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Nutritional Compositions of *Baccaurea sapida* and *Eleaocarpus sikkimnesis* of Sikkim Himalaya

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A B S T R A C T

Sikkim Himalaya has huge diversity of wild edible fruits which has immense nutritional values. Keeping the view of vital nutritional potential of wild fruits, present study had conducted at laboratory of Department of Horticulture, Sikkim University to assess the nutrient content like crude protein, crude fat, crude fibre, carbohydrate, energy value, ash, moisture and dry matter and some mineral elements like Ca, K, Mg, Na, Mo, Cu, Fe and Zn of two under utilized fruit crops *viz. Baccaurea sapida* and *Eleaocarpus sikkimnesis* from Sikkim Himalayas. The present study revealed that the fruit of *Eleaocarpus sikkimnesis* contains highest calorific value that is 389.56±3.29 kcal/kg as compared to *Baccaurea sapida* (377.44±3.26 kcal/g). Crude protein (6.93±0.03) and available carbohydrate (88.17±0.80) per cent was also noted highest in *Eleaocarpus sikkimnesis.* Minerals viz. potassium was noted as highest in both *Baccaurea sapida* (374.37± 9.68µg/L) and *Eleaocarpus sikkimnesis* (223.59± 6.21 µg/L). Other elements like Na, Cu, Mg, Ca, Fe, and Mn were noted significantly in a range of 7.99 to 37.29 µg/L in *Baccaurea sapida* which was highest than that of *Eleaocarpus sikkimnesis.*

Introduction

Sikkim, a North-Eastern State of India is one of the few places on earth with such a unique biodiversity comprising different agro-climatic zones with a wide range of plant species having medicinal and nutritional properties. Due to high forest coverage the state wild edible plants are being highly consumed in the daily diet of the local people and they directly rely on wild plant species and their genetic resources for food and medicine. Fruit species, particularly those currently identified as 'underutilized', can contribute significantly to improve human health and nutrition, livelihoods, household food security and ecological sustainability which constitute an essential component in the diet of many ethnic population. The diversity of underutilized or wild edible lesser known plants species is very high (>250 species) in the Sikkim Himalaya. The

majority of these species are considered as poor man's food (Sharma *et al.,* 2016). Underutilized fruits are vital source of an adequate diet and they serve as food supplements, appetizer and sometimes the nutritional values of underutilized fruits are found higher than several known cultivated food yielding species as reported by Orech *et al.,* (2007), but very few nutritional studies have emphasized over the significant benefits of such fruit species. Keeping the above points in mind, the nutritional constituents of two under utilized fruits of Sikkim Himalayas like *Baccaurea sapida* and *Elaeocarpus sikkimensis* were studied and discussed in the current proposed research paper.

Baccaurea sapida (Phyllanthaceae)is native to the Southeast Asian region and found growing wild as well as under cultivation in Nepal, India, Myanmar, South China, Indo-China, Thailand, the Andaman Islands, and Peninsular Malaysia. It is an underutilized fruit species locally known as Kusum. The different species of *Baccaurea* is found in Sikkim, Darjeeling, Arunachal Pradesh, Assam, Meghalaya, Tripura, Mizoram and Manipur. It is a semi deciduous tree small to medium in size, approximately 8-10 m in height. Generally ripe fruits are edible and the colour of the fruit is yellowish to pinkish pulpy aril uses as table fruit. Fruits are glabrous of size 25 to 30 mm in diameter. The fruits ripened during June –July which sold in the local market at Rs. 40/kg. The fruit is used to cure the skin diseases.

Eleaocarpus sikkimensis (Elaeocarpaceae)It is woody evergreen large tree that grows up to 40 m high. Leaves are clustered spirally arranged near the end of the branches. Fruit is ellipsoidal from broad base, greenish in colour. The stone fruits have one to five chambers. Ripe fruits are available during November- December. Edible fruits are used to make pickles and chutneys. Different species of Elaeocarpus are very important in the field of medical science due to the presence of their phytochemicals with their high medicinal values. Mainly these chemicals are alkaloids, flavonoids, tannins, glycosides, and ellagic acid derivatives (Dadhich *et al.,* 2013).

Materials and Methods

The present investigation entitled "Nutritional composition of *Baccaurea sapida* and *Eleaocarpus sikkimnesis* fruits of Sikkim Himalayas." was carried out at Laboratory of Department of Horticulture, Sikkim University during the year 2014-2017. Experiment was conducted on two underutilized fruits grown naturally at forest vegetation of Sikkim Himalayas were directly collected from the forest area of different region of Sikkim. Nutritional component *viz.* crude protein, crude fat, crude fibre, available carbohydrate, energy value, ash, moisture and dry matter content and some vital elements were estimated using standard method of chemical analysis which is mentioned below:

Moisture and dry matter content

Moisture and Dry matter content were determined by following the method given by A.O.A.C, 1990. Weighed sample (5.0 g) of each fresh fruit was taken in a sterilize weighed petri dish and kept in the hot air oven at 105^{o}C for 12 hours and petri dish were then allowed to cool and weighed.

The loss in weight represents the moisture content of the sample whereas, the dry matter content of the sample represents the amount of material left after the complete removal of moisture from the sample. The per cent moisture and dry matter content from the fruit sample were calculated by using the following formula: -

$$\text{Moisture content (\%)} = \frac{\text{(Weight of fresh sample - Weight of dry sample)}}{\text{Weight of fresh sample}} \times 100$$

$$\text{Dry matter (\%)} = \frac{\text{(Weight of petri dish + Weight of dried sample)- Weight of dish}}{\text{Weight of sample before drying}} \times 100$$

Ash content

Ash content was determined by following the method of A.O.A.C., 1990. For this crucible were kept in a muffle furnace at 600^0 C for 1h. Then they were transferred from furnace and cooled to room temperature and weighed (W_1) as quickly as possible to prevent moisture absorption. 2 g dried fruit sample was taken in crucible and placed in a muffle furnace at 600^o C for 6h. Then crucible was transferred to cool at room temperature and weighed (W_2), Then the percentage of ash was calculated by using the following formula:-

$$\text{Ash (\%)} = \frac{W_2 - W_1 \text{ (weight of ash)}}{\text{Weight of sample}} \times 100$$

Crude fibre

Crude fibre was analyzed using fibre estimation system, model no Fibra plus-FES 04 AS DLS, PELICAN. 2 g of moisture and fat free sample were taken in the crucibles then it was loaded in the instrument. 150 ml of 1.25 % of H_2SO_4 was added from the top and boiled at 500^o C for 30 minutes. Once the boiling was completed the reagents was drained out with the help of fibra flow then 150 ml of 1.25 % NaOH was added from the top and heat the sample at 400^o C for 45 minutes which led to digestion of sample. After completion of digestion reagents was drained out and residue was dried in hot air oven at 90 -100^o C and cooled and weighed the dried residue (W1) then the residue was kept in pre-weighed porcelain crucible and put in the muffle furnace for ashes at 600 ^{o} C in 3 hours then it was cooled and weighed (W_2). Crude fibre content was expressed as percentage loss in weight on ignition (A.O.A.C., 1990) and calculated using following formula:

$$\text{Crude Fibre (\%)} = \frac{W_1 - W_2}{\text{Weight of sample}} \times 100$$

Crude fat

Crude fat content was determined by soxhlet principle with slight modification (A.O.A.C, 1990) The fat from the oven dried fruit sample was extracted in essential oil extractor (model no. Socsplus-SCS 06 DLS, PELICAN) using petroleum ether as solvent then ether is evaporated and determined the weight of the fat recovered using following formula:

$$\text{Crude Fat (\%)} = \frac{W_2 - W_1}{\text{Weight of sample}} \times 100$$

Crude protein

The crude protein was estimated by Lowry's method **(**Lowry *et al.*, 1951**)** by using UV/VIS Spectrophotometer, Perkin Elmer, Lambda 35 UV/VIS spectrometer.

Available carbohydrate

The percentage of available carbohydrate was calculated by: 100- (Percentage of ash+ Percentage of fat + Percentage of fibre + Percentage of protein) (A.O.A.C., 1990).

Energy value/nutritive value

The energy value in kilocalorie per gram (Kcal/g) was determined by multiplying the percentage of crude proteins, crude fat and carbohydrate by the recommended factor 4, 9 and 4, respectively and then taken the sum of

values. The value was then converted to kilojoules by multiplying with 4.2 (A.O.A.C., 1990)

Energy value (Kcal/g) = (CP x 4) + (CF x 9) + (Carb. x 4)

Minerals

ICP-MS (Inductively Coupled Plasma Mass Spectrophotometry) Perkin Elmer Nex ION 300X was used for estimation of some mineral elements. Digested samples were analyzed for the ionic constitution using multi elements standards for detecting the elements such as Ca, Fe, Mg,Mn, Mo, Na, Zn. The micro wave digestion system (Anton par microwave 3000) was used for sample digestion as 0.5 gm sample were along 9ml of 69% nitric acid and 2ml HCl were added into the digestion tube and run the instrument for 40 minutes. The digested samples were then transferred into 50ml volumetric flask when the temperature of the sample was reduced and distilled water was added for making the volume of 50 ml. The liquid sample was transferred into narrow mouth bottle until the minerals were determined in ICP-MS. The values of the elements were expressed as µg/L.

Statistical analysis

All the assays were carried out in triplicate and values were obtained by calculating the average of three experiments using Microsoft excel programmed (Microsoft excel- 10) and data are presented as Mean ± standard deviation.

Results and Discussion

Moisture and dry matter content

The moisture content is one of the important factors amongst the physical properties of edible fruits that may vary due to changing its value in nutritional composition. In the present study moisture content was found to be higher in the fruit of *Baccaurea sapida* i.e. 81.17±0.65 % then *Eleaocarpus sikkimenss* (68.67±0.40). our finding regarding moisture content in the fruit of *Baccauresapida* is similar to the finding of (Mann *et al.,* 2016)(81.65 %). Dry matter content was observed as 31.33±0.40 % in *Eleaocarpus sikkimenss* and 81.17±0.65 % in *Baccaurea sapida.*

Fiber and ash content

Fibre rich diets are essential for effective removal of waste and percentage of ash represents the mineral content that is present in the fruits. It was noted that 3.59±0.72 % of ash and 3.60±0.03 % of Fiber content was estimated from the fruit of *Baccaurea sapida* whereas, 1.88±0.78 % and 2.0±0.05 % of ash and fiber, respectively were obtained from the fruit of *Eleaocarpus sikkimnesis.* Mann et al (2016)also reported the dietary fibre of pulp of *Baccaurea sapida* as 3.6 g/100g and the ash content of pulp and peel of *Baccaurea sapida* reported to be 5.42 g/100g and 5.31 g/100 g, respectively. There is not much research evidence found for *Eleaocarpus sikkimnesis.*

Crude fat and crude protein

Crude fat content was noted as 1.24±0.09 % in *Baccaurea sapida* and 1.02±0.03 % in *Eleaocarpus sikkimnesis* and crude protein content in *Baccaurea sapida* and *Eleaocarpus sikkimnesis*was found to be 5.43±0.87 % and 6.93±0.03 %, respectively. Bhutia (2013)also reported 6.5 % protein and 0.3 % fat in the fruit of *Eleaocarpus sikkimensis* which was similar to our recent finding. Seal et al (2014) reported 6.94 % crude protein in the fruits of *Baccaurea sapida* which is slightly higher than our finding.

Available carbohydrate and Energy value

Available carbohydrate content was found to be highest as 88.17±0.80 % in the fruit of *Eleaocarpus sikkimensis* whereas, the fruit of *Baccaurea sapida* contains 86.14±1.49 %. As far as Energy value/ nutritive value is concerned it was observed highest in *Eleaocarpus sikkimensis* than *Baccaurea sapida* i.e. 389.56±3.29 Kcal/g and 377.44±3.26 Kcal/g,

respectively. Ibrahim et al (2013) reported 74.14 per cent of carbohydrate content in the freeze-dried fruits of *Baccaurea angulate.* The fruits having good composition of carbohydrates are very nutritious for health products and responsible for their high calorific value (Ozcan, *et al.*, 2007). The nutritional composition like moisture and dry matter content, Ash, fibre, fat, protein, carbohydrate and energy value table 1.

Table.1 Nutritional composition of *Baccaurea sapida* and *Eleaocarpus sikkimnesis*

Sl. No.	Nutritional Parameters (%)	*Baccaurea sapida*	*Eleaocarpus sikkimnesis*
1.	Moisture content	81.17±0.65	68.67±0.40
2.	Dry Matter content	18.83±0.65	31.33±0.40
3.	Ash content	3.59±0.72	1.88±0.78
4.	Fibre	3.60±0.03	2.0±0.05
5.	Crude Fat	1.24±0.09	1.02±0.03
6.	Crude Protein	5.43±0.87	6.93±0.03
7.	Available Carbohydrate	86.14±1.49	88.17±0.80
8.	Energy value (Kcal/g)	377.44±3.26	389.56±3.29

Table.2 Minerals content of *Baccaurea sapida*and*Eleaocarpus sikkimnesis(*µg/L*)*

Sl. No.	Minerals content (µg/L)	*Baccaurea sapida*	*Eleaocarpus sikkimnesis*
1.	Calcium	23.77 ± 2.0	2.89 ± 0.32
2.	Magnesium	21.67 ± 1.2	21.67 ± 1.4
3.	Potassium	375.37 ± 9.68	223.59 ± 6.21
4.	Molybdenum	1.03 ± 0.12	1.99 ± 0.9
5.	Sodium	7.99 ± 1.8	8.09 ± 1.6
6.	Zinc	0.97 ± 0.18	0.33 ± 0.8
7.	Iron	29.55 ± 2.6	24.29 ± 2.3
8.	Copper	14.33 ± 1.2	4.27 ± 0.96
9.	Manganese	37.29 ± 3.8	11.46 ± 1.1

Minerals

Among all the essential elements, potassium content was found to be highest as the value of 375.37 ± 9.68 µg/L and 223.59 ± 6.21 µg/L in the fruit of *Baccaurea sapida* and *Eleaocarpus sikkimnesis*, respectively. Manganese was noted highest in *Baccaurea sapida* (37.29 ± 3.8 µg/L) and lowest in *Eleaocarpus sikkimnesis* (11.46 ± 1.1 µg/L). Significant amount of iron was also noted in a range of 29.55 ± 2.6 µg/L to 24.29 ± 2.3 µg/L in the fruit of *Baccaurea sapida* and *Eleaocarpus sikkimnesis*, respectively. Calcium content was found as 23.77 ± 2.0 µg/L which is highest in the fruit of *Baccaurea sapida* whereas, the fruit of *Eleaocarpus sikkimnesis* contains only 2.89 ± 0.32 µg/L. Elements like magnesium, copper, sodium and zinc were observed in a range of 21.67 ± 1.2 µg/L, 14.33 ± 1.2 µg/L, 7.99 ± 1.8µg/Land 0.97 ± 0.18 µg/L respectively, in the fruit of *Baccaurea sapida*and range of 21.67 ± 1.4 µg/L, 4.27 ± 0.96 µg/L, 8.09 ± 1.6 µg/L and 0.33 ± 0.8 µg/L respectively, in *Eleaocarpus sikkimnesis.* Rai *et al.*, (2005) reported the appreciable amount of mineral concentration from the wild edible fruits of Sikkim which was similar to our findings. The data related to minerals are presented in the table 2.

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