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Pabitra Subba
Department of Horticulture, Sikkim University
6th Mile, Tadong, Gangtok, Sikkim, India

Sujata Upadhyay
Department of Horticulture, Sikkim University
6th Mile, Tadong, Gangtok, Sikkim, India

VR Muddarsu
Department of Horticulture, Sikkim University
6th Mile, Tadong, Gangtok, Sikkim, India

S Manivannan
Department of Horticulture, Sikkim University
6th Mile, Tadong, Gangtok, Sikkim, India

Reymit Lepcha
Department of Horticulture, Sikkim University
6th Mile, Tadong, Gangtok, Sikkim, India

Correspondence
Sujata Upadhyay
Department of Horticulture, Sikkim University
6th Mile, Tadong, Gangtok, Sikkim, India

Determination of nutritional profile of Himalayan filbert (*Corylus ferox*)

Pabitra Subba, Sujata Upadhyay, VR Muddarsu, S Manivannan and Reymit Lepcha

Abstract
Himalayan filbert (*Corylus ferox*) is one of the indigenous underutilized fruit crops of the State of Sikkim. The study has been conducted at Department of Horticulture, Sikkim University, Gangtok during 2014-15 with an objective to determine the various dietary nutrients of Himalayan filbert (*Corylus ferox*). The Himalayan filbert fruits were collected from all the four districts of Sikkim i.e. East, West, North and South. There were altogether eight samples i.e. two samples from each of the four districts of Sikkim. Three replications were taken for each sample and the statistical design used was Completely Randomized Design (CRD). The study includes determination of crude fat, ash, crude fibre, crude protein, Vitamin C content of Himalayan filbert (*Corylus ferox*). The multi-elements determined in the study are being reported in a separate publication. One of the significance of the study is comparison of Himalayan filbert (*Corylus ferox*) with European Hazelnut (*Corylus avellana*) in terms of nutritional value which may lead to enhancement of production and marketing of Himalayan filbert. As per the experiments conducted, Himalayan filbert (*Corylus ferox*) has shown similar results in terms of nutritional value as European filbert (*Corylus avellana*).

Keywords: Himalayan filbert, underutilized fruit crop, nutritional profile

Introduction
The *Corylus* L. genus contains a wide diversity of deciduous shrub and tree species that are important components of many temperate forests across the Northern Hemisphere. The hazelnut is one of the major world nut crops and the top hazelnut producing country in the world is Turkey and its production accounts for approximately 75 percent of worldwide production in 2014. Production of hazelnut in Turkey usually reaches nearly 600,000 tons a year and other significant production areas are Italy, Spain, and USA. Small producers are China, Iran, Georgia, and Azerbaijan (Kilic and Alkan 2006) [4]. Hazelnut is also known as cobnut or filbert nut.

The genus *Corylus* has sub family Coryloideae, family Betulaceae and order Fagales. As many as 25 species have been described, only 9 species are generally recognized (Thompson *et al.*, 1996). *Corylus ferox*, is also known as Himalayan tree hazel occurring in high latitudes in India, Nepal, Bhutan, Sikkim and North-Western Yunnan Province in China. *Himalayan filbert having spiny husk which is available in Sikkim, Nepal, Bhutan etc. is locally called as "Kotus" in* Sikkim and it has same genera as well as nut characteristics as those of European filbert. In Sikkim it grows in forests on mountain slopes up to 1700-3800 m. It is a deciduous tree species growing up to height of 9 to 10m, hardy in nature. Plants are single-trunk trees and young shoots are pubescent, sometimes stipulate glandular or glabrous. Leaves are 5 -15cm long and are ovate-oblong, obovate oblong, obovate, or elliptic in shape. The leaf margins are sharply and doubly mucronate serrate. It starts flowering from May to July and fruiting is from July to September. The nuts develop in clusters of 3-6 in spiny husk, cup shaped involucres unlike any of the other *Corylus species*. The cluster is very similar to the spiny chestnuts (*Castanea* L.) burrs. Nuts are ovoid globose to slightly compressed and 1.0 to 1.5 cm in diameter. The chromosomal number of *Corylus ferox* is 2n = 22 (Mehlenbacher, 1991) [6].

The comparison of Himalayan filbert to European filbert in terms of nutritional value would be beneficial in commercialization of Himalayan filbert. By keeping in view, the above mentioned points regarding development of full nutritional profile of Himalayan filbert, the present study was undertaken with the objectives of determination of various dietary nutrients present in Himalayan filbert (*Corylus ferox*).

Materials and Methods

The present research work entitled "Determination of Nutritional Profile of Himalayan filbert (*Corylus ferox*)" was carried out during the year 2013-2015 in the P.G Laboratory, Department of Horticulture, Sikkim University, 6th mile Samdur, Tadong, Gangtok at the altitude of 1610m and with latitude and longitude as $N^0 27^0 18.$ 495' and $E^0 88^0 35.307$'. The details of materials used and methodology employed during the course of investigation are being described as follows:

Instruments used

The instruments used in the research work were ICP-MS and micro-wave digestion, digital balance, crude fibre extractor, muffle furnace, hot air oven, Willey mill, exhaust fan, oil extractor, centrifuge, UV/VIS spectrophotometer, mortar and pestle, hot plate, water bath and centrifuge were used.

Experimental material and sample collection

The Himalayan filbert nuts were the experimental materials used in the present study. The samples were collected during the months of November and December, 2014. Himalayan filberts were collected from different parts of Sikkim such as East, West, North and South districts. The numbers of treatments were eight for each treatment with three replications. The samples were collected from East Sikkim i.e., T1 from Namcheybong and T2 from Lashithang; West Sikkim i.e., T3 from Chikhaldara and T4 from Sombaria; T5 was collected from Ganbari and T6 from Perbing from South Sikkim; T7 from Phudong and T8 from Mangshela from North Sikkim.

Experimental methods

The present research was conducted in PG Laboratory, Department of Horticulture, Sikkim University, 6th mile Tadong, Samdur, Gangtok. The dietary nutrients were analyzed by following methods as given below:-

Extraction of crude fat

Crude fats was determined by essential oil extractor, model no Socsplus-SCS 06 DLS, PELICAN. In this method ether extracted material in food was extracted from an oven-dried sample using Soxhlet extraction apparatus. The residue was weighed after evaporation of ether. In this method water soluble materials are not extracted since the sample was thoroughly dried prior to extraction with anhydrous ether or petroleum ether. The percentage of crude fat content of the sample is calculated by the following formula which gives the difference in the weights of the original flask and the flask plus extracted fat which represents the weight of the fat present in the original sample.

Hence,

% of crude fat content of the sample = $(W_2 - W_1)$/ Wt. of sample × 100

Where, W1 = weight of the empty beaker (g)
W2 = weight of the beaker + fat (g)

Estimation of crude fibre

Crude fibre was analyzed using fibre estimation system; model no Fibra plus-FES 04 AS DLS, PELICAN. Crude fibre is the organic residue which remains after the food samples have been digested under standardized conditions with 1.25% of sulphuric acid at 500^0C for 30 min and 1.25% of sodium hydroxide at 400^0C at 45 min. The crude fibre consists largely of cellulose with little lignin. As the recovery of cellulose using the specified procedure seldom exceeds four-fifths of that actually present, the crude fibre content does not represent a measure of a specific group of substances.

Crude fibre content of the sample was calculated out by using the following formula:

Hence,

% of crude fibre content of the sample = $(W_2 - W_1)$/ Wt. of sample x 100

Where, W1 = weight of the sample + crucible before ashing (g)
W2 = weight of the sample after ashing (g)

Estimation of Ash content

According to this method, 2.5gm oven dried samples were weighted out in a crucible, this crucible was heated in muffle furnace at 600 ^{0}C for three hours, and then it was cooled in a desiccator, waited for completion of ash and then cooled. When the ash becomes white or greyish in colour, weight of the ash content is calculated out by using the following formula-

Ash % = (Weight of ash sample)/ (Weight of the sample taken) ×100

Estimation of crude protein

The crude protein was determined using Lawry's method as given by Thimmaiah (2004) [10] by UV/VIS Spectrophotometer, Perkin Elmer, Lambda 35 UV/VIS spectrometer. Protein reacts with the Folic-Ciocalteu reagent (FCR) to give a blue-coloured complex. The colour so formed is due to the reaction of the alkaline copper with the protein as in the biuret test and the reduction of phosphomolybdic-phosphotungstic compounds in the FCR by the amino acids tyrosine and tryptophan present in the protein. The intensity of the blue colour is measured calorimetrically at 660nm. The intensity of the colour depends on the amount of aromatic amino acids present and will thus vary for different proteins as reported by Thimmaiah (2004) [10].

Determination of vitamin C

Vitamin C (Ascorbic acid) content was determined by 2, 6-dichlorophenol-indophenol visual titration method as suggested by Ranganna (2012) [7]. Many fruits and vegetables are important sources of ascorbic acid. The most satisfactory chemical methods of estimation are based on the reduction of 2, 6-dichlorophenol indophenol by ascorbic acid and those on the reaction of dehydroascorbic acid with 2, 4-dinitrophenylhydrazine. The dye, which is blue in alkaline solution and red in acid solutions is reduced by ascorbic acid to a colourless form. The reaction is qualitative and practically specific for ascorbic acid in solution in the pH range of 1.0-3.5.

Formula:

$$\text{Dye factor} = \frac{0.5}{\text{Titre}}$$

Vitamin C content of the sample was calculated by using the following formula:

$$\text{mg of ascorbic acid per 100g or ml taken for estimation} = \frac{\text{Titre} \times \text{Dye factor} \times \text{Volume made up} \times 100}{\text{Aliquot of extract taken for estimation} \times \text{wt. or volume of sample taken for estimation}}$$

Statistical Analysis

The treatments were subjected to ANOVA using Completely Randomized Design (CRD). The number of samples (treatments) were eight for Himalayan filbert. The data were recorded for estimation of crude fat, crude fibre, ash content, crude protein, reducing sugar and Vitamin-C. Three replications for all the treatments were taken for different objectives. The percentage data were subjected to arc sine transformation.

Results and Discussion

Estimation of crude fat in Himalayan filbert

The crude fat content of the samples was above 40% and was between the values of 43.2% and 55.73% (Table 1). Ganbari (55.73%) which had the highest crude fat content followed by Chikhaldara (55.33%), Namchaybong (55.2%) and Phudong (53.33%). The lowest percentage of crude fat content was found in Mangshela (41.6%) with in all samples. Himalayan filbert was found to be lower fat content as compared to European filbert as per the findings of Koksal *et al.* (2005) [5]. When comparing these result with the ones previously obtained for the same genera European filbert by Koksal *et al.* (2005) [5] some differences can be noticed due to the different location of the orchard from where the samples were collected, as well as to the year of harvest.

Estimation of crude fibre in Himalayan filbert

The results showed that (Table 1) the crude fibre content of the samples was ranging from 2.15% in Perbing to 4.31% in Sombaria. Hence, the Himalayan filbert was found to have lower crude fibre content as compared to European filbert as per the findings of Erdemir and Gucer (2014) [2]. Himalayan filbert has spiny husk present on the fruit and it is available in hilly areas up to 1700-3800m and it belongs to different species, geographical origin, soil type, climatic conditions, temperature, storage and handling conditions and also different methods were applied at the time of extraction which might have affected the chemical composition of Himalayan filbert.

Estimation of ash in Himalayan filbert

The results showed that (Table 1) the ash content in Himalayan filbert were reported between 1.53-2.13%. Phudong samples showed the lowest 1.53% and Sombaria had highest ash content (2.13%) followed by Namchaybong (2.04%). So the recent finding was similar with Koksal *et al.* (2005) [5] who reported the average ash content in hazelnut varieties as 2.34%. The minimum and maximum values, based on ash ranged between 1.87% in Kalinkara and 2.72% in Cavcava varieties. Hence, the Himalayan filbert was found to have similar ash content to European filbert as per the findings of Koksal *et al.* (2005) [5] which might be due to use of similar instrument at the time of sample extraction, apparatus and same temperature i.e. 550 ^{0}C.

Estimation of crude protein in Himalayan filbert

The results showed that (Table 1) in this research protein content of the samples were above 8.0%. The maximum percentage of crude protein content in Himalayan filbert had found in Chikhaldara (11.02%) followed by Mangshela (10.77%) and Lashithang (10.18%) while Ganbari (8.78%) sample had the lowest protein contents. Thus, the Himalayan filbert was found to have lower crude protein content as compared to European filbert as per the findings of Koksal *et al.* (2005) [5] due to different factors such as different species. In fact there are evidences that harvesting year, climatic condition, soil type, instruments and orchard location can influence the chemical composition of Himalayan filbert.

Table 1: Estimation of crude fat, crude fibre, ash content, crude protein, reducing sugar, Vitamin C in Himalayan filbert

Treatment No.	Crude fat%	Crude fibre%	Ash%	Crude protein%	Vitamin C mg/100g
T1	55.2(47.94)*	2.2(8.51)	2.04(8.21)	10.13(18.59)*	4.4
T2	44.53(41.80)	3.93(11.40)	1.8(7.75)	10.18(18.60)	5.13
T3	55.33(47.99)	3.68(10.24)	1.57(7.19)	11.02(19.39)	5.87
T4	44.13(41.59)	4.31(11.95)	2.13(8.39)	9.65(18.09)	4.4
T5	55.73(48.22)	2.76(9.67)	1.68 (7.44)	8.78(17.24)	5.13
T6	44.93(42.04)	2.15(8.39)	1.61(7.29)	8.79(17.25)	3.67
T7	53.33(46.86)	2.41(8.89)	1.53(7.12)	9.01(17.47)	5.13
T8	43.2(41.02)	3.23(10.33)	1.89 (7.92)	10.77 (19.16)	5.87
G.M.	44.683	9.923	7.658	18.227	4.95
SE m	1.286	0.294	0.413	0.492	0.635
CD at 5%	3.855	0.882	0.124	0.148	1.904

Estimation of Vitamin C in Himalayan filbert

The vitamin C content in Himalayan filbert were reported between 3.67-5.87mg/100g (Table 1). Chikhaldara and Mangshela (5.87mg/100g) which had the highest vitamin C content in Himalayan filbert. Perbing (3.67mg/100g) sample had the lowest vitamin C contents in Himalayan filbert. Koksal *et al.* (2005) [5] reported that vitamin C content in European filbert ranged from 1.38mg/100g in Kan 3.00mg/100g to Yassi Badem varieties respectively. Accordingly, Alasalvar *et al.* (2008) [1] reported Vitamin C content as 5.54mg/100g. So, as per results of present study, Himalayan filbert was observed to have vitamin C content ranging from 5.87mg/100g to 3.67mg/100g. Thus, Himalayan filbert was observed to have higher vitamin C as compared with European filbert. As Vitamin C is important for proper health and prevention of various diseases like scurvy, the finding has significant value in promotion of production of Himalayan filbert in Sikkim and its processing and export.

Table 2: Comparison of dietary nutrients in Himalayan filbert and European filbert

Sl. No.	Dietary nutrients	Himalayan filbert	European filbert
1	Crude fat %	55.73	68.52
2	Crude fibre %	4.31	5.97
3	Ash %	2.13	2.34
4	Crude protein %	11.02	12.7
6	Vitamin C (mg/100 g)	5.87	3.00

Conclusions

Experimental findings concerning nutritional composition revealed that Himalayan filbert available in Sikkim is rich in nutrients and comparable to European filbert. Best nutrients in Himalayan filbert were found in Sample T3 which was collected from Chikhaldara followed by sample T4 which was collected from Sombaria, West Sikkim. As per findings of the present study it may be concluded that Himalayan filbert is nearly similar to European filbert in all the nutrients. Himalayan filbert may be recommended as a substitute for European filbert for dietary nutrients. The commercial production of Himalayan filbert in the State of Sikkim and its export with proper packaging or processing need to be strengthened.

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