Original Research article

Ethnobotanically Important Plants Used by the Nocte Tribe of Eastern Himalaya

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Abstract: Ethnic communities around the world has survived their hardest time, depending on plant based food, clothing and shelter. Likewise, the Noctes of Eastern Himalayan region are considered as an expert bioresource manager. An ethnobotanic field study was conducted in Nocte dominated remote hills and data was generated accordingly. The study has recorded a total of 48 plant species, of which, the most commonly found species belonged to family Moraceae and maximum of the collected plants were trees. The majority of the ethnic folks of this region used leaves (25.45%) for various purposes; whereas, roots, petioles and whole-plant were scored to be the least. Though maximum of these plants were used as food and medicine, some of the collected plants also have multiple utility such as food-beverages, food-medicine, and food-oil. Among all the collected plants, *Gynocardia odorata* was reported with the highest UV_C scores of 96.67%. These plants were also traded in local markets in exchange for financial security. It would be essential to carry out studies on the nutritional values of these plants. In addition, validation of the collected medicinal plants seeks further in vitro researches. The knowledge on the use of these plants are also waning away alongside the older generation. Thus, the awareness on the conservation and sustainable management of these bioresources and further exploration in neighbouring areas is important.

Key words: Ethnobotany, indigenous tribes, traditional knowledge, wild edible plants

Introduction

World over, the tribal population still stores a vast traditional knowledge on the utilization of local plants as food material and other uses (Sundriyal *et al.* 1998). Thus, documenting and safeguarding Traditional Knowledge Systems (TKS) have become eminent in management of bioresources (Tangjang *et al.* 2015). Accumulated traditional knowledge on plants is the result of thousands of years of experience. These plants exist in the nearby jungles, protected areas, community forests; and are gathered for food, shelter and clothing by different tribal communities around the world. Among many indigenous people residing in Arunachal Pradesh, the utilization of plant-based resources is an integral component of Noctes culture. The potential of these plants in providing a source of income and livelihoods in rural settings is acknowledged around the world (Jain, 1963). These plants and their parts are commonly used as food supplements, dying clothes, health care, handicrafts, rituals, beverages, fishing, and hunting (Sarmah *et al.* 2000). Likewise, some of the wild edible fruit plants have even become important part of the culture in some indigenous peoples' tradition and are known to be effective against certain diseases thus getting popular and commercialized into various products (Prakash *et al.* 2012).

The wild edible plants (WEPs) refer to species that are neither cultivated nor domesticated, but available from their natural habitat and used as sources of food (Beluhan and Ranogajec, 2010). Most of the traditional knowledge about these plants, however disappearing fast as a consequence of socio-economic and land use changes promote intensive agriculture, industrialization, and the migration of rural populations to urban areas (Signorini *et al.* 2009). Similarly, the dependence on WEPs also gradually declined as more exotic plants have been introduced.

Owing to its remoteness, this region have been exposed to very less external force of modernization. Thus, they are still maintaining their cultural heritage, along with their traditional knowledge systems, predominantly in the remote areas. On contrary, with the modernization, availability of several new alternatives and progressively loosing traditional knowledge; the awareness and understanding on these plants are rapidly eroding amid the new generation. Consequently, it is very crucial to document the fast-disappearing traditional knowledge before it vanishes. Through this study, we have attempted to fill the knowledge gap in the context of existing data on diversity, traditional knowledge, economic potential, and conservation value of ethnobotanically important plants from Tirap district, Arunachal Pradesh of Eastern Himalaya.

Materials and methods

Study area and ethnic community

Tirap district occupies an area of 2362 square kilometres, with the elevation ranges from 200 meters in the northwest to 4000 meters in the Patkai hills. It lies between the latitude 26^{0}38′ N and 27^{0}47′ N. Moktowa and Lapnan villages of the district was selected for the study (Fig. 1). The district shares border with Changlang and Longding districts of Arunachal Pradesh, State border with Nagaland and Assam, and international border with Myanmar. Tirap district is inhabited by the Nocte and the Tutsa tribe. They have rich culture that was passed on from their forefathers. The climate of these villages are sub-tropical, while monsoon is plentiful and rains continuously for a month providing sufficient amount of water for the growth of plants. The village dwellers are very simple, hardworking and superstitious (believes in *Rang*, the unseen deity). Shifting agriculture or *jhum* is the primary source of food, income and livelihood, while the villages are govern by the Chief and his council members (Wangpan *et al.* 2017).

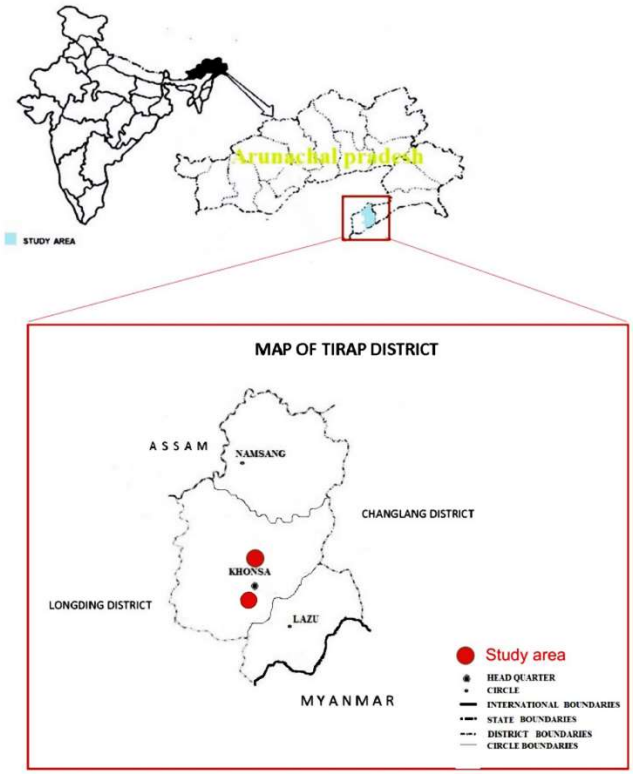

Fig. 1. Map of Tirap District, Arunachal Pradesh, India showing Study Site.

Field data collection

Standard methodologies of the field and herbarium techniques was followed (Jain and Rao, 1977). A field survey was carried out with the help of standard questionnaires to know the availability and authentication of the use of these plants. Comparative statements were generated through group interviews. The information regarding the usefulness of plant parts at local level was also recorded. Finally, the rural market survey was done to evaluate the commercial viability of these plants. The collected plant were identified with the help of taxonomic literatures, Floras and Herbaria of BSI (Itanagar). The name of the plants was further verified following the website http://www.theplantlist.org/

Data analysis

The relative importance was calculated employing the use value (UVc) Index (Albuquerque *et al.* 2007), a quantitative measure of the relative importance of species known locally. It is calculated using formula:

$UVc = \acute{O}U/ns$.

Where, U is the sum of the total number of use cited by the informants for a plant species, divided by the total number of informants (ns). High UVc scores usually implies that the plant is important, and the score approach zero when there are few reports on its usage.

Results

Taxonomic evaluation

The taxonomic details on the collected plants along with its mode of utilization is depicted in Table 1. In addition, the pictures of some of these plants are depicted in Photo plate-1. The study has recorded 47 plant species belonging to 41 genera and 30 taxonomic families; of which, the most commonly found species were Moraceae family (5 nos), Urticaceae (4 nos), Arecaceae (3 nos) and Asteraceae (3 nos) (Fig. 2). In this study, most of the collected plants were trees (33.33%), followed by herbs (31.25%), shrub (16.67%), climbers (10.42%) and lianas (8.33%) (Fig. 3).

Ethnobotanic evaluation

It is revealed that the majority of the ethnic folks of this region use leaves (25.45%) for various purposes, followed by flowers (21.82%), fruits (14.55%) and stems (10.91%); whereas roots, petioles and whole plant were the least frequently used plants parts (Fig. 4). Additionally, maximum of the ethnobotanically important plants were recorded to be used as food (48%), and medicine (26%); while, rest (26%) of the plants were found to be used for other purposes including hunting, oil extraction and fibres for rope making, beverages, spices and famine food (Fig. 5). Some of these collected plants also have multiple utility such as *Rhus chinensis* (food and beverages), *Houttuynia cordata* (food and medicine), *Hodgsonia macrocarpa* (food and oil).

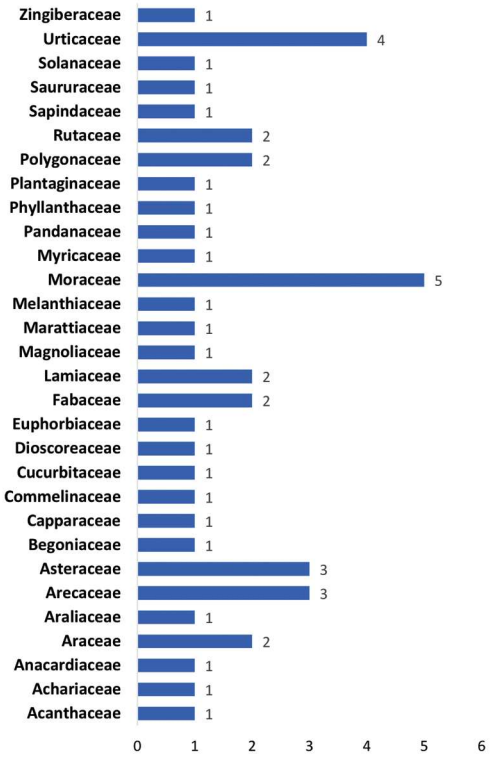

Fig. 2. Family distribution of the ethnobotanically important plants. The family Moraceae scored with highest number of plant taxa.

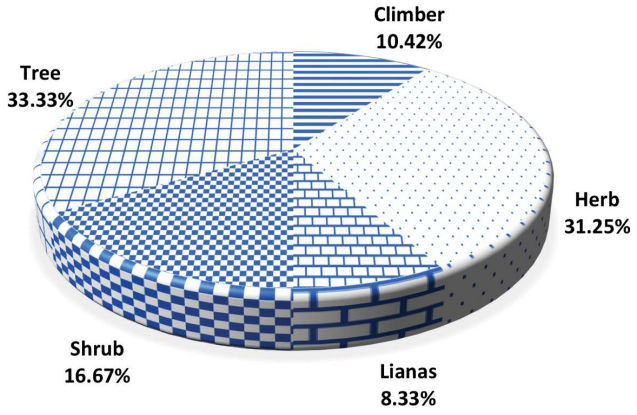

Fig. 3. Habits of the ethnobotanically important plants. The maximum percentage of collected plants were comprises of trees; lianas shared minimum percentage.

Among the collected plants, *Gynocardia odorata* (96.67%), *Rhus chinensis* (95.83%), *Dioscorea* sp. (94.17%), *Hodgsonia macrocarpa* (93.33%) and *Myrica esculenta*

(90.83%) were recorded with the highest UVc score. While, plant species *Scoparia dulcis* (16%) was reported with the lowest UVc.

In the present study, the commonly marketed food plants in district headquarter 'Khonsa' include *Baccauria sapida, Gynocardia odorata, Dioscorea* sp., *Hodgsonia macrocarpa, Houttuynia cordata, Magnolia hodgsonii, Manihot esculenta, Morus alba, Myrica esculenta, Nephelium lappaceum, Rhus chinensis, Zanthoxylum rhetsa* and *Zanthoxylum* Sp. The fruits are usually traded in raw form, except *Gynocardia odorata*, which needs to be processed before selling. The average cost

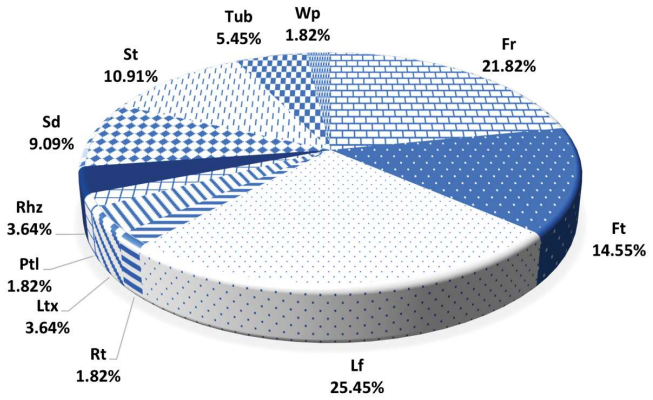

Fig. 4. Edible plant parts of the ethnobotanically important plants. Lv scored highest; Rt and Wp plants scored least. Note: Tub: Tubers; Fr: Flower; Ft: Fruit; Lf: leaf; Rt: Root; Ltx: latex; Ptl: petiole; Rhz: rhizome; Sd: Seed; St: Stem.

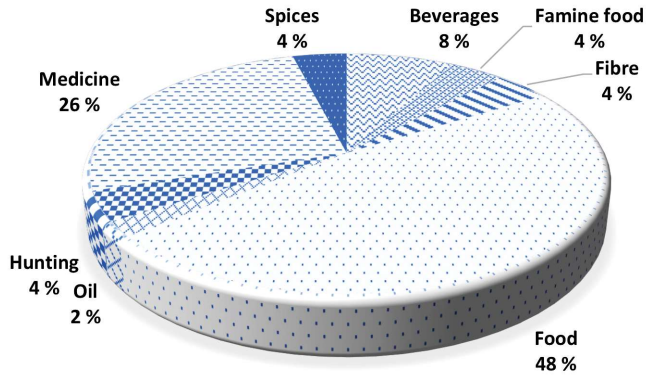

Fig. 5. Mode of utilization of the ethnobotanically important plants. The maximum collected plants were utilized as food and medicine; least frequent was oil extraction.

of leaves (leafy vegetables) may range between Rs.20 and Rs.30 per bundle in headquarters. While, the tubers such as, Tapioca and yam may cost up to 50 rupees per kilo. On the other hand, the cultivated cereals crop (rice, maize and millets), however, may cost up to Rs.20-30/kg.

Discussion

Plant specimens (both domestic and wild) were reported on the basis of the theoretical knowledge of the local folk. The knowledge on the traditional use of plants was evenly distributed among the population. Wild plants have been recognized as the cheapest and most abundant source of food and medicine since many decades. In context of this region, these plants provided food in the form of fruits, leaves, roots, seeds, etc. and herbal medicines in the form of extracts, decoction, infusion, and milky latex. Furthermore, these plants also acted as flavouring agent in the form of spices and lastly enhances household income. The result also corroborated with the findings of Angami *et al.* (2006) as most of the species has multipurpose use.

Various studies have found the wild edible plants as potential source of nutrition while in many cases are more nutritious than conventionally eaten crops (Grivetti and Ogle, 2000). It also contain a significant level of biologically active components and are generally high in fibres, rich sources of vitamins, minerals and other nutrients (Chauhan *et al.*, 2016). On the other hand, the ethnomedicinally important plants are the primary mode of healthcare for most of the rural population in Arunachal Pradesh (Namsa *et al.*, 2011). Recently because of high chemical inputs such as fertilizers, plant growth regulators, herbicides, the cultivated plants has lost their nutritive values (Sekeroglu *et al.*, 2016). So, depending on the wild plant based foods could be an alternative to cultivated landraces. Moreover, according to the previous study, the nutraceutical value of these wild plants foods could be comparable or even sometimes superior to the common vegetables (Aberoumand, 2011; Seal *et al.*, 2017). Hence, the sustainable harvesting of these bioresources and its

Photo Plate 1. Ethnobotanically important plants used by Noctes of Arunachal Pradesh, India: a) *Myrica esculenta,* b) *Angiopteris evecta,* c) *Gynocardia odorata,* d) *Ficus elastica,* e) *Paris polyphylla,* f) *Mucuna pruriens,* g) *Morus alba,* h) *Hodgsonia macrocarpa,* i) *Pilea sp.,* j) *Rhus chinensis,* k) *Debregeasia orientalis,* l) *Phlogacanthus curviflorus,* m) *Entada rheedii,* n) *Zanthoxylum armatum,* o) *Streptolirion volubile,* p) *Staxis suaveolens,* q) *Persicaria chinensis,* r) *Aconogonum moll,* s) *Baccauria sapida.* t) *Calamus erectus*

Table 1. Ethnobotanically important plants among the Noctes of Tirap District, Arunachal Pradesh, India.

Sl. No.	Botanical Name	Local Name	Family	Parts Used	Habit	Mode of Use	UVc (%)
1	*Aconogonum molle* (D. Don) H. Hara	Sisuak	Polygonaceae	St, Lv	Herb	Stem consumed raw and young shoot cooked for vegetables	45.83
2	*Ageratum conyzoides* (L.) L.	Tham jin	Asteraceae	Lf	Herb	Fresh leaf paste is applied on cuts and wounds	47.50
3	*Alpinia nigra* (Gaertn.) Burtt	Puejong	Zingiberaceae	Ft, Fr	Herb	Fruits and flowers are eaten raw	52.50
4	*Amorphophallus sp.*	Tu	Araceae	Tub	Shrub	Famine food	24.17
5	*Angiopteris evecta* (G. Forst.) Hoffm.	Maahtik	Marattiaceae	Rhz	herb	Made a paste and cooked.	49.17
6	*Artemisia dubia* Wall.	Patti	Asteraceae	Lf	Herb	Leaves paste are used to treat ring worms. Leaves can be boil with water before bath to prevent skin irritations.	46.67
7	*Baccaurea sapida* (Roxb.) Müll.Arg.	Sabuam ree	Phyllanthaceae	Fr	Tree	Fruits are edible and eaten raw.	73.33
8	*Begonia silhetensis* (A.DC.) C.B.Clarke.	Sukun	Begoniaceae	Ptl	Herb	Young petioles are consumed raw as salad	49.17
9	*Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Bercht. & J.Presl	Bonglu	Solanaceae	Lf, St	Shrub	Leaves paste are applied externally to treat wounds, rashes. While Stem is use to heal animals suffering from skin disorders	43.33
10	*Calamus floribundus* Griff.	Reeri	Arecaceae	Ft	Tree	Eaten in raw form or either as decoction.	63.33
11	*Calamus erectus* Roxb.	Gee	Arecacae	St	Climbers	The fibres extracted from bark is used in making ropes. It is also used to in local handcrafts.	76.67
12	*Caryota urens* L.	Jok Pan	Arecaceae	St	Tree	The stem is crushed and is grounded into powder. Whenever there was a shortage of rice, these powder were boiled with rice as to increase the quantity of meal.	28.33
13	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Kap lao lao nyu	Asteraceae	Lf	Herb	Young leaves are crushed and the resulting liquid is use to stop bleeding.	38.33
14	*Clerodendrum colebrookianum* Walp.	Mokmit	Lamiaceae	Lf	Herb	tender leaves as boiled vegetables, leaf used in hyper tension and bowel troubles.	37.50
15	*Cyathea spinulosa* Wall. ex Hook.	Kuno	Moraceae	St	Tree	The stem of Kuno is cut, fermented for 1-2 weeks and dried. The resultant dried stem product is mixed with rice and cook.	55.00
16	*Debregeasia longifolia* (Burm.f.) Wedd.	Tukhi	Urticaceae	Ft, Lf	Shrubs	Fruit and young leaves can be used to treat stomach ache, blood dysentery. The juice of the leaves is applied to areas of the skin affected by scabies	19.17

17	*Debregeasia orientalis* C.J.Chen	Rukhi	Urticaceae	Fr	Shrub	Eaten raw or either processed into wine	48.33
18	*Dioscorea alata* L.	Khan	Dioscoreaceae	Tub	Lianas	Tubers are boiled to cook and consumed	94.17
19	*Entada rheedii* Spreng.	Bira/Widaa	Fabaceae	Sd	Lianas	The outer covering of bira is boil up to a certain temperature, after the covering is removed a white substance is there which can be eaten. It is a famously used in chutney	65.00
20	*Ficus Benjamina* L.	Naisa	Moraceae	Ltx	Tree	The secretion of Nai sa plant (milky white latex) is used to make a special type of Gum, This Gum is then used for capturing of birds. This Gum is known as Phanpe in our language and is made my mixing of secretion of Nai sa plant and secretion of Nai Nyu (*ficus elastica*) plant.	65.00
21	*Ficus elastica* Roxb. ex Hornem.	Nai Nyu	Moraceae	Ltx	Tree	A milky white latex is secrete from the stem .This latex is use to make gum. This Gum is known as Phanphe. Phanphe can be made only when secretion of Ficus benjamina and Ficus elastica are mixed.	75.00
22	*Ficus fulva Reinw.* ex Blume	Phug	Moraceae	Fr	Tree	Eaten raw	72.50
23	*Ficus semicordata* Buch.-Ham. ex Sm.	Chatsa	Moraceae	Ft	Tree	Fruit is edible.	74.17
24	*Gynocardia odorata* R.Br.	Baah	Achariaceae	Sd	Tree	The seeds are processed and boiled for 24 hours prior to consumption.	96.67
25	*Hodgsonia macrocarpa* (Blume) Cogn.	Pih/Pai	Cucurbitaceae	Sd	Lianas	Used as food. Eaten raw or boiled. Seeds also used for oil extraction	93.33
26	*Houttuynia cordata* Thunb.	Tham Nam	Saururaceae	Lf, Rt	Herb	Leaves and roots are eaten as salad and roots are used in curing diarrhoea.	58.33
27	*Hydrocotyle javanica* Thunb.	Gu-sa	Araliaceae	Lf	Creeper	The juice of the plant is used in the treatment of fevers. A paste made from the plant is applied externally to wounds and boils. Leaves can be chew or eaten raw during period cramps.	21.67
28	*Leucas aspera* (Willd.) Link	Paan-kam	Lamiaceae	Lf	Herb	Used for treatment of piles	26.67
29	*Magnolia hodgsonii* (Hook.f. & Thomson) H.Keng	Aao Kuan	Magnoliaceae	Ft	Tree	The fruit of Aao kuan is used in toothaches. Person suffering from toothache can chew this fruit and it will provide relief from pain and can make the teeth strong.	25.00

30	*Manihot esculenta* Crantz.	Pankhan	Euphorbiaceae	Tub	Climbers	Tubers are edible and are fermented to make alcoholic beverages.	65.00
31	*Morus alba* L.	Suhree	Moraceae	Fr	Shrub Lianas	Fruits are edible and eaten raw. Non alcolohlic as well as alcoholic beverages is also prepared using the fruit	69.17
32	*Mucuna pruriens* (L.) DC.	Huna/Pitu	Fabaceae	Sd	Tree	Used as vegetable	71.67
33	*Myrica esculenta* Buch.-Ham. ex D. Don	Jonri	Myricaceae	Fr	Tree	Raw fruits are made pickles and the ripe ones are eaten directly.	90.83
34	*Nephelium lappaceum* L.	Chaanri	Sapindaceae	Fr	Shrubs	The fruits are eaten raw	74.17
35	*Pandanus utilis* Bory.	Gai	Pandanaceae	Ft		The shell of the fruit of Pandanus Sp. is dried and when it is completely dried it is cut in desired shape and is used as comb. The fruit is also edible.	31.67
36	*Paris polyphylla* Sm.	Kekuak	Melanthiaceae	Rhz	Herb	Decoction. Used as Carminative and for many remedies.	36.67
37	*Persicaria chinensis* (L.) H. Gross	Jubaan sukun	Polygonaceae	Fr	Herb	Eaten in raw form.	36.67
38	*Phlogacanthus curviflorus* (Wall.) Nees	Binchinkang	Acanthaceae	Fr	Shrub	Used as condiments and nectar is also consumed.	54.17
39	*Pilea sp.*	Kansing	Urticaceae	Lf	Herb	Used as vegetable	48.33
40	*Raphidophora sp.*	Gak sui	Araceae	Lf	Herb	Leaves are used in healing cuts and wounds.	25.00
41	*Rhus chinensis* Mill.	Baahsaa	Anacardiaceae	Fr	Tree	Used as salt or rennet substance. Eaten raw or either decoction.	95.83
42	*Scoparia dulcis* L.	Pankam	Plantaginaceae	Wp	Herb	paste made from leaves, stem, root can be used to treat piles	16.67
43	*Stixis suaveolens* (Roxburgh) Pierre	Langchan ree	Capparaceae	Fr	Climber	Eaten raw	51.67
44	*Streptolirion volubile* Edgew.	Manvih	Commelinaceae	Lv	Climber	Boiled tender leaves are consumed as vegetable	40.83
45	*Urtica dioica* L.	Gih Pan	Urticaceae	St	Tree	The thread extracted from the fibres of stem can be used to weave clothes, and to make fishing nets.	70.83
46	*Zanthoxylum rhetsa* DC.	Matkaat	Rutaceae	Sd	Tree	Used as condiment. A pepper substitute.	85.00
47	*Zanthoxylum armatum* DC.	Chiaruh	Rutaceae	Lf, Fr	Shrub or tree	Used as condiment and additive in curry.	83.33

Note: Tub: Tubers; Fr: Flower; Ft: Fruit; Lf: leaf; Rt: Root; Ltx: latex; Ptl: petiole; Rhz: rhizome; Sd: Seed; St: Stem.

management is eminent after the social and cultural instincts (Wangpan *et al.*, 2015).

As mentioned in the result, the plants with high UVc scores are the most important among the collected plants species. At the same time, the plant species with lowest UVc score would be considered as least important.

In the previous studies, it was observed that the trading of wild edible fruit in the state is mostly confined to

sites near the district headquarters (Lyngdoh *et al*., 2016). In similar fashion, the trading of these plants were restricted to the nearby town areas. The selling of these vegetable crops, wild fruits and tubers would give them a handsome economic returns.

Conclusion

Food gathering and harvesting of forest product is the most common activity among the Noctes and many people of the region still depends on wild plants because of its wide range of local applications. Locally used WEPs have the potential to become valuable staple foods and alternatives to the cultivated crops. Further, such wild resources may have the potential to become conventional foods of the future, paving a new way of food and financial security. Also, it would be indispensable to carry out studies on the nutritional values of these plants. The study has led to collection of good numbers of medicinal plants also, which requires further investigation on the active compounds, secondary metabolites and *in vitro* clinical trials. At the same time, it was also observed that the knowledge on the use of these plants are also eroding alongside the old generation of the villages. Enhanced use of these bioresources would not only supplement the food scarcity, but would also uplift the economy of the region. Thus, the awareness on the conservation and sustainable bioresource management of these plants and further exploration in neighbouring areas is crucial.

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References

Tangjang S, Wangpan T, Taka T, Namsa ND and Arunachalam A. 2015. Balancing traditional knowledge for conservation and utilization of bamboo resources in Arunachal Pradesh, India. ENVIS Bulletin on Himalayan Ecology, GBPIHED. 1-5.

Signorini MA, Piredda M and Bruschi P. 2009. Plants and traditional knowledge: an ethnobotanical investigation on Monte Ortobene (Nuoro, Sardinia). J Ethnobiol Ethnomed. 5:6. doi:10.1186/1746-4269-5-6.

Lyngdoh N, Piloo N, Gab T, Kumar M and Pandey AK. 2016. Wild edible fruit tree resources of Arunachal Pradesh, North East India. Journal of Applied and Natural Science. 8(2): 883-889.

Namsa ND, Mandal M, Tangjang S and Mandal SC. 2011. Ethnobotany of the Monpa ethnic group at Arunachal Pradesh, India. Journal of Ethnobiology and Ethnomedicine. 7:31. https://doi.org/10.1186/1746-4269-7-31.

Angami A, Gajurel PR, Rethy P, Singh B and Kalita SK. 2006. Status and potential of wild edible plants of Arunachal Pradesh. Indian Journal of Traditional Knowledge. 5(4): 541-550.

Aberoumand A. 2011. Screening of Less known Two Food Plants for Comparison of Nutrient Contents: Iranian and Indian Vegetables. Functional Foods in Health and Disease.10:416-423

Beluhan S and Ranogajec A. 2010. Chemical composition and non-volatile components of Crotial wild edible mushrooms. Food Chemistry. 124:1076-1082.

Chauhan PP, Nigam A and Santvan. VK. 2016. Ethnobotanical study of wild fruits in Pabbar Valley, District Shimla, Himachal Pradesh. Journal of Medicinal Plants Studies. 4(2):216-220.

Grivetti LE and Ogle BM. 2000. Value of traditional foods in meeting macro- and micronutrient needs: the wild plant connection. Nutrition Research Reviews. 13:31-46.

Jain SK. 1963. Wild plant-foods of the tribals of Bastar (Madhya Pradesh). *Bulletin of Botanical Survey of India*. 30(2):56-80

Prakash D, Upadhyay G, Gupta C, Pushpangadan P and Singh KK. 2012. Antioxidant and free radical scavenging activities of some promising wild edible fruits. International Food Research Journal. 19(3):1109-1116.

Seal T, Pillai B and Chaudhuri K. 2017. Nutritional potential of five unexplored wild edible plants consumed by the tribal people of Arunachal Pradesh state in India. International Journal of Food Science and Nutrition. 2(2):101-105.

Sekeroglu N, Ozkutlu F, Deveci M, Dede O and Yilmaz N. 2016. Evaluation of some wild plants aspect of their nutritional values used as vegetable in eastern black sea region of Turkey. Asian Journal of Plant Science. 5:185-189.

Sundriyal M, Sundriyal RC, Sharma E and Porohit AN. 1998. Wild edible and other useful plants from the Sikkim Himalaya, India. Oecologia Montana. 7: 43-54.

Wangpan T, Tangjang S and Arunachalam A. 2017. Tribal agriculture: tradition in transition in the Indian Eastern Himalaya. Current Science. 112(7): 1327-1329.

Wangpan T, Taka T, Tangjang S and Arunachalam A. 2015. Sustainability of Indigenous Farming Practices: A Case Study among Apatani, Nocte and Wancho tribes in Arunachal Pradesh, Northeast India. International Journal on Agricultural Sciences. 6(1):103-108.

Albuquerque UP, Medeiros PM, Almeida AL, Monteiro J M, Lins Neto EMF, Melo JG and Santos, JP. 2007. Medicinal plants of the caatinga (semi-arid) vegetation of NE Brazil: a quantitative approach. Journal of Ethnopharmacology. 114:325-354.

Sarmah A, Haridasan K and Bisht NS. 2000. Development of medicinal plants as aan economic venture in Arunachal Pradesh: Prospects and constraints. Arunachal Forster News. 18: 85-92.