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Ethno–botanical survey of edible wild fruits in Benguet, Cordillera administrative region, the Philippines

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PEER REVIEW

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Comments

The research is an important contribution to biodiversity and ethnobotanical studies. It shows the interrelationships of traditional and cultural factors to the utilization and acceptance of the wild fruits as food. The distribution of the plant samples in the various municipalities may also be considered in relation to environmental conditions in future studies.

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ABSTRACT

Objective: To conduct a survey on the common name/s, traditional uses and cultural importance of the edible wild fruits in different municipalities of Benguet, Cordillera administrative region.

Methods: Interviews using questionnaires with barangay leaders and indigenous people were conducted with 176 key informants from June 2011 to July 2013.

Results: A total of 36 fruit species were found in different municipalities of Benguet. These fruit species belong to 27 genera and 20 families. Among the 13 municipalities of Benguet, Kibungan has the highest number of species. There are many uses of wild fruits which ranged from food (snack/dessert/table food), forage (especially for birds, monkeys and wild animals such as cloud rat and grass eaters), offertory, processed/preserved (as jam, jellies, candies, juice and wine), condiment or ingredient (for cooking), source of dye or ink, decoration (to garnish food) and as medicine to common ailments or health problems. Based on the inventory and calculated cultural importance index, *Garcinia binucao* (balokok) belonging to Clusiaceae is the most abundant fruit, hence it is the commonly used fruit for various purposes such as food, forage, processing/preservation and condiment/ingredient; *Vaccinium myrtilloides* (ayusip) for offerings and as source of dye/ink; *Saurauia elegans* (uyok) for decoration, and, *Antidesma bunius* (bugnay) for medicine.

Conclusions: Benguet province in the Cordillera region provides a diversity of edible wild fruits. The data gathered from the study signifies that collection, processing and utilization of edible wild fruits are still part of the daily activities of the people in Benguet.

KEYWORDS

Edible wild fruits, Benguet, Ethnobotanical knowledge, Cultural importance index

1. Introduction

Our growing population requires increasing food sources. Food and Agricultural Organization reported that 925 million people in the world are food insecure. By definition, food security is a state where all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life^[1]. Limited research on food security has been done in the Philippines^[2].

Wild fruits may be consumed during times when food source is scarce^[3,4]. The term wild refers to non–cultivated plants gathered in the field^[5]. Wild fruits make up the greatest percentage of wild food plants^[6]. Hence, many wild fruits are eaten worldwide^[1]. However, consumption of wild fruits has gradually decreased due to the introduction of exotic fruits^[4].

Benguet province is richly endowed with forest lands abundant in flora and fauna. About 66% to 80% of the land area is predominated by forest and shrub land. Unfortunately, there is a rapid decline in the number of

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forest resources[7].

At present, there are very limited studies conducted on wild fruits of Benguet[8–10]. Survey on the kinds, traditional uses and cultural importance of edible wild fruits in different municipalities of Benguet namely Atok, Bakun, Bokod, Buguias, Itogon, Kabayan, Kapangan, Kibungan, La Trinidad, Mankayan, Sablan, Tuba and Tublay have not yet been undertaken. Therefore, this study aimed to identify and classify the species of edible wild fruits found in each municipality, to record the uses of each edible wild fruit to document the traditional knowledge of the people in the study area and to evaluate the cultural significance of each species of fruit.

2. Materials and methods

2.1. Study area

Benguet lies southernmost in the Cordillera administrative region, the Philippines (Figure 1). It is located between 16°33' north latitude and 120°34' to 120°52' east longitude. On the north, it is bounded by Mountain province, on the south by Pangasinan, on the east by Ifugao and Nueva Viscaya, and on the west by La Union and Ilocos Sur. This province is composed of 13 municipalities namely Atok, Bakun, Bokod, Buguias, Itogon, Kabayan, Kapangan, Kibungan, La Trinidad, Mankayan, Sablan, Tuba and Tublay.

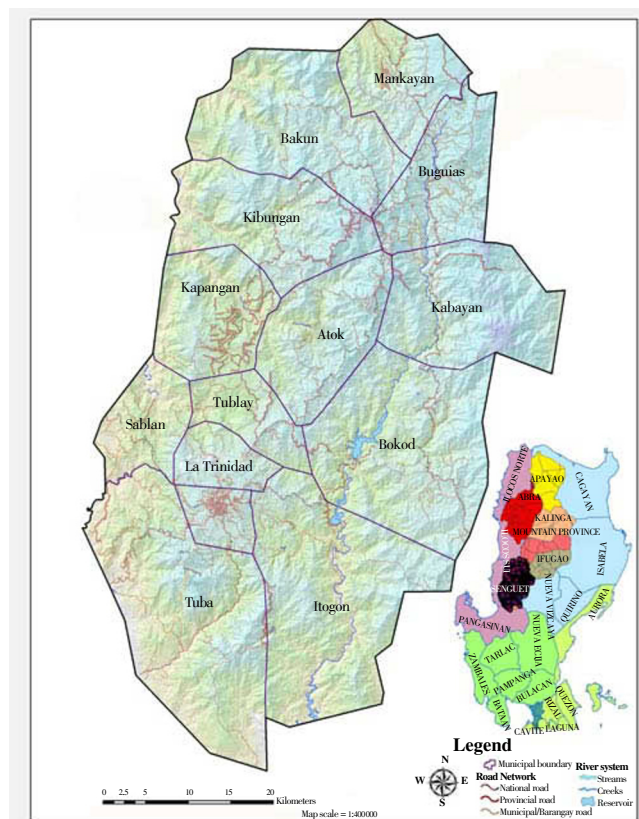


Figure 1. Map of the study area showing Benguet province, Cordillera administrative region in the Philippines and the 13 survey municipalities.

2.2. Data collection and analysis

Participatory approach involving survey through interview in the local language with barangay leaders and indigenous people, who are the original inhabitants of the area, was conducted in the 13 municipalities of Benguet province consisting of 140 barangays from June 2011 to July 2013, with a total of 176 key informants. The informants were chosen through cluster sampling (Reference: Kerry S, Bland J. Statistics notes: the intracluster correlation coefficient in cluster randomization. *Br Med J* 1998; 316: 1455–1460.). Selection was based on the informant's sound traditional knowledge of edible wild fruits. These key informants are most credible, informed, most experienced people on the edible wild fruits found in the area. Informants were between the ages of 25 and 77 with an average age of 47 years.

Structured survey was carried out to gather qualitative and quantitative data related to traditional plant use. Questionnaires were distributed to facilitate the individual and group interviews. Questions addressed to the informants about edible wild fruit consumption were mainly focused on the common local name, knowledge about the past and present ethno-botanical and medicinal uses and place of collection.

Voucher specimens were deposited at the Fr. Gerard Braeckman Museum of Natural History in Saint Louis University, Baguio City. Identification was carried out using keys, online plant databases, pictorial flora, plant dictionaries and taxonomic references[11–19]. Further, this study did not deal with the cataloguing of edible wild fruits in Mt. Pulag, Kabayan, Benguet since this research primarily focused on the edible wild fruits present in different barangays inhabited by the local people and their traditional uses. In addition, abiotic and agronomic factors such as light, soil type, amount of rainfall, soil pH and humidity, which could affect the geographical distribution of the fruits were not investigated and accounted for in the study.

2.3. Food use categories of wild edible fruits based on folk perceptions

Data were grouped into the following fruit use categories based on folk perceptions: food (snack/dessert/table food), forage (food for animals), offertory (food for offerings), processed/preserved (in the form of jams, jellies, candy, juice or wine), condiment/ingredient, medicinal, dye/ink and decoration (garnish/ornament food).

2.4. Estimation of cultural significance of each species

After listing the fruits used per category, the cultural significance of each species was estimated for the entire Benguet province following the formula used in the study by Pardo-de-Santayana *et al.* where the summation of use report in every use-category mentioned for a species was divided by the total number of survey participants (N)[20].

Every plant species mentioned by an informant within one–use category was counted as one–use–report. The cultural importance index (CI) could be expressed through the formula below:

$$CI = \sum_{i=1}^{i=NU} \frac{UR_i}{N}$$

Where i– varies from only one use to the total number of uses, NU mentioned for a species and N– total number of informants in the survey. For example, *Medinilla pendula* (*M. pendula*) (agubangbang) in Benguet was reported as used in food (snack/dessert/table food) by four informants, for forage by four, for decoration/garnish by one and for medicinal (treatment for cough and colds) by one. The total number of respondents is 82. Therefore, the CI of agubangbang is 0.122.

This additive index takes into account the spread of use for each species and versatility. The theoretical maximum value of the index is the total number of the different use categories. Meanwhile, to measure the cultural importance

of families (CIf), the indices of the species from each family were added. The highest CI/CIf confirms the most widely used and most important fruit species/family for a given category of usage, while the fruit with the lowest CI/CIf indicates that it is least used or of minimum importance.

The ranking of fruit species and plant families was based on the over–all cultural significance of each fruit and family arranged from the highest to the lowest using the total CI of each fruit (sum total of CI in all use category) and computation of CIf for each family.

3. Results

A total of 36 fruit species are found in the different municipalities of Benguet (Figure 2). These are classified in 27 genera and 20 families (Table 1). Among the 13 municipalities of Benguet, Kibungan has the highest number of species with a total of 16 followed by Sablan and La Trinidad with 14, and Kapangan as third with 12. The lowest number is found in Kabayan (Figure 3). Figure

Table 1
Edible wild fruits in Benguet.

Family	Scientific name	Local name	Availability in Municipalities															
			A	B	O	U	I	K	P	N	L	M	S	T	Y			
Actinidiaceae	<i>Saurauia</i> sp.	Soybo (Igt)												√				
	<i>Saurauia elegans</i>	Uyok (Igt, Knk)	√		√	√	√	√	√	√	√	√	√	√	√	√		√
	<i>Saurauia sparsifolia</i>	Sapuwan (Igt)/Degway (Knk)	√	√	√	√		√	√	√	√	√	√	√	√	√		√
Arecaceae	<i>Callamus manillensis</i>	Litoko (Ilk)					√										√	√
Clusiaceae	<i>Garcinia binucao</i>	Balokok (Igt)	√	√	√		√	√	√	√	√	√	√	√	√	√	√	√
	<i>Rheedia edulis</i> or <i>Garcinia intermedia</i>	Chinese Santol (Tag)/Lemon drop mangosteen (Eng)																√
	<i>Garcinia vidalii</i>	Bilis/Belis (Igt)		√	√					√	√	√						
Dilleniaceae	<i>Dillenia philippinensis</i>	Palali (Igt)		√														√
Elaeagnaceae	<i>Elaeagnus triflora</i>	Bennaken/Banaken (Bon); Kopapey (Igt)											√		√			√
Ericaceae	<i>Vaccinium barandanum</i>	Lusong (Igt)	√				√					√	√					
	<i>Vaccinium myrtilloides</i>	Ayosep/Ayusip (Igt); Alumani(Bon); Gotmo (Knk)	√	√	√	√	√	√				√	√	√	√	√	√	√
Flacourtiaceae	<i>Flacourtia rukam</i>	Kalominga/Kaluminga (Igt); Native Cherry (Eng)												√			√	√
	<i>Medinilla pendula</i>	Agubangbang/Balanban/Ballangbang/Gubangbang (Igt)										√	√	√	√			
Melastomataceae	<i>Melastoma malabathricum</i>	Baksi/Dagaday/Tagad–ay (Igt)										√						
Moraceae	<i>Ficus</i> sp.	Aplas/Appas/Opdas (Igt)													√			
	<i>Ficus minahassae</i>	Alomit (Igt)															√	√
	<i>Morus alba</i>	Moras (Tag)					√	√										√
Muntingiaceae	<i>Muntingia calabura</i>	Sarisa (Ilk)															√	
Musaceae	<i>Musa rosacea</i>	Bayating/Amoting (Igt)															√	√
Myrsinaceae	<i>Embelia philippinensis</i>	Bisolak/Bisudak (Igt)		√			√				√							
Myrtaceae	<i>Psidium guajava</i>	Wild Guava (Eng)/Bayabas (Tag/Ilk)				√		√		√	√							
Passifloraceae	<i>Passiflora edulis</i>	Masaplor/Masaplor (Ibl)	√				√	√										√
Phyllanthaceae	<i>Antidesma bunius</i>	Bugnay/Bignay (ManyLgs)		√			√									√	√	√
	<i>Antidesma montanum</i> or <i>Antidesma angustifolium</i>	Balekesan (Igt)													√			
Rosaceae	<i>Photinia serratifolia</i>	Sugsuggat (Igt)												√				
	<i>Rubus ellipticus</i>	Batnak/Butnak (Igt); Bunut (Bon)	√				√											
	<i>Rubus fraxinifolius</i>	Pinit (Ilk); Doting/Luting/Buyot (Igt); Sapinit (Tag)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Solanaceae	<i>Solanum betacea</i>	Dulce/Tamarillo (Sp)	√				√											
	<i>Physalis peruviana</i>	Gobbayas/Gumbais (Igt) Cape gooseberry (Eng)	√											√				
	<i>Solanum pimpinellifolium</i>	Marble Tomato (Eng)											√					
Urticaceae	<i>Debregeasia longifolia</i>	Ngamoy/Ngamey (Ifig); Namey (Knk)					√											
	<i>Leucosyke benguetensis</i>	Lapsek/Lapsik (Igt)															√	
Vitaceae	<i>Tetragium</i> sp.	Ngalatngat (Igt); Ngaratngat (Neg)																√
Zingiberaceae	<i>Alpinia vanoverberghii</i>	Akhab (Knk/Bon)		√									√	√				
	<i>Amomum lepicarpum</i>	Gadang (Igt)			√						√	√	√					
	<i>Leptosolena haenkei</i>	Poli (Igt); Panawil (Knk)												√	√			

√: fruit is present. Local name languages: Bon–Bontok; Eng–English; Ibl–Inibaloi; Ifg–Ifugao; Igt–Igorot; Ilk–Ilokano; Knk–Kankana–ey; Neg–Negrito; Sp–Spanish; Tag–Tagalog; ManyLgs–Many Languages. Municipality: A–Atok; B–Bakun; O–Bokod; U–Buguias; I–Itogon; K–Kabayan; P–Kapangan; N–Kibungan; L–La Trinidad; M–Mankayan; S–Sablan; T–Tuba; Y–Tublay.

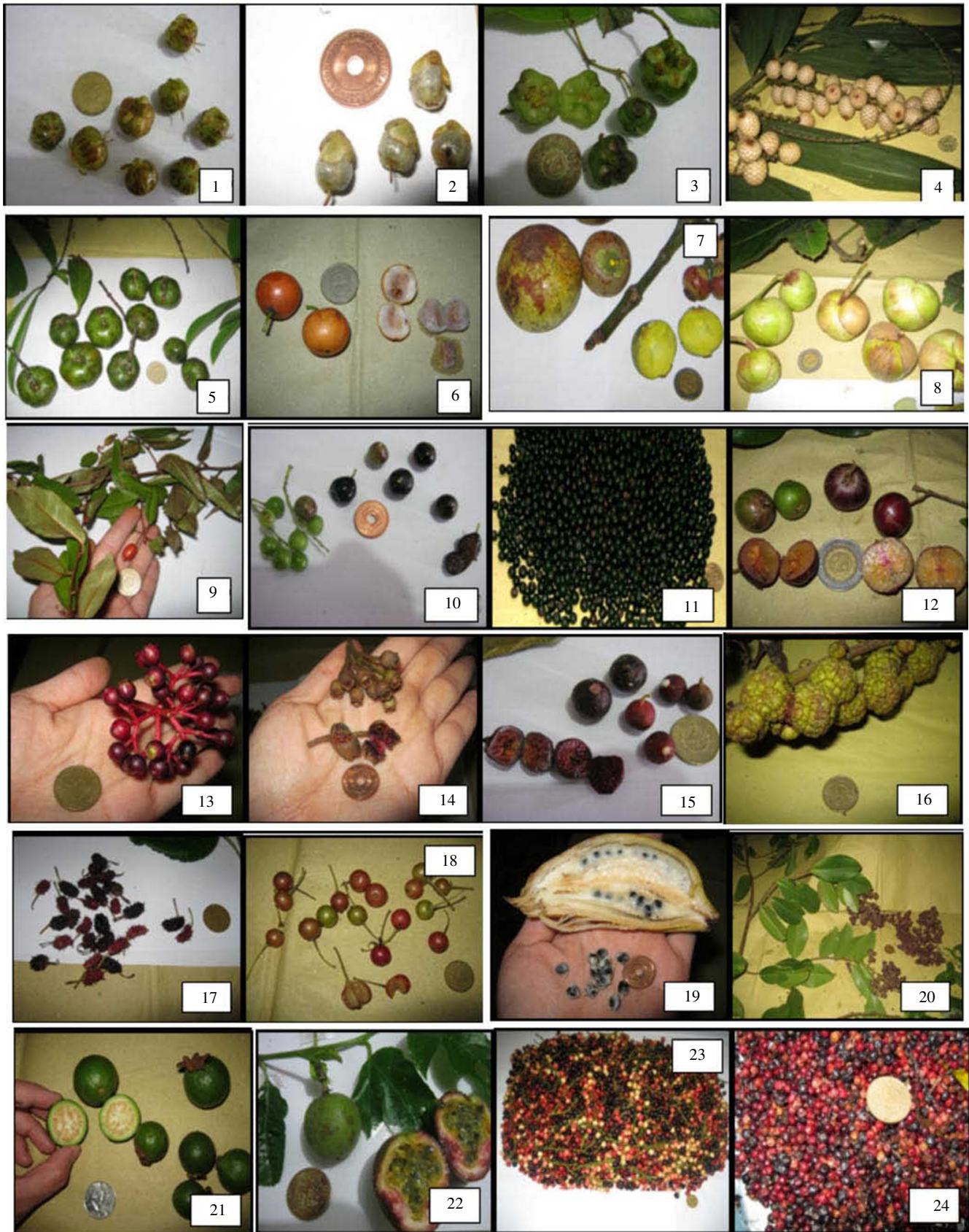


Figure 2. Photographs of edible wild fruits in the different municipalities of Benguet.

1: *Saurauia* sp. (soybo), 2: *Saurauia elegans* (uyok), 3: *Saurauia sparsifolia* (degway), 4: *Calamus manillensis* (litoko), 5: *Garcinia binucao* (balokok), 6: *Garcinia intermedia* (Chinese santol), 7: *Garcinia vidalii* (belis), 8: *Dillenia philippinensis* (palali), 9: *Elaeagnus triflora* (bennaken), 10: *Vaccinium barandatum* (lusong), 11: *Vaccinium myrtoides* (ayusip), 12: *Flacourtia rukam* (kaluminga), 13: *Medinilla pendula* (agubangbang), 14: *Melastoma malabathricum* (dagad-ay), 15: *Ficus* sp. (aplas), 16: *Ficus minahassae* (alomit), 17: *Morus alba* (moras), 18: *Muntigia calabura* (sarisa), 19: *Musa rosacea* (bayating), 20: *Embelia philippinensis* (bisudak), 21: *Psidium guajava* (bayabas), 22: *Passiflora edulis* (masaplora), 23: *Antidesma bunius* (bugnay), 24: *Antidesma montanum* (balekesan).

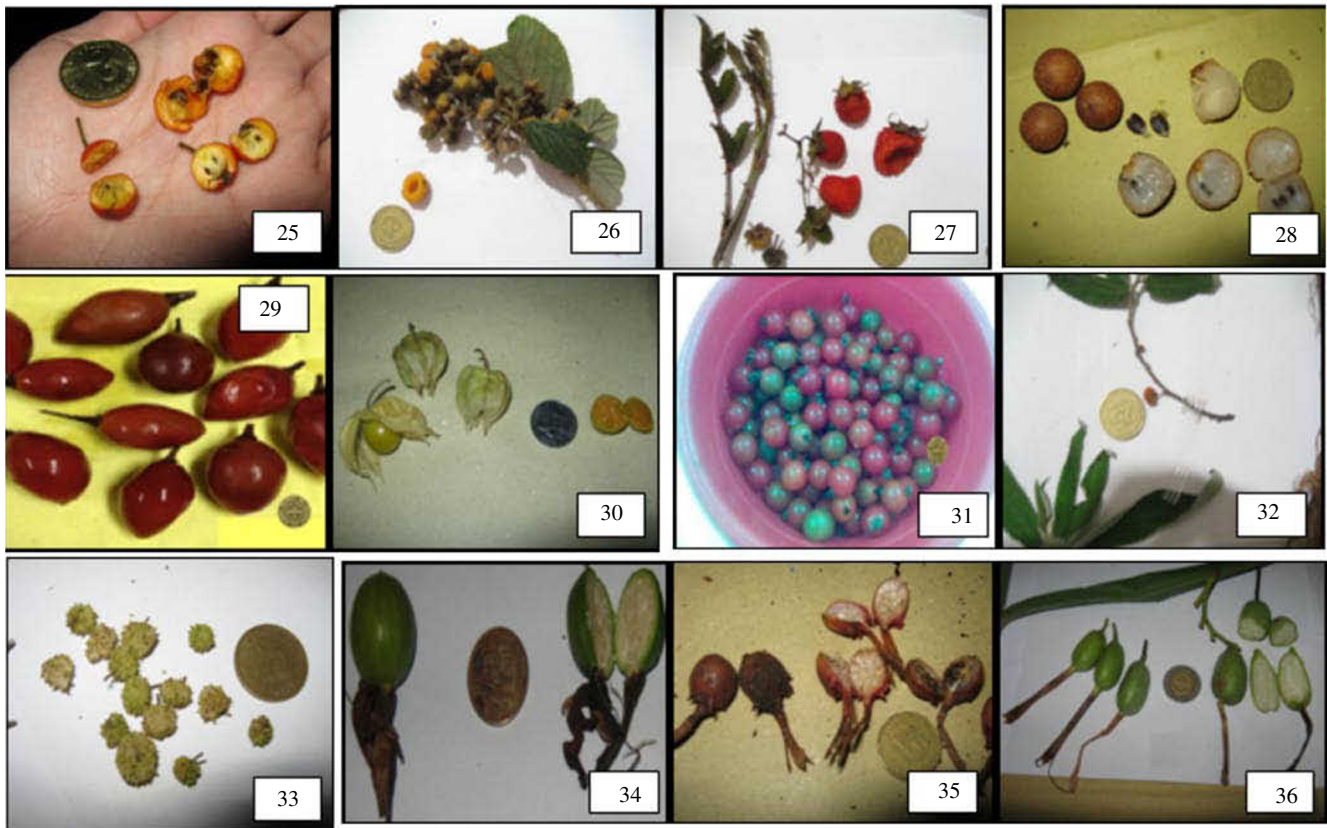


Figure 2 (continued). Photographs of edible wild fruits in the different municipalities of Benguet.

25: *Photinia serratifolia* (sugsuggat), 26: *Rubus ellipticus* (batnak), 27: *Rubus fraxinifolius* (pinit), 28: *Tetrastigma* sp. (ngalatngat), 29: *Solanum betacea* (dulce), 30: *Physalis peruviana* (gobbayas), 31: *Solanum pimpinellifolium* (marble tomato), 32: *Debregeasia longifolia* (ngamey), 33: *Leucosyke benguetensis* (lapsek), 34: *Alpinia vanoverberghii* (akbab), 35: *Amomum lepicarpum* (gadang), 36: *Leptosolena haenkei* (poli).

4 shows the distribution of edible wild fruits based on the total number of location sites (barangays) in the different municipalities where the fruits can be found in Benguet.

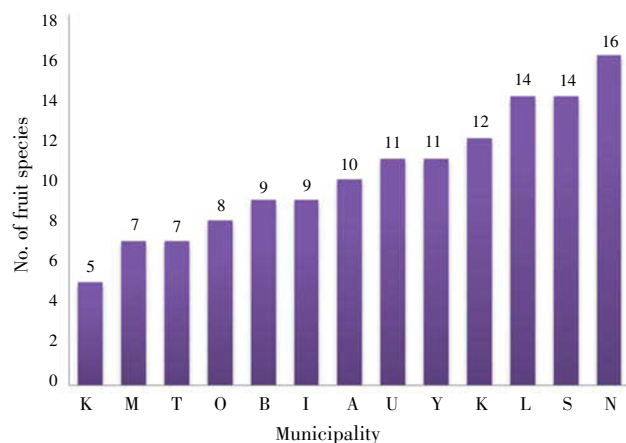


Figure 3. Ranking of municipalities based on the number of fruit species present. K: Kabayan; M: Mankayan; T: Tuba; O: Bokod; B: Bakun; I: Itogon; A: Atok; U: Buguias; Y: Tublay; K: Kapangan; L: La Trinidad; S: Sablan; N: Kibungan.

Out of the 140 barangays, *Garcinia binucao* (*G. binucao*) belonging to Clusiaceae is the most abundant fruit found in Benguet (37 barangays), followed by *Saurauia sparsifolia* (*S. sparsifolia*) (36 barangays) and *Rubus fraxinifolius* (*R. fraxinifolius*) (32 barangays). On the other hand, several fruits are limited to a specific barangay and municipality. *Photinia serratifolia* (*P. serratifolia*) is only found in Kapangan

(Pudong), *Saurauia* sp. (soybo) in Kibungan (Tacadang), *Muntigia calabura* (*M. calabura*) in Sablan (Poblacion), *Tetrastigma* sp. (ngalatngat) in Tublay (Tuel), *Solanum pimpinellifolium* (*S. pimpinellifolium*) in Kapangan (Paykek), *Leucosyke benguetensis* (*L. benguetensis*) in La Trinidad (Shilan), *Melastoma malabathricum* (*M. malabathricum*) in Kapangan (Pudong), *Rheedia edulis* (*R. edulis*) in Sablan (Poblacion), *Antidesma montanum* (*A. montanum*) in La Trinidad (Shilan) and *Ficus* sp. (aplas) in La Trinidad (Shilan).

Table 2 summarizes the uses of edible wild fruits in Benguet. In terms of food, a total of 36 kinds of fruits were listed during the survey. Figure 5 shows the cultural importance index of the fruits used for food. *G. binucao* has the highest CI value of 0.451 followed by *S. sparsifolia* (0.439) and *R. fraxinifolius* (0.390). On the other hand, the following fruits such as *P. serratifolia*, *Saurauia* sp., *M. calabura*, *Tetrastigma* sp., *S. pimpinellifolium*, *L. benguetensis*, *M. malabathricum*, *R. edulis*, *A. montanum*, and *Ficus* sp. (aplas) have the lowest CI of 0.012. In forage use, a total of 23 fruits were listed (Figure 6). Among the 23 fruits, *G. binucao* has the highest CI value of 0.341 followed by *R. fraxinifolius* and *Vaccinium myrtooides* (*V. myrtooides*) at 0.232 and 0.183 CI values respectively.

In this study, a total of 10 fruits were listed for offerings. *V. myrtooides* has the highest CI value of 0.073 followed by *S. sparsifolia* and *Psidium guajava* (*P. guajava*) with both 0.061 CI value (Figure 7).

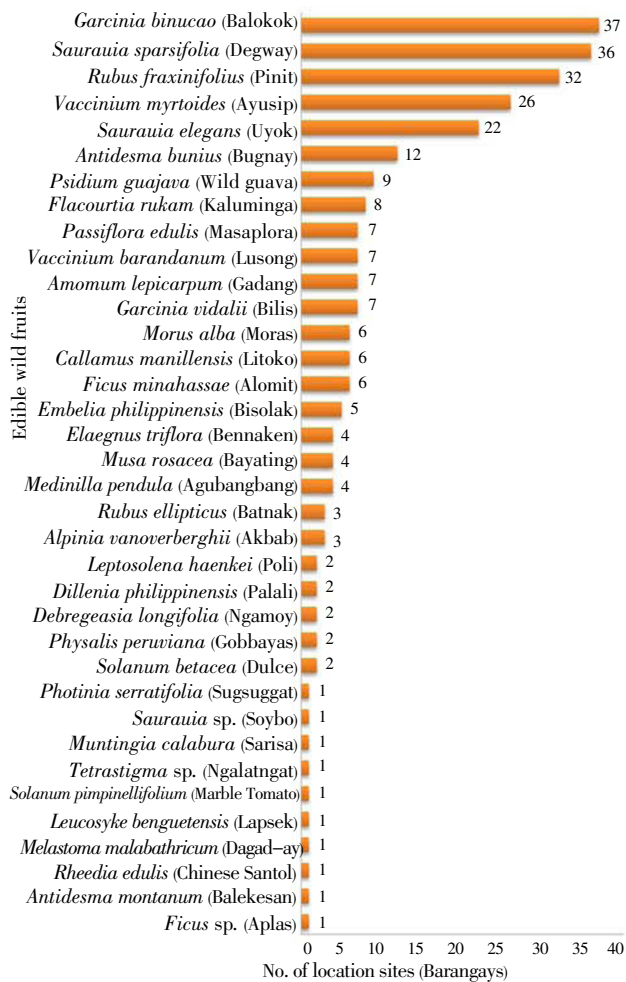


Figure 4. Ranking of edible wild fruits based on distribution.

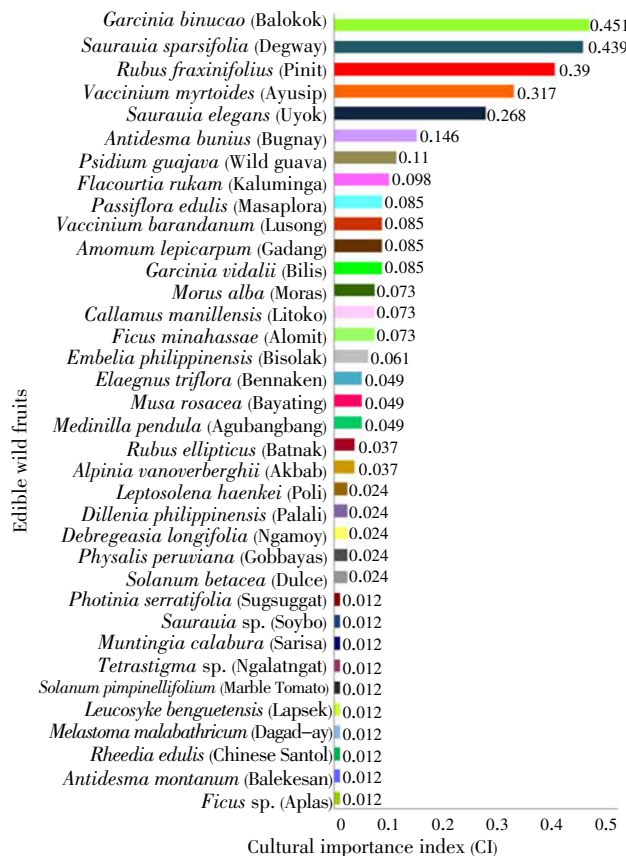


Figure 5. Ranking of edible wild fruits used as food.

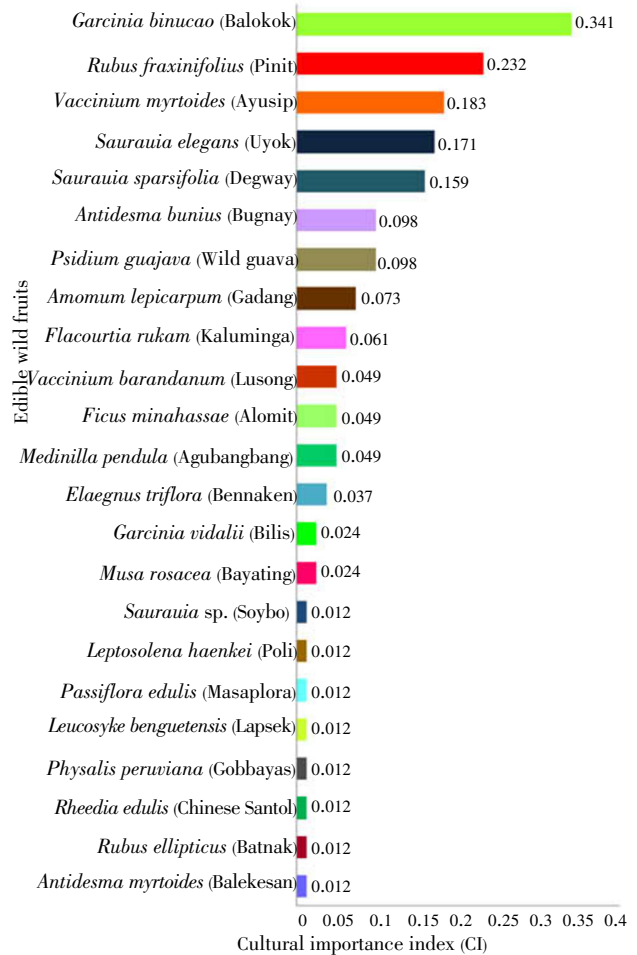


Figure 6. Ranking of edible wild fruits used as forage/food for animals.

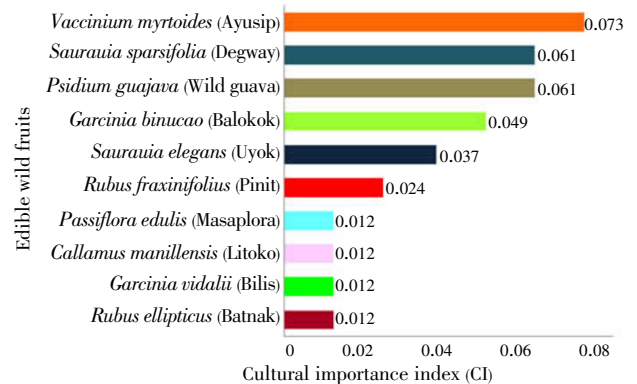


Figure 7. Ranking of edible wild fruits used in offerings.

In food processing/preservation specifically making jams, jelly, candy, juice and wine, a total of 24, 19, 14, 13 and 22 fruits were listed respectively. Among these fruits, *G. binucao* has the highest CI value in jam and wine with 0.427 (Figure 8) and 0.354 (Figure 9) respectively. Meanwhile, *R. fraxinifolius* has the highest CI value of 0.366 in jellies (Figure 10), 0.28 in candy (Figure 11) and 0.159 in juice (Figure 12).

In condiment/ingredient, there are 10 kinds of fruits listed. *G. binucao* has the highest CI value of 0.427 followed by *S. sparsifolia* and *P. guajava* with 0.171 and 0.098 respectively (Figure 13). In dye or ink, there are only three fruits listed. *V. myrtooides* has the highest CI value of 0.049 followed by *Morus alba* (0.037) and *R. fraxinifolius* (0.024). In food décor,

Table 2

Summary of uses of edible wild fruits in Benguet.

Local name/s	Scientific name	Food (snack/ dessert/table food)	Forage	Offertory	Processed/preserved					Condiment/ ingredient	Dye/ ink	Decoration	Medicinal use/s
					Jam	Jellies	Candies	Juice	Wine				
Soybo (Igt)	<i>Saurauia</i> sp.	√	√ birds		√	√	√	√	√				
Uyok (Igt, Knk)	<i>Saurauia elegans</i>	√	√ birds, grass eaters, wild rat	√	√	√	√	√	√		√	lung problem	
Sapuwan (Igt/Degway (Knk)	<i>Saurauia sparsifolia</i>	√	√ birds, wild animals	√	√	√	√	√	√	√		flu, cough, hypertension, “agas ti nginao” – for conceiving mother’s cravings	
Litoko (Ilk)	<i>Callamus manillensis</i>	√		√	√		√		√			cough, flu, arthritis, “agas ti nginao” – for conceiving mother’s cravings	
Balokok (Igt)	<i>Garcinia binucao</i>	√	√ birds, grass eaters	√	√	√	√	√	√	√		source of vitamin C for flu	
Chinese Santol (Tag/Lemon drop mangosteen (Eng)	<i>Rheedea edulis</i> or <i>Garcinia intermedia</i>	√	√ birds										
Bilis/Belis (Igt)	<i>Garcinia vidalii</i>	√	√ birds	√	√	√	√		√	√			
Palali (Igt)	<i>Dillenia philippinensis</i>	√											
Bennaken/Banaken (Bon); Kopapey (Igt)	<i>Elaeagnus triflora</i>	√	√ birds, wild animals	√	√	√	√	√				cough	
Lusong (Igt)	<i>Vaccinium barandanum</i>	√	√ birds		√	√	√	√					
Ayosep/Ayusip (Igt); Alumani (Bon); Gotmo (Knk)	<i>Vaccinium myrtooides</i>	√	√ birds	√	√	√	√		√	√		poor eyesight, diabetes, antioxidant, flu, anti-cancer	
Kalominga/Kaluminga (Igt); Native Cherry (Eng)	<i>Flacourtia rukam</i>	√	√ birds, bats		√	√		√	√				
Agubangbang/Balanban/ Ballangbang/Gubangbang (Igt)	<i>Medinilla pendula</i>	√	√ birds								√	cough, colds	
Baksi/Dagaday/Tagad-ay (Igt)	<i>Melastoma malabathricum</i>	√											
Aplas/Appas/Opdas(Igt)	<i>Ficus</i> sp.	√											
Alomit (Igt)	<i>Ficus minahassae</i>	√	√ birds, cloud rat, wild animals		√				√				
Moras (Tag)	<i>Morus alba</i>	√			√	√		√	√		√		
Sarisa (Ilk)	<i>Muntingia calabura</i>	√			√						√		
Bayating/Amoting (Igt)	<i>Musa rosacea</i>	√	√ birds, monkey		√				√				
Bisolak/Bisudak (Igt)	<i>Embelia philippinensis</i>	√			√	√			√				
Wild Guava (Eng/ Bayabas (Tag/Ilk)	<i>Psidium guajava</i>	√	√ birds, goat	√	√	√		√	√	√	√		
Masaplor/Masaplor (Ibl)	<i>Passiflora edulis</i>	√	√ birds	√	√			√	√		√		
Bugnay/Bignay (ManyLgs)	<i>Antidesma bunius</i>	√	√ birds		√	√	√	√	√	√		diabetes, body cleansing	
Balekesan (Igt)	<i>Antidesma montanum</i> or <i>A. angustifolium</i>	√	√ birds		√	√	√	√	√	√	√		
Sugsuggat (Igt)	<i>Photinia serratifolia</i>	√											
Batnak/Butnak (Igt); Bunut (Bon)	<i>Rubus ellipticus</i>	√	√ birds		√	√	√		√				
Pinit (Ilk); Doting/Luting/ Buyot (Igt); Sapinit (Tag)	<i>Rubus fraxinifolius</i>	√	√ birds, wild animals		√	√	√	√	√	√	√	stomachache, sore eyes, urinary tract infection, cough	
Ngalatngat (Igt); Ngaratngat (Neg)	<i>Tetrastigma</i> sp.	√											
Dulce/Tamarillo (Sp)	<i>Solanum betacea</i>	√			√	√			√			anti-cancer	
Gobbayas/Gumbais (Igt/Cape gooseberry (Eng)	<i>Physalis peruviana</i>	√	√ wild animals		√	√							
Marble Tomato (Eng)	<i>Solanum pimpinellifolium</i>	√								√			
Ngamoy/Ngamey (Ifg;Namey (Knk)	<i>Debregeasia longifolia</i>	√											
Lapsek/Lapsik (Igt)	<i>Leucosyke benguetensis</i>	√	√ birds		√	√	√						
Akhab (Knk/Bon)	<i>Alpinia vanoverberghii</i>	√							√			loose bowel movement	
Gadang (Igt)	<i>Amonum lepicarpum</i>	√	√ birds							√		loose bowel movement	
Poli (Igt); Panawil (Knk)	<i>Leptosolena haenkei</i>	√	√ birds, wild animals							√			

√: fruit is present. Local name languages: Bon–Bontok; Eng–English; Ibl–Inibaloi; Ifg–Ifugao; Igt–Igorot; Ilk–Ilokano; Knk–Kankana-ey; Neg–Negrito; Sp–Spanish; Tag–Tagalog; ManyLgs–Many Languages.

among the eight fruits, *Saurauia elegans* (*S. elegans*) has the highest CI value (0.122) followed by the fruits *M. calabura* (0.012), *R. fraxinifolius* (0.012), *Passiflora edulis* (0.012), *S. sparsifolia* (0.012), *P. guajava* (0.012), *A. montanum* (0.012) and *M. pendula* (0.012). In medicine, 12 fruits were listed to have

medicinal use. These are *Antidesma bunius* (*A. bunius*) for diabetes and body cleansing; *V. myrtooides* for good eye sight, diabetes, antioxidant, flu, anti-cancer; *S. sparsifolia* for “agas ti nginao” (for conceiving mothers’ cravings), flu, cough and hypertension; *R. fraxinifolius* for stomachache, sore eyes,

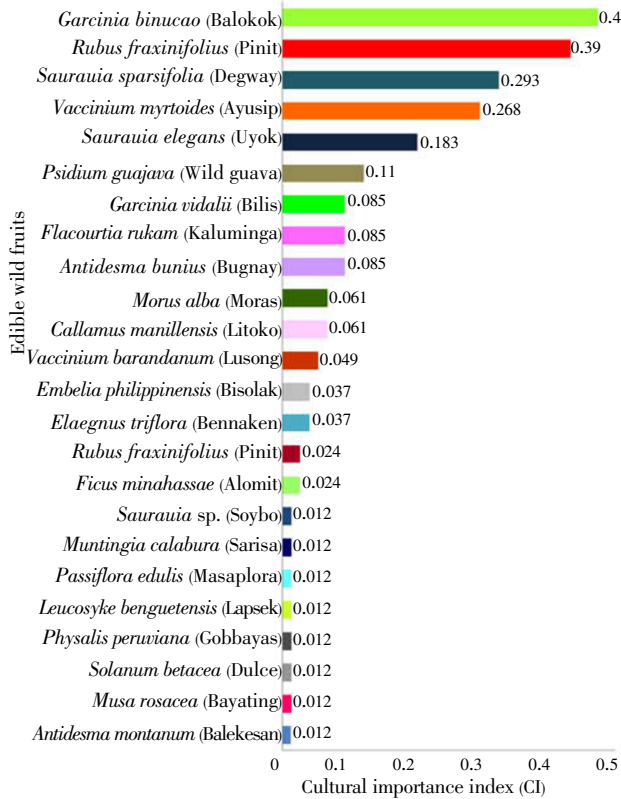


Figure 8. Ranking of edible wild fruits used in making jams.

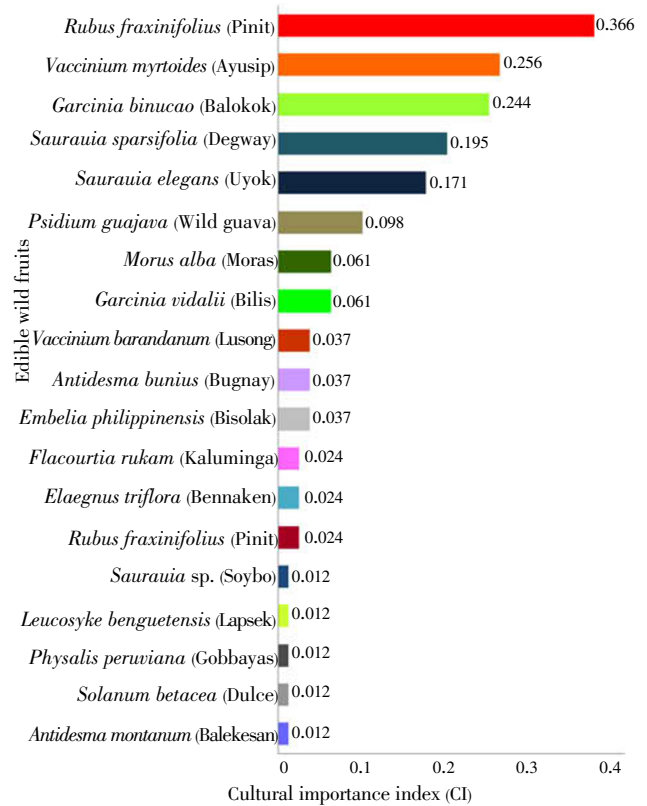


Figure 10. Ranking of edible wild fruits used in making jellies.

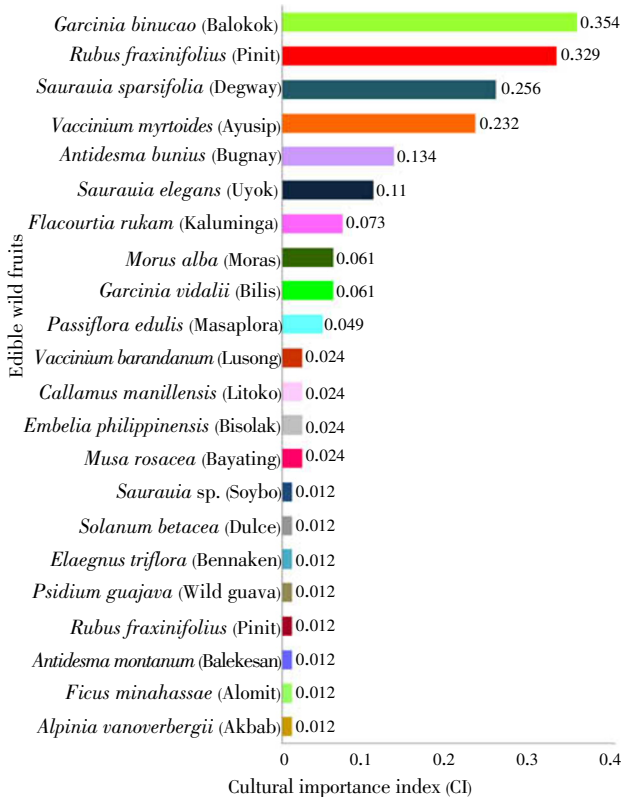


Figure 9. Ranking of edible wild fruits used in making wine.

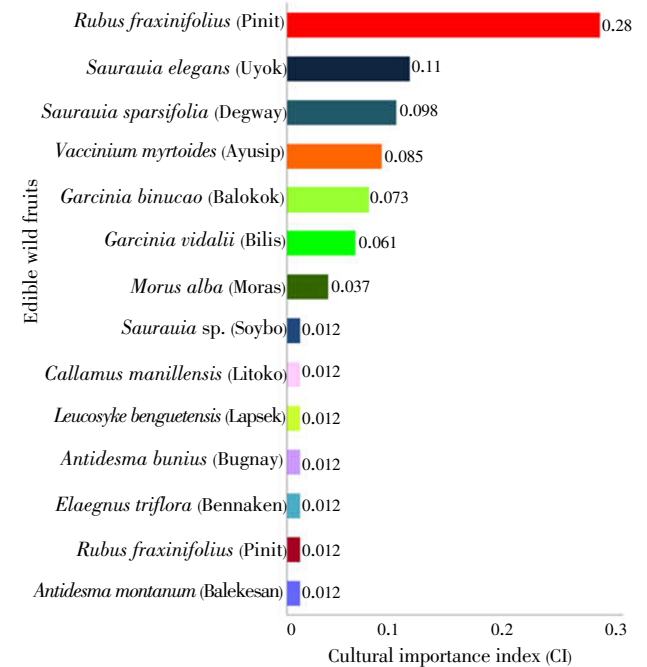


Figure 11. Ranking of edible wild fruits used in making candies.

urinary tract infection and cough; *G. binucao* for “agas ti nginao” (conceiving mothers’ cravings), cough, flu and arthritis; *Amomum lepnicarpum* for loose bowel movement; *Solanum betacea* for anti-cancer; *R. edulis* for good source

of vitamin C; *Elaegmus triflora* for cough; *S. elegans* for lung problem (respiratory) *Alpinia vanoverbergii* for loose bowel movement and *M. pendula* for cough and colds. Among these fruits, *A. bunius* has the highest CI value of 0.098 followed by

V. myrtilloides with 0.073 and *S. sparsifolia* with 0.061 (Figure 14).

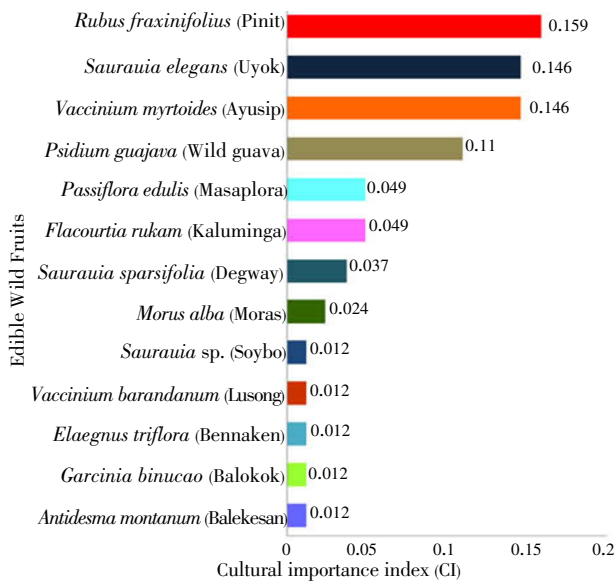


Figure 12. Ranking of edible wild fruits used as juice.

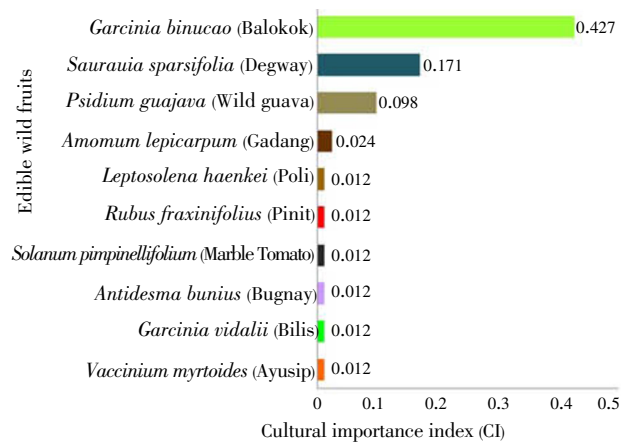


Figure 13. Ranking of edible wild fruits used as condiments/ingredients.

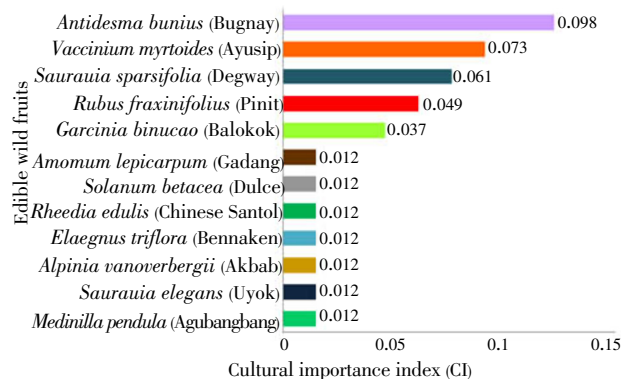


Figure 14. Ranking of edible wild fruits with medicinal uses.

Figure 15 shows the over-all cultural importance of plant families. Actinidiaceae is ranked number 1 among the 20 families accounted in this study. It has the highest cultural significance index (Clf) of 3.194 followed by Clusiaceae and Rosaceae with 2.854 and 2.414 values respectively.

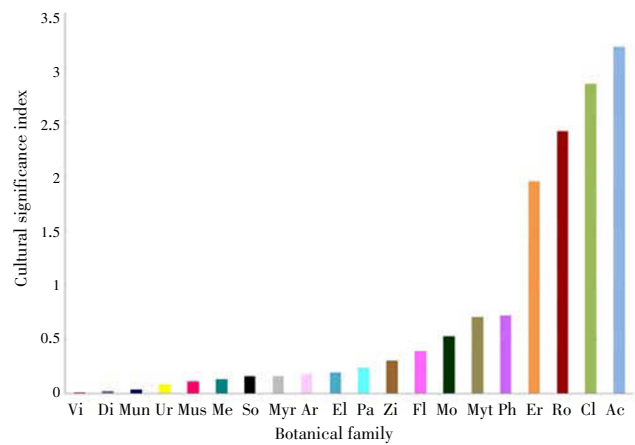


Figure 15. Ranking of edible wild fruit families based on cultural significance index of families (Clf).

Vi: Vitaceae; Di: Dilleniaceae; Mun: Muntingiaceae; Ur: Urticaceae; Mus: Musaceae; Me: Melastomataceae; So: Solanaceae; Myr: Myrsinaceae; Ar: Arecaceae; El: Elaeagnaceae; Pa: Passifloraceae; Zi: Zingiberaceae; Fl: Flacourtiaceae; Mo: Moraceae; Myt: Mytaceae; Ph: Phyllanthaceae; Er: Ericaceae; Ro: Rosaceae; Cl: Clusiaceae; Ac: Actinidiaceae.

4. Discussion

4.1. Taxonomic diversity and distribution of edible wild fruits in Benguet

This ethno-botanical survey reveals the presence of edible wild fruits in the different municipalities of Benguet in the Cordillera administrative region, the Philippines. The fruits listed in this study are found in the forests of the different municipalities. The climate in the province is under Type 1 classification by Corona’s system with two distinct pronounced seasons, wet from May to October and dry from November to April. This subtropical climate is suitable for the growth of different wild fruits^[21].

Based on municipal records, Kibungan has a total land area of 30 158.5959 ha. The barangays differ in topographies and landforms ranging from steep slope to mountainous terrain with an elevation of 2500 m and more above sea level. Some 23951.7052 ha or 79% of the municipality’s total land area is classified as forest while 6106.1845 ha is dedicated to agriculture which focuses on the cultivation of *Sechium edule* (sayote) as a cash crop. Sablan is one of the top fruit producing municipalities of the province. Some of the municipality’s fruit produces include banana, santol, mango, pineapple among others^[22]. Hectares of land are set aside in the municipality as communal forest and watersheds. According to the municipal agriculture office, 1413.88 ha out of 2827.76 ha of agricultural lands are devoted to crops. Aside from palay, root crops, legumes and plantation crops, fruit trees are also given priority in the area. In the 1900s, many parts of La Trinidad were thickly forested. However, due to urban development brought about by a very high population growth rate, conversion of agricultural lands to

residential and commercial areas took effect in the different areas of La Trinidad with a total number of 16 barangays^[23]. Despite this scenario, at present protected communal forests where edible wild fruits grow can still be found such as in Shilan. This barangay is considered one of the minor urban areas together with Puguis, Alapang and Cruz which cover a total of 2030.72 ha. Unfortunately, this is under constant threat of human occupation and is transformed into an adventure eco–park^[24]. The lowest rank of Kabayan may be due to only 133.0 ha of land is used as a communal forest as compared to other land use classification as follows: agriculture 2524.283 ha, pasture 1014.5 ha and forest reserved 11550 ha^[22]. Aside from this, Mt. Pulag, a national park in Kabayan protected by the Department of Environment and Natural Resources, was not included in the survey. A study conducted by Viray *et al.* cited deforestation as one of the reasons for a declining number of species in Mt. Pulag^[25]. Limited plant species were identified. These belong to Poaceae such as *Coix lacryma*, *Imperata cylindrica*, *Miscanthus sinensis*, *Saccharum spontaneum*, *Pollinia quadrinervis*, *Rottboellia ophiuroides*, *Anthraxon ciliaris*, *Anthraxon microphyllum*, *Themeda triandra*, *Themeda gigantea*, *Apluda mutica*, *Arundinella selosa*, *Digitaria longiflora*, *Digitaria sanguinalis*, *Isachne mysotis*, *Isachne beneckel*, *Isachne pangerangensis*, *Isachne pauciflora*, *Isachne magna*, *Penicum crus–galli* among others^[25]. Aside from these, 12 wild fruits were identified namely *Physalis angulata* (batbatauang), *Rubus pectinellus* (pinit), *Rubus niveus* (duting), *Leucosyke capitellata* (namey), *Rubus chrysophullus* (mangkunetrap), *Vaccinium myrtooides* (ayusip), *Rubus* sp. (batnak), *S. elegans* (oyok), *Saurauia bontocensis* (degway), *Vaccinium whitfordii* (vaccinium), *Calamus* spp. (oway) and *P. guajava* (bayabas)^[9]. Further, bryoflora is one of the more diverse communities in Mt. Pulag^[26].

In this study, the loss or decline of wild species is due to the following reasons: 1) replacement of wild flora with introduced crops; 2) domination of commercial farms; 3) unsustainable use of wild fruits; 4) forest habitat destruction due to natural disasters, population growth and pollution^[27]. Overall, man–made activities have greatly caused massive forest destruction resulting to declining biodiversity^[28].

The top three fruits commonly eaten by the inhabitants of Benguet are *G. binucao*, *S. sparsifolia* and *R. fraxinifolius*. *G. binucao* is common and widely distributed throughout Luzon and the Visayan islands of the Philippines^[29]. Trees of *G. binucao* are found scattered and are second–storey trees of primary lowland and secondary forests. It is easily propagated by allowing ripe fruits to fall on the ground and wait for the seeds of fallen fruits to germinate^[30]. Like *G. binucao*, *S. sparsifolia* and *R. fraxinifolius* are common wild fruits that abound in Cordillera. *S. sparsifolia* is a medium–sized tree reaching a maximum height of about 6.0 m. It is prolific and fruits heavily over a long period of time, around

four months or more starting from the month of July. *R. fraxinifolius*, on the other hand, is a scrambling, spiny shrub growing in thickets at 800–1300 m, having 5 to 9 leaflets with toothed margins. These wild berries occur in terminal clusters and with a good flavor^[18,19].

4.2. Ethnobotanical uses of edible wild fruits in Benguet

There are many uses of wild fruits ranging from food (snack/dessert/table food), forage (especially for birds, monkeys and wild animals like cloud rat), offertory, processed/preserved (as jam, jellies, candies, juice and wine), condiment or ingredient (for cooking), source of dye or ink, decoration (to garnish food) and as medicine to common ailments or health problems.

In terms of food, all the fruits are edible and may be eaten raw. Based on the index, *G. binucao* is widely eaten as snack/dessert or table food. This is due to the abundant distribution of this fruit in all the municipalities except in Buguias where the main fruits present are *S. sparsifolia* and *V. myrtooides*. This fruit is not present in Buguias because as per municipal record, the municipality has high elevation that ranges 1200 to 2819 m above sea level compared to other municipalities. *G. binucao* requires a well drained area at a low altitude^[30]. Moreover, in a Visayan community in Palawan, *G. binucao* called as “kandis” is used for food consumption and for sale. It grows at the forest edge, and is relatively easy to harvest when fruits are available^[31]. On the other hand, *P. serratifolia*, *Saurauia* sp. (soybo), *Tetrastigma* sp. (ngalatngat), *S. pimpinellifolium*, *L. benguetensis*, *M. malabathricum*, *R. edulis*, *A. montanum* and *Ficus* sp. (aplas) are not commonly eaten by the local people in Benguet due to their limited availability and distribution.

Results of the survey indicate that *G. binucao* fruits are eaten not only by humans but also by wild birds and given to animals as food, especially to grass eaters. Birds eat an extremely wide variety of foods, including fruits, vegetables, seeds, grain and nectar. Different species of birds have different dietary needs. Some birds only eat seeds, and no vegetables or fruit. However, most domesticated birds eat a varied diet including fruits and vegetables^[32]. Like birds, cloud rats found in Benguet are vegetarian, hence, they feed on fruits. There are two nocturnal and arboreal species found in the province. These are the Northern Luzon bushy tailed *Crateromys schandebergi*, commonly known as “bu–ut” or “buwet,” and the bigger, longer and rare slender–tailed *Phloeomys pallidus* or “yut–yut”^[33].

In offerings during special occasions and rituals, edible wild fruits may be used. Results reveal that *V. myrtooides* is commonly used for offerings. Benguet people believe in the existence of unseen beings that emanate from the sky world and the underworld. That these unseen beings are called spirits thought to have power over man. With this belief, the

people strive to win the favor of the spirits using prayers and material offerings in a ritual. Thanksgiving rituals consist of animals, food, rice wine, and other materials as gifts. Usually food comes in the form of crops and fruits. Moreover, traditional inhabitants have several rituals that they perform occasionally and when it becomes necessary. These rituals, feasts, caniaos or celebration are necessary because these are their folk medicines, and they perform these for their own social and economic uplift. One of the beliefs and practice in Benguet is planting fruit trees during the full moon to be productive. Also, crops planted after the ritual called “pakshel” shall be fruitful^[34].

G. binucao is commonly used in making jams and wine while *R. fraxinifolius* is for jellies, candy and juice. These fruits are ideal to use in food processing and preservation. Other good potential candidates are *S. sparsifolia* for jam and wine; *V. myrtooides* for jelly; *S. elegans* and *S. sparsifolia* for candies; *S. elegans* and *V. myrtooides* for juice. There are many advantages of processing and preserving wild fruits. Usually, these activities can provide source of income to families, aid in malnutrition and serve as alternative sources of food during scarcity.

The wild fruits commonly processed in the country belong to the genus *Rubus*, *Saurauia*, *Antidesma*, *Sarcandra*, *Garcinia* and others^[36–40]. Further, wild fruits were enumerated to be used in Poland for making juice, jam and wine. These fruits are *Vaccinium myrtillus*, *Rubus idaeus*, *Fragaria vesca*, *Vaccinium vitis-idaea*, *Rubus* sp., *Prunus spinosa* among others. These fruits are stored for winter with added sugar^[41].

G. binucao is the widely used condiment/ ingredient in cooking by the local people. This fruit is round and about 4 cm or more in diameter. The flesh turns yellowish when ripe. It is used as an alternative for tamarind and vinegar due to its sour taste. This fruit is commonly used in cooking paksiw^[42]. In Visayas, it is a favorite condiment in local dishes^[39]. On the other hand, *Saurauia* fruit is smooth, yellowish, subacid and juicy^[19]. These attributes of the fruit makes it used in cooking purposes or as a condiment. Meanwhile, there are many recipes utilizing guavas. They are mixed in cakes, pies, pudding among others. When cooked its strong odor is removed. In South Africa, guavas are mixed with cornmeal and other ingredients to make breakfast food flakes^[43].

V. myrtooides is dominantly used as a source of dye or ink in Benguet. Small fruits such as *V. myrtooides*, *M. alba* and *R. fraxinifolius* are rich sources of both anthocyanins and phenolic compounds^[44]. Anthocyanins are colored substances commonly obtained from plants especially fruits^[45]. When England lacked aniline dye during the First World War, blue–black berries were utilized as sources of pigments. As a result, a small number of berries were left for making jams^[46].

S. elegans is the most commonly used fruit in decorating dishes. The fruits are small and fleshy berries with sweet juice inside. They are usually borne in clusters^[19]. These characteristics make *S. elegans* as a fruit garnish which contributes to improving the appearance of food and enhance its taste.

The utilization of wild fruits to cure ailments and other health conditions are well supported by other literatures. For instance, the flavonoids and polyphenolic compounds in *A. buniis* extracts were reported to exhibit glucose lowering effect of on fasted, non–diabetic and alloxan–induced diabetic rats^[47]. *Vaccinium* sp. (blueberries) exhibit a strong antioxidant activity and this is correlated with the total polyphenols and flavonoids in the fruits^[48]. The use of *S. sparsifolia*, *G. binucao*, *G. intermedia* and *M. pendula* for flu may be due to their acidic pulp which contains vitamin C that boosts the immune system to avoid flu and cough. Thus, wild fruits are important sources of nutrients such as vitamins, minerals and carbohydrates^[4].

In Bangladesh, folk medicinal practitioners use fruits of *Amomum aromaticum*, belonging to the Zingiberaceae family, for the treatment of diarrhea or loose bowel movement^[49]. Meanwhile, the carotenoids in *Solanum betacea* (tree tomato or tamarillo) have been discovered to be involved in the protective effects against degenerative diseases such as cancer and cardiovascular disorders^[50].

Investigations of other *Rubus* species, on the other hand, have shown possible application for a wide range of indications, including bacterial infections, anxiety, pain and inflammation^[51]. All the aforementioned studies support the claims of the key informants regarding the medicinal properties of the fruit/s they use. However, additional and further studies must be carried out to validate the other claims.

4.3. Cultural significance of edible wild fruits and their families

The importance of the fruits greatly depends on the extent of distribution (No. of location sites) and total number of uses. *G. binucao* is the most significant fruit in Benguet. One factor that mainly contributed to its common use by the local people is its wide distribution. This fruit is found in the 12 out of 13 municipalities of Benguet except Buguias. Moreover, it has many uses such food (snack/ dessert/table food), forage (birds and grass eaters), offertory, processed/preserved (jam, jellies, candy, juice and wine), condiment/ ingredient and medicinal use (“agas ti nginao” – for conceiving mothers’ cravings, cough, flu and arthritis). On the other hand, the fruits with the lowest rank at CI index value of 0.012 are *Ficus* sp. (aplas), *M. malabathricum*, *Tetrastigma* sp. (ngalatngat) and *P. serratifolia*. Their lowest rank is due to their limited distribution being confined to

one municipality and only used as food (snack/dessert/table food).

Actinidiaceae is the most important family of edible wild fruits found in Benguet. This plant family is found in temperate and tropical regions of Asia. Most are shrubs which grow on the bank of streams and broken hillsides at 1000 m to 1500 m elevation^[18,52]. In this study, there are three species that belong this family namely *Saurauia* sp. (soybo), *S. elegans* (uyok) and *S. sparsifolia* (degway). Aside from food (snack/dessert/table food), all these fruits are used in forage and processed/preserved except soybo. Both uyok and degway are used for offertory and medicinal purposes. Uyok is used for lung problem (respiratory) while degway for “agas ti nginao” (conceiving mothers’ cravings), flu, cough and hypertension. Hence, among the three species, only uyok is used for decoration. On the other hand, the least important family is Vitaceae since there is only one species belonging to this family found in Benguet (Tublay) and that there is only one use report surveyed about its use as a snack/dessert/table food.

In conclusion, this study reflects both the traditional and current knowledge of the people on the use and significance of the fruits. Unfortunately, urban development has a big impact not only on the physical land causing transformations but also on the life style and practices of the people including dietary habits and perceptions. Efforts must be given not only to protect and conserve wild fruits in Benguet but also to maintain and improve the state of their habitat. Therefore, this study proposes the following: increasing one’s level of awareness regarding the state of edible wild fruits through information dissemination campaigns to boost the current value of these fruits, additional declaration of protected areas, especially in the municipalities where the rare fruits mentioned in this study are found, and promoting the sustainable use of edible wild fruits in the society.

Finally, information gathered from this study mainly contributes to the strategies of the National Biodiversity Strategy and Action Plan of the Philippines that is to expand and improve knowledge on the extent, characteristics, uses and values of natural resources. Results of this study may be used in developing sustainable natural resource use strategies, climate change adaptation plans and for improving agroforestry systems with the integration of wild species. Hence, it aids not only in addressing food security issues but also in maintaining and reinforcing links between communities and the environment by promoting a sustained acceptance of wild fruits as important dietary components and their propagation.

Conflict of interest statement

We declare that we have no conflict of interest.

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Comments

Background

The increasing demand for adequate, safe and nutritious food needs to be addressed. Plants are primary sources of food. Exploring the edibility, availability and cultural significance of wild fruits in an upland province like Benguet, the Philippines can contribute to an increased utilization as food which can help in meeting the dietary needs of people in this locality.

Research frontiers

The study consolidates and documents valuable data on Benguet wild fruits, confirmed their taxonomic classification, known uses, traditional knowledge of the community and

how these are integrated in the cultural practices. This research provides a comprehensive reference material for future researches.

Related reports

The communities that participated in this study have knowledge on the common names and uses of the wild fruits. As food, they were either consumed upon collection or processed into fruit preserves and wine. Decorative and folkloric medicinal uses were also identified.

Innovations and breakthroughs

A database in the form of an ethnobotanical inventory on wild fruits does not yet exist for Benguet, so this research would be the first. Calculation of cultural importance indices of plant species and families and their scientific classifications are also confirmed in this study.

Applications

Information gathered from the study can contribute to the strategies of the National Biodiversity Strategy and Action Plan of the Philippines. The output of this study aids in addressing issues on food security and promotes acceptance of wild fruits as important dietary components.

Peer review

The research is an important contribution to biodiversity and ethnobotanical studies. It shows the interrelationships of traditional and cultural factors to the utilization and acceptance of the wild fruits as food. The distribution of the plant samples in the various municipalities may also be considered in relation to environmental conditions in future studies.

References

- [1] Food and Agriculture Organization of the United Nations. Food security and nutrition. Rome: FAO; 2011. [Online] Available from: <http://www.fao.org/docrep/014/i2011e/i2011e00.pdf> [Accessed on 15 October, 2013]
- [2] Molano W, Barba C, Espana MN, Casio, M. Household food insecurity in the Philippines; 2004. [Online] Available from: <http://www.fnri.dost.gov.ph/files/fnri%20files/abstracts30th/insecurity.pdf> [Accessed on 26 July, 2013]
- [3] Rasingam L. Ethnobotanical studies on the wild edible plants of Irula tribe of Pillur valley, Coimbatore district, Tamil Nadu, India. *Asian Pac J Trop Biomed* 2012; **2**(Suppl 3): S1493–S1497.
- [4] Deshmukh B, Waghmode A. Role of wild edible fruits as a food resource: traditional knowledge. *Int J Pharm Life Sci* 2011; **2**: 919–924.
- [5] Tardio J, Pardo de-Santayana M, Morales R. Ethnobotanical review of wild edible plants in Spain. *Bot J Linn Soc* 2006; **152**: 27–71.
- [6] Kenyatta C, Henderson A. The potential of indigenous wild foods. Washington D.C.: USAID; 2001. [Online] Available from: http://pdf.usaid.gov/pdf_docs/Pnacl441.pdf [Accessed on 10 October, 2013]
- [7] Benguet Planning and Development Office. *Benguet province: socio-economic profile*. La Trinidad: Benguet; 2007.
- [8] Tacloy J. *Indigenous trees and shrubs within the forest reservation of Benguet State University*. La Trinidad: Benguet State University; 2008, p. 1–52.
- [9] Tangan F. Wild food plants within Mt. Pulag national park in the Cordillera region. *Ecosys Res Dig* 2001; **10**(2): 13–23.
- [10] Ladilad A, Bawang F, Gonzales F, Kudan S, Amado A, Alperes M. *Collection, identification and characterization of indigenous fruit crops eaten by the people of Benguet and Mountain province*. La Trinidad: Benguet State University; 2009, p. 2–43.
- [11] Molina J. Philippine biogeography; 2011. [Online] Available from: <http://www.philippineplants.org/Biogeography.html> [Accessed on 8 August, 2013]
- [12] The Royal Botanic Gardens. Herbarium catalogue. Kew: RBC; 2013. [Online] Available from: <http://apps.kew.org/herbcat/navigator.do> [Accessed on 19 July, 2013]
- [13] ASEAN Tropical Plant Database; 2005. [Online] Available from: <http://211.114.21.20/tropicalplant/html/search01.html> [Accessed on 15 September, 2013]
- [14] Tropicos. Missouri botanical garden; 2013. [Online] Available from: <http://www.tropicos.org> [Accessed on 11 August, 2013]
- [15] Plants of Southeast Asia; 2013. [Online] Available from: <http://www.asianplant.net/> [Accessed on 29 June, 2013]
- [16] United States Department of Agriculture (USDA) Natural Resources Conservation Service; 2013. [Online] Available from: <http://plants.usda.gov/java/> [Accessed on 20 August, 2013]
- [17] Taiwan Plant Names—Flora of Taiwan and China; 2013. [Online] Available from: <http://www.eFloras.org> [Accessed on 22 June, 2013]
- [18] La Frankie J. *Trees of tropical Asia*. Philippines: Black Tree Publications; 2010, p. 378–379, 611.
- [19] Coronel R. *Important and underutilized edible fruits of the Philippines*. Philippines: University of the Philippines Los Banos Foundation Inc.; 2011, p. 1–220.
- [20] Pardo-de-Santayana M, Tardio J, Blanco E, Carvalho A, Lastra J, Miguel E, et al. Traditional knowledge of wild edible plants used in the northwest of the Iberian Peninsula (Spain and Portugal): a comparative study. *J Ethnobiol Ethnomed* 2007; **3**: 27.
- [21] Padilla L. Benguet: an exquisite haven of strawberries and more. *BAR Digest* [Internet]. 2012; [cited 2013 November 5]; **12**(3). Available from: <http://www.bar.gov.ph/digest-home/digest-archives/367-2012-3rd-quarter/4415-julsep2012-benguet-straberrries>
- [22] Department of the Interior and Local Government. *Cordillera almanac*. Benguet: Local Government Units–DILG; 1999, p. 1–241.

- [23] Dacumos S. *History of the people of La Trinidad*. La Trinidad: New Baguio Offset Press; 2012, p. 1–50.
- [24] Dacumos S. *La Trinidad physical and socio-economic profile*. La Trinidad: Municipal Planning and Development Office; 2011, p. 1–63.
- [25] Viray L, Accos J, Costales A. *Preliminary report on the flora and fauna species population in Mount Pulag National Park*. Baguio City, Philippines: Department of Environment and Natural Resources; 1992.
- [26] Hipol R, Tolentino D, Fernando E, Cadiz N. Life strategies of mosses in Mt. Pulag, Benguet province, Philippines. *Philipp J Sci* 2007; **136**(1): 11–18.
- [27] Guiam V. Saving the underutilized crops. *BAR Digest* [Internet]. 2010; [cited 2013 June 5]; **12**. Available from: <http://www.bar.gov.ph/digest-home/digest-archives/124-2010-3rd-4th-quarter/444-saving-the-underutilized-indigenous-crops>
- [28] Nanzala E. Nature's choice: utilizing wild plants in the Philippines. Philippine: Philippine Agriculturist; 2008. [Online] Available from <http://www.new-ag.info/en/focus/focusItem.php?a=456> [Accessed on 29 June, 2013]
- [29] Pati AK. Batuan (*Garcinia binucao*). PRLOG Press Release Distribution; 2010. [Online] Available from <http://www.prlog.org/10747690-batuan-garcinia-binucao-drabhay-kuamr-pati-ceo-biotecahyur-odisha-india.html> [Accessed on 23 September, 2013].
- [30] Florido H, Cortiguera F. Lesser known edible tree species. *Res Inf Series Ecosyst* 2003; **15**(3): 1–8.
- [31] Lacuna-Richman C. The use of non-wood forest products by migrants in a new settlement: experiences of a Visayan community in Palawan, Philippines. *J Ethnobiol Ethnomed* 2006; **2**: 36.
- [32] Modotti M. Types of fruits and vegetables birds eat; 2013. [Online] Available from: http://www.ehow.com/list_6466141_types-vegetables-can-birds-eat_.html [Accessed on 11 August, 2013]
- [33] Fernandez R. Rat species found only in RP faces extinction. PhilStar; 2004. [Online] Available from: <http://www.philstar.com/nation/238183/rat-species-found-only-rp-faces-extinction> [Accessed on 2 September, 2013]
- [34] Baucas B. *Traditional beliefs and cultural practices in Benguet*. La Trinidad: New Baguio Offset Press; 2003, p. 18, 28, 31.
- [35] Hoover E, Tepe E. *Wild and edible fruits of Minnesota*. University of Minnesota; 2007. [Online] Available from: <http://www.extension.umn.edu/garden/yard-garden/fruit/wild-and-edible-fruits-of-minnesota/> [Accessed on 6 September, 2013]
- [36] Brion AC. Bangkok Kahoy Valley is one of Quezon's undiscovered paradise. *BAR Digest* [Internet]. 2012; [cited 2013 September 20]; **14**. Available from: <http://www.bar.gov.ph/digest-home/digest-archives/367-2012-3rd-quarter/4419-julsep2012-bangkok-kahoy-quezon>
- [37] Sarian Z. Wild raspberry makes good wine; 2012. [Online] Available from: <http://trc.dost.gov.ph/trcfile/Technology-Snapshots/Food-Processing-and-Preservation/raspsberry.pdf> [Accessed on 20 September, 2013]
- [38] Rodriguez T. Provincial agriculturist makes good bignay. *Agric Monthly Manila Bull* 2012; **16**: 24–25.
- [39] Cruz RD. Promoting the less known, phytochemical rich pinoy fruits. *BAR Digest* [Internet]. 2012 [cited 2013 September 20]; **14**. Available from: <http://www.bar.gov.ph/digest-home/digest-archives/368-2012-4th-quarter/4617-octdec2012-less-known-fruits>
- [40] Polinag M. *Food from the wilderness*. Laguna: DENR-Ecosystems Research and Development Bureau; 2003, p. 1–2.
- [41] Łuczaj Ł. Archival data on wild food plants used in Poland in 1948. *J Ethnobiol Ethnomed* 2008; **4**: 4.
- [42] Tajanlangit E. *Garcinia binucao*. The Visayan Daily Star; 2011. [Online] Available from: <http://www.visayandailystar.com/2011/January/12/goodlife.htm> [Accessed on 5 July, 2013]
- [43] Morton J. Guava; 2013. [Online] Available from: <http://www.hort.purdue.edu/newcrop/morton/guava.html> [Accessed on 4 September, 2013]
- [44] Ozgen M, Schereens J, Reese N, Miller R. Total phenolic, anthocyanin contents and antioxidant capacity of selected elderberry (*Sambucus canadensis* L.) accessions. *Pharmacogn Mag* 2010; **6**(23): 198–203.
- [45] Qin C, Li Y, Niu W, Ding Y, Zhang R, Shang X. Analysis and characterization of anthocyanins in mulberry fruit. *Czech J Food Sci* 2010; **28**(2): 117–126.
- [46] Agriculture and Agri-Food Canada. *Vaccinium myrtillus* L. (Bilberry). Canada: AAFC; 2013. [Online] Available from: <http://www.agr.gc.ca/eng/science-and-innovation/science-publications-and-resources/resources/canadian-medicinal-crops/medicinal-crops/vaccinium-myrtillus-l-bilberry/?id=1301437041046#a11> [Accessed on 11 October, 2013]
- [47] Herrera S, Panopio A, Pedrezuela H, Perez R, Dumaoal S. Antiglycemic effect of bignay (*Antidesma bunius*) flavonoids in Sprague Dawley rats; 2011. [Online] Available from <http://www.stuartxchange.com/Bignay.html>. [Accessed on 3 September, 2013].
- [48] Jakobek L, Seruga M, Novak I, Medvidovic-Kosanovic M. Flavonoids, phenolic acids and antioxidant activity of red fruit. *Dtsch Lebensm Rundsch* 2007; **103**: 369–378.
- [49] Das P, Akter S, Islam M, Kabir M, Haque M, Khatun Z, et al. A selection of medicinal plants used for treatment of diarrhea by folk medicinal practitioners of Bangladesh. *Am Eurasian J Sustain Agric* 2012; **6**(3): 153–161.
- [50] Mertz C, Gancel A, Gunata Z, Alter P, Mayer C, Vaillant F, et al. Phenolic compounds, carotenoids and antioxidant activity of three tropical fruits. *J Food Comp Anal* 2009; **22**: 381–387.
- [51] Rummel D. *Useful plants of the Philippines: a scientific guide to modern botanical medicine*. Pasig City: C & E Publishing Inc.; 2005, p. 379.
- [52] Dressler S, Bayer C. *Flowering plants: dicotyledons*. Germany: Springer; 2004, p. 14–19.