraction of oil was evaluated for preparation of protein isolate for its use in food supplementation. The apricot kernels contained 45–50% oil, 23.6–26.2% protein, 4.2% ash, 5.42% crude fibre, 8.2% carbohydrates and 90 mg HCN/100 g kernels, while press cake obtained after oil extraction contained 34.5% crude protein, which can be utilized for preparation of protein isolates. The method standardized for extraction of protein isolate broadly consisted of boiling the press cake with water in 1:20 (w/v) ratio for 1 h, raising pH to 8 and stirring for a few min followed by filtration, coagulation at pH 4 prior to sieving and pressing of coagulant for overnight and drying followed by grinding which resulted in extraction of about 71.3% of the protein contained in the press cake. The protein isolate contained 68.8% protein, 6.4% crude fat, 0.8% ash, 2.2% crude fibre and 12.7% carbohydrates. Thus the apricot kernel press cake can be utilized for preparation of protein isolate to improve the nutritional status of many food formulations.

Keywords Apricot kernels · Press cake · Crude protein · Protein isolate · HCN

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Introduction

Apricot (*Prunus armeniaca* L.) is an important temperate fruit, each and every part of which is useful for mankind. The apricot is commercially cultivated in different parts of the world and in India, it is grown in Himachal Pradesh, Jammu and Kashmir, Uttrakhand and to a limited extent in the Nilgiris. The apricot fruits due to their perishable nature are used as fresh and are also used for preparation of different value-added products. After processing, the stone/pits left are thrown as a waste leading to environmental pollution. However, the apricot kernels obtained from these stones is a good source of edible oil (45–50%) containing high amount of unsaturated and polyunsaturated fatty acids like linoleic and linolenic acid besides oleic acid as monounsaturated and is reported to be good for all skin types including aged skin and dry or irritated skins (Anon 2003). According to Gutfinger et al. (1972), the apricot oil owing to the presence of tocopherols (630 μg/g) can find place in many cosmetic preparations.

Hallabo et al. (1977) reported that apricot kernel contained 28% protein and 52% oil whereas, almond contained 21% protein and 52% of oil. Apricot kernels mainly consist of low molecular weight protein and albumin is the main protein fraction (Abd El-Aal et al. 1986). The press cake left after extraction of oil from bitter kernels of almond is the source of essential oil commercially known as bitter almond oil. The essential oil does not exist as such in the kernels but in the form of cyanogenic glucoside-amygdalin (C_{20} H_{27} NO_{11}- mandelo nitrile genitobioside). The residue, which is free from HCN, can be used as an animal feed or for isolation of proteins. Chemically, the apricot kernels are known to contain 4.3% moisture, 31.4% proteins, 53.4% oil, 8.1% sugar as dextrose, 4.8% fibre and 2.6% ash (Winton and Winton

Table 1 Standardization of conditions for removal of HCN[a] from apricot press cake prior to extraction of protein isolate

(Press cake : water ratio)	Boiling time, min	Residual HCN, mg/100 g	HCN removed,%
1 : 10	15	58.5	35.2
1 : 10	30	53.3	42.0
1 : 10	45	13.5	85.0
1 : 10	60	10.5	89.3
1 : 20	15	52.2	43.0
1 : 20	30	45.0	50.0
1 : 20	45	7.1	92.1
1 : 20	60	0	100
$CD_{0.05}$	–	2.65	6.43

[a] Initial HCN in press cake 90 mg/100 g

1950). 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 bitter component. Therefore, the press cake left after extraction of apricot kernel oil being high in protein contents can be utilized for preparation of protein isolate after detoxification.

Materials and methods

The wild apricot (*Prunus armeniaca* L.) stones collected from temperate regions of Himachal Pradesh were utilized for the studies. The kernels obtained after decortication of stones and separation are utilized for extraction of oil by oil expeller and the press cake was used for extraction of protein isolate. The press cake contains bitter and toxic compound HCN, therefore, detoxification of cake before extraction of isolate is important. The press cake was diluted with water in 1:10 and 1:20 ratio and boiled for 15, 30, 45 and 60 min and the presence of residual HCN was evaluated at different intervals. Further for preparation of protein isolate from the press cake with water in 1:20 (w/v) ratio was the most appropriate for handling and preparation of extract (Gandhi et al. 2000). However, for solubilization of proteins from the press cake the conditions were optimized by maintaining the pH of extract at 7, 8 and 9 by using 0.1 N NaOH. Further, for coagulation of protein isolate, the pH of the filtrate was maintained between 4 and 5 by using 1% citric acid followed by filtration. The optimum pH for maximum solubility and coagulation of proteins was worked out by measuring protein isolate yield, extraction efficiency and protein concentration in protein isolate. Total proteins and ash contents (AOAC 1984), crude fibre (Sankaram 1966), crude fat (Ranganna 1986) and water and oil absorption capacity of protein isolate (Rosario and Flores 1981) were determined. For determining emulsification capacity of protein isolate, the emulsion was prepared according to the method given by Sathe and Salunkhe (1981) and foam capacity was determined at pH 7 (Coffmann and Garsia 1977). The data was statistically analyzed by using completely randomized design (Cochran and Cox 1967) and triplicate determinations were made for each parameter.

Results and discussion

The apricot kernel press cake left after extraction of oil initially contained 7.2% moisture, 34.3% protein, 9.7% crude lipids, 10.8% crude fibre, 27.5% carbohydrates and inherent HCN content was 90 mg/100 g press cake. Boiling of slurry (press cake and water in 1:10 proportion) for 15, 30, 45 and 60 min removed 35.2, 42, 85 and 89.3% HCN from the press cake, respectively (Table 1) and the slurry obtained was found quite thick and difficult to filter resulting in very low extract yield. However, dilution of press cake with water in 1:20 (w/v) proportion followed by boiling for 15, 30, 45 and 60 min brought about 43.0, 50.0, 92.1, and 100% removal of HCN, respectively. Thus 1:20 (w/v) dilution of press cake with water followed by boiling for 60 min resulted in the free flowing slurry with better yield and thus recommended for detoxification of press cake prior to its use for extraction of protein isolate.

The protein solubility increased from 5 to 87% beyond pH 4 up to pH 8 and at pH 2 only 20% proteins got solubilized (Table 2). The maximum solubility (87%) was obtained at pH 8, and then the solubility decreased to 82% at pH 10. Among all combinations, the treatment consisting of protein solubilization at pH 8 and coagulation of filtrate at pH 4 gave highest protein isolate yield (24.3%), with an extraction efficiency of 71.3% and highest protein content

Table 2 Influence of pH on protein solubility of apricot press cake

pH	Protein solubility,%
2	20
3	15
4	5
5	10
6	35
7	60
8	87
9	85
10	82
(n=3)	

Table 3 Standardization of conditions for solubilization and coagulation of protein isolate from apricot kernel press cake

Treatment[a]	Protein isolate yield,%	Extraction efficiency,%	Protein in protein isolate,%
pH 7→4	14.8	43.5	59.5
pH 7→5	13.5	39.7	58.1
pH 8→4	24.3	71.3	68.8
pH 8→5	22.2	65.2	65.7
pH 9→4	18.3	53.9	64.4
pH 9→5	16.3	47.8	63.0
$CD_{(0.05)}$ (n=3)	0.25	0.66	0.41

[a] Refer to solubility of protein isolate at pH 7, 8, 9 and coagulation at pH 4 and 5 in combinations

(68.8%) was recorded in the protein isolate (Table 3). Gandhi et al. (2000) prepared protein isolate from soy meal by extraction with 0.2 M NaOH in meal to water ratio of 1:20 at pH 9 and coagulation of proteins at pH 4.5 by using 1 M H_2SO_4. The treatment yielded 45% protein with 91% protein in the isolate. Keeping in view the optimized conditions, the methodology has been standardized for extraction of protein isolate from the press cake (Fig. 1).

Composition and functional properties of protein isolate

The proximate composition and functional properties of protein isolate prepared under optimized conditions are presented in Table 4. In confirmation to these results, Rahma and Abd El-Aal (1988) also recorded almost similar (1.38 g/g protein) water absorption capacity in defatted peach flavour. Emulsification capacity of protein isolate was 5.5 ml/g, while foam capacity represented as percent (%) increase of volume upon foaming was observed to be 21%. The duration for stabilization of foam represented by foam stability was 3 h. The results are statistically significant and match with the standard pea and soybean protein isolate having water absorption capacity 1.7±0.1 and 1.3±0.1, and oil absorption capacity 9.2±0.1 and 1.1±0.1, respectively. Further the foam stability (%) was observed 94±4 and 93±3, respectively for pea and soybean protein isolate (Lecomte et al. 1993; Fernandez-Quintela et al. 1997). Thus the water and oil absorption capacity and foaming properties of apricot protein isolate were fairly good and can be used to fortify soft drinks and beverages to prepare protein enriched ready to serve drinks.

The extracted protein isolate can be utilized for the improvement of the nutritional status of many food formulations and it seems to be a profitable proposition. Thus, apricot kernel press cake can be utilized in extraction

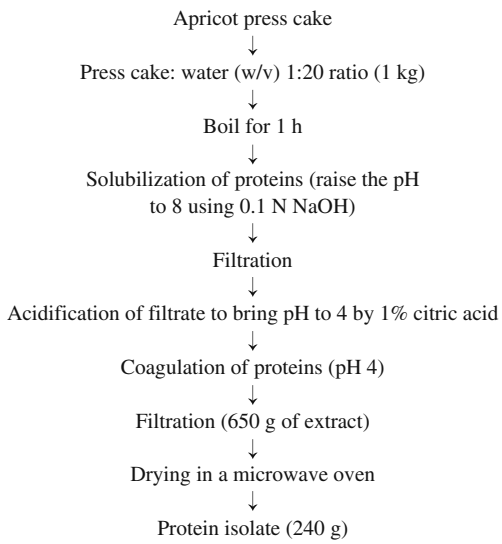

Fig. 1 Schematic diagram for preparation of protein isolate from apricot kernel press cake

Table 4 Composition and functional properties of protein isolate prepared under optimized conditions

Composition	
Moisture,%	9.1±0.08
Crude protein,%	68.8±0.02
Crude lipids,%	6.4±0.06
Total ash,%	0.8±0.01
Crude fibre,%	2.2±0.12
Total carbohydrate,%	12.7±0.26
Hydrocyanic acid, mg/100 g	0.0
Functional properties	
Water absorption capacity, g/g proteins	1.4±0.08
Oil absorption capacity, g/g proteins	1.4±0.06
Emulsification capacity, ml/g proteins	5.5±0.1
Foaming stability, h	3.0±0.7
Foam capacity (% increase)	21±0.8
Foam stability rate (% increase)	
0.0 min	21
15 min	12
30 min	11
45 min	10
60 min	9.5
(n=3)	

of protein isolate for its use in food supplementation in the food industry.

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