Original Article

The nutritional value of indigenous fruits and vegetables in Sarawak

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The proximate composition including mineral and vitamin contents of 16 fruits and 46 vegetables (leaves, fruits, palm hearts and shoots) of indigenous origin in Sarawak are provided. Fruits like dabai (*Canarium odontophyllum),* kembayau *(Dacryodes rostrata f. cuspidata),* durian nyekak *(Durio kutejensis)* and durian kuning *(Durio graveolens*) are very nutritious with high values for energy, protein and potassium. Among the vegetables, the protein content of letup (*Passiflora foetida),* kepayang *(Pangium edule)* and tubu *(Pycnarrhena tumetacta*) is high, ranging from 6 to 7%. The range of nutrients among foods of indigenous origin are generally comparable with those of many cultivated species except for vitamin C, which is lower. Teh Kampung (*Leucosyke capitellata*) leaves are particularly high in magnesium (626 mg/100 g). Some of the indigenous vegetables contain antinutritional factors. Kepayang has very high levels of hydrogen cyanide (1834 µg/g on dry basis) but this poison can be completely evaporated by boiling. Indigenous fruits and vegetables which are pesticide residue free are important food sources for rural populations. Nutritious indigenous fruits and vegetables have the potential to be promoted for wider use, domestication and commercialization.

Key words: food composition, indigenous fruit, indigenous vegetables, Sarawak, Malaysia, food toxicants, cyanide.

Introduction

The very rich biodiversity of the tropical rain forests in Sarawak offers an excellent source of indigenous fruits and vegetables, especially for the rural communities. Apart from being a food source, they are also a source of supplementary income. Indigenous fruits and vegetables are commonly sold in jungle produce markets throughout Sarawak. They are generally viewed by urban populations as nutritionally inferior and of low prestige. The recent problem of high pesticide residue in commercial vegetables, however, has resulted in a major shift by health conscious consumers to indigenous vegetables which are pesticide free.

Given that indigenous fruits and vegetables are better adapted to the local ecology, they are easier to grow and have few pests and diseases compared with introduced varieties.

Research

In recent years the potential of crops of indigenous origin has slowly been recognized. In 1985 the Department of Agriculture (DOA), Sarawak began research work on collection, documentation, conservation, agronomic and crop improvement studies as well as on nutritional analysis. Laboratory procedures were in accordance with the 1975 official methods of analysis of the Association of Official Analytical Chemists (AOAC). The major part of this paper is based on the work carried out since then. The study was aimed at popularizing naturally occurring indigenous food and exploring the potential for possible commercial exploitation of such foods.

Nutritional composition

Indigenous fruits

The nutrient composition of 16 fruit species analyzed are shown in Table 1.[1] Four species, namely the durian nyekak (*Durio kutejensis*), durian kuning (*Durio graveolens*), kembayau (*Dacryodes rostrata f. cuspidata*) and dabai (*Canarium odontophyllum*) stand out as being very nutritious for their high energy (149–339 kcal), protein (2.6–3.8%) and potassium (362–810 mg) values. Dabai is also a very good source of phosphorus (65 mg), calcium (200 mg) and magnesium (106 mg). This fruit is already in cultivation in the Sibu and Kapit Divisions.

All of the fruits analyzed are very low in Vitamin C. Only durian nyekak and durian kuning contain more than 10 mg/100 g edible portion of this vitamin.

Indigenous leafy vegetables

The nutrient compositions of 25 leafy vegetables are shown in Table 2.[1] As expected of leafy vegetables the energy values are low, except for kepayang, tubu and bungkang (*Eugenia* sp.), with values slightly over 100 kcal per 100 g. The leaves of tubu and sindu (*Scorodocarpus borneensis*) have the lowest moisture content of 64 and 67%, respectively, as only the older leaves are used, for seasoning rather than for consumption as a vegetable. For leafy vegetables, the protein

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Table 1. Nutritional composition of indigenous fruits of Sarawak

Food item	Nutritional composition per 100 g edible portion															
	Proximate composition							Minerals								
	Energy (kcal)	Moisture (%)	Protein (%)	Fat (%)	CHO (%)	Crude fibre (%)	Ash (%)	P (mg)	K (mg)	Ca (mg)	Mg (mg)	Fe (mg)	Mn (p.p.m.)	Cu (p.p.m.)	Zn (p.p.m.)	Vitamin C (mg)
Asam raba (*Mangifera grafithii*)	8	90.6	0.4	0.2	1.1	0.9	0.7	7	148	15	6	2.9	3	0.9	2.0	0.6
Belimbing hutan (*Baccaurea reticulata*)	93	73.8	1.0	0.2	21.9	2.1	1.0	39	352	21	21	0.6	5	2.6	5.8	0.1
Dabai (*Canarium odontophyllum*)	339	41.3	3.8	26.2	22.1	4.3	2.3	65	810	200	106	1.3	8	7.0	4.7	–
Durian kuning (*Durio graveolens*)	152	66.7	2.6	6.2	21.5	2.0	1.0	43	529	10	27	0.6	4	7.0	5.9	10.4
Durian nyekek (*Durio kutejensis*)	149	61.5	2.6	1.7	30.9	1.9	1.5	25	362	19	19	0.7	5	3.2	7.3	15.9
Engkala (*Litsea garciae*)	104	78.3	1.4	6.8	10.0	1.0	2.5	26	355	7	17	0.5	5	2.6	10.2	3.4
Kejirak (*Baccaurea* sp.)	151	65.7	1.7	4.7	25.5	1.7	0.8	24	347	21	38	0.7	3	6.9	5.2	1.0
Kembayau (*Dacryodes rostrata f. cuspidata*)	241	56.2	3.4	16.1	20.7	2.4	1.3	35	399	83	83	1.1	84	7.5	10.0	–
Keranji (*Dialium* sp.)	126	63.8	1.2	0.3	29.7	0.2	4.8	29	438	4	4	1.1	18	3.3	9.1	1.2
Langgir (*Xanthophyllum amoenum*)	124	71.0	2.3	2.9	22.1	1.6	0.2	29	139	20	9	0.6	11	8.4	33.1	1.2
Pedalai (*Artocarpus sericicarpus*)	119	69.3	1.7	0.3	27.4	0.5	1.7	33	322	22	25	0.8	1	2.5	7.4	1.8
Puak (*Baccaurea macrocarpa*)	127	66.7	1.5	1.1	27.9	2.2	0.9	43	293	10	20	0.9	3	7.3	18.3	0.1
Remayong (*Zalacca magnifica*)	78	79.8	0.6	0.2	18.4	0.4	0.7	3	276	30	4	1.3	3	0.9	20.4	0.9
Selanking (*Artocarpus nitidus*)	77	80.8	1.7	1.6	14.0	1.2	0.7	12	164	29	12	0.6	3	1.7	2.3	3.3
Tamang (*Elaeocarpus sphaeroblastus*)	109	70.3	1.6	0.1	25.6	1.3	1.1	24	339	33	33	1.4	7	1.5	6.5	–
Tampoi paya (*Baccaurea bracteata*)	163	64.2	2.1	5.4	26.6	1.1	0.6	54	204	11	29	0.6	5	3.9	3.9	0.8

Table 2. Nutritional composition of indigenous leafy vegetables of Sarawak

	Nutritional composition per 100 g edible portion																
	Proximate composition							Minerals									
Food item	Energy (kcal)	Moisture (%)	Protein (%)	Fat (%)	CHO (%)	Crude fibre (%)	Ash (%)	P (mg)	K (mg)	Ca (mg)	Mg (mg)	Fe (mg)	Mn (p.p.m.)	Cu (p.p.m.)	Zn (p.p.m.)	Vitamin C (mg)
Anak mambung (*Sonchus* sp.)	22	92.5	1.6	0.7	2.4	0.8	2.0	32	586	58	16	2.7	16	6.3	8.8	1.2
Akar kura (*Cissus repens*)	32	90.9	1.9	0.6	4.8	1.0	0.8	26	199	84	53	2.4	7	1.5	1.5	5.0
Bungkang (*Eugenia* sp.)	115	67.4	3.1	2.0	21.2	4.4	1.7	39	310	313	80	2.0	6	17.3	10.4	—
Germi (*Portulaca oleraca*)	25	90.8	1.3	0.3	4.4	0.9	2.3	32	292	42	57	42.6	21	2.1	9.8	0.0
Kacam rumpong (*Embelia* sp.)	86	80.1	2.6	4.4	9.1	2.7	1.1	30	336	129	22	0.4	7	0.0	5.4	1.8
Kepayang (*Pangium edule*)	106	71.2	6.2	2.3	15.0	3.3	2.0	66	231	439	95	7.3	19	8.9	25.0	2.3
Keremak (*Alternanthera sessilis*)	46	82.3	2.0	0.3	8.9	2.7	3.8	27	474	65	104	42.4	83	8.5	45.6	NA
Letup (*Passiflora foetida*)	73	79.1	6.5	1.1	9.2	1.8	2.2	98	660	261	71	5.4	32	2.7	26.1	2.9
Melinjau (*Gnetum gnemon*)	57	81.7	4.2	1.5	6.6	4.7	1.3	68	419	94	37	3.8	41	1.5	12.1	1.5
Merudang (*Smilax barbata*)	39	88.1	3.1	0.1	6.4	1.0	1.3	52	396	49	19	1.9	38	2.5	6.2	16.0
Miding (*Stenochlaena palustris*)	33	92.3	2.5	0.9	3.4	0.6	0.9	56	295	12	21	3.1	6	3.3	1.2	1.75
Paku ikan (*Athyrium esculentum*)	24	92.5	2.7	0.5	2.2	0.8	1.2	83	410	14	19	1.8	3	1.9	0.6	0.0
Paku kelindang (*Blechnum orientale*)	40	88.5	1.2	0.7	7.2	1.3	1.1	21	338	26	33	2.4	3	14.5	2.1	0.3
Paku kubuk (*Nephrolepis acutifolia*)	28	92.4	1.5	1.0	3.3	0.9	1.0	43	371	22	27	3.0	5	10.3	0.6	0.6
Riang batu (*Begonia chlorosticia*)	25	91.9	0.7	0.6	4.2	2.1	0.6	34	69	70	20	2.8	37	0.9	6.5	0.6
Rinyuh (*Vernonia* sp.)	70	81.0	2.9	1.4	1.2	1.7	1.8	57	568	127	42	1.2	10	4.2	7.2	0.4
Sawi rusa (*Erechtities hieraiifolia*)	30	89.7	2.2	0.4	4.4	1.3	2.0	129	417	78	45	1.3	14	3.2	68.0	NA
Sempulang padi (*Costa speciosus*)	69	80.7	2.3	1.9	10.6	2.3	2.2	15	587	114	44	2.6	151	22.2	4.3	–
Sepang (*Acalypha* sp.)	60	81.8	4.1	0.8	9.5	2.0	1.8	60	400	280	151	2.8	103	74.3	20.0	–
Sindu (*Scorodocarpus borneensis*)	93	66.5	3.7	3.6	11.6	13.7	0.9	46	405	0	33	0.0	20	0.0	10.0	3.5
Singkil (*Premna cordifolia*)	76	78.0	3.6	0.4	14.4	1.9	1.7	55	393	116	77	1.4	28	6.8	25.7	–
Tengang (*Gnetum* sp.)	74	77.8	4.7	3.5	5.8	7.1	1.0	21	32	42	51	1.2	29	0	14.4	4.6
Teh kampung (*Leucosyke capitellata*)	74	75.0	3.3	0.5	14.2	3.8	3.3	35	310	403	626	3.5	8	3.1	3.1	6.5
Tongkat langit (*Helminthostachys* sp.)	56	85.0	3.2	1.9	6.5	1.5	1.9	50	342	53	32	84.4	34	2.0	0.9	0.0
Tubu (*Pycnarrhena tumetacta*)	110	63.5	7.3	2.2	15.3	10.3	1.4	48	340	215	33	2.9	14	6.8	6.8	–

Table 3. Nutritional composition of indigenous fruit vegetables of Sarawak

Food item	Nutritional composition per 100 g edible portion															
	Proximate composition							Minerals								
	Energy (kcal)	Moisture (%)	Protein (%)	Fat (%)	CHO (%)	Crude fibre (%)	Ash (%)	P (mg)	K (mg)	Ca (mg)	Mg (mg)	Fe (mg)	Mn (p.p.m.)	Cu (p.p.m.)	Zn (p.p.m.)	Vitamin C (mg)
Ara (*Ficus* sp.)	176	50.9	6.3	4.8	26.8	6.8	4.4	192	1473	182	88	8.9	6	5.9	26.0	–
Asam paya (*Eleiodoxa conferta*)	78	82.8	0.8	3.1	11.8	0.8	0.7	10	227	26	22	5.5	5	2.9	8.9	0.6
Empaong (*Baccaurea lanceolata*)	18	92.4	0.2	0.2	3.7	2.2	0.8	6	126	35	11	0.3	2	1.5	6.3	0.6
Jering (*Pithecellobium lobatum*)	184	52.5	5.0	0.4	40.0	1.7	0.5	—	—	—	—	—	—	—	—	—
Kepayang (*Pangium edule*)	227	57.7	7.3	20.2	4.1	9.6	1.1	30	401	42	97	2.1	47	3.4	14.0	19.0
Lakom (*Vitis triloba*)	23	92.9	0.8	0.5	3.9	1.4	0.6	28	129	58	36	0.6	6	1.9	2.9	0.6
Melinjau (*Gnetum gnemon*)	92	72.6	5.2	2.1	13.3	5.2	1.8	82	624	68	52	15.6	34	1.9	11.8	2.9
Pedada (*Sonneratia caseolaris*)	58	79.2	2.3	1.1	9.8	5.9	1.7	56	306	42	27	0.9	24	3.1	8.7	0.6
Petai (*Parkia javanica*)	91	76.0	6.0	1.6	13.2	2.0	1.2	115	341	108	29	2.2	42	36.7	8.2	—
Terong bulu (*Solanum ferox*)	62	78.8	1.8	1.3	10.9	5.3	1.9	58	381	55	23	4.5	2	3.2	5.7	0.0
Terong Dayak (*Solanum lasiocarpum*)	36	89.5	1.1	0.9	5.9	1.7	0.8	27	188	3	6	0.6	2	0.6	3.9	8.0
Terong pipit (*Solanum torvum*)	45	83.2	2.2	0.6	7.8	5.1	1.2	69	402	61	39	2.6	11	2.4	5.2	0.6
Timun Dayak (*Cucumis sativus*)	15	95.4	0.6	0.6	2.1	0.6	0.7	19	206	14	12	0.4	1	0.8	2.8	0.0

content of letup (*Passiflora foetida*), kepayang and tubu is very high at 6–7%.

Sawi rusa (*Erechtities hieraiifolia*) has high phosphorus content at 129 mg whereas the others are below 100 mg. Most of the leafy vegetables are good sources of potassium, except for tengang (*Gnetum* sp.) and riang batu (*Begonia chlorosticia*). The leaves of teh kampung (*Leucosyke capitellata*) are outstanding in terms of magnesium content, at 626 mg per 100 g. Tongkat langit (*Helminthostachys* sp.) is a very good source of iron (84 mg) and sawi rusa is a very good source of zinc (68 mg). Vitamin C levels for all of the vegetables analyzed were very low.

On the whole, sepang (*Acalypha* sp.) is superior with good nutritional composition in all the parameters analyzed. The two most important indigenous vegetables, paku ikan (*Athyrium esculentum*) and miding (*Stenochlaena palustris*) have low nutritional values, except for phosphorus (83 and 56 mg, respectively) and potassium (410 and 295 mg, respectively).

Indigenous fruit vegetables

The food values of 13 types of indigenous fruit vegetables are tabulated in Table 3.[1] Kepayang has a very high energy level at 227 kcal/100 g because the oily kernels are consumed. Five fruit vegetables with high protein content ranging from 5.0 to 7.3% are jering (*Pithecellobium lobatum*), melinjau (*Gnetum gnemon*), petai (*Parkia speciosa*), ara (*Ficus* sp.) and kepayang. Ara has a remarkable potassium content at 1437 mg. Vitamin C content for all types analyzed was very low.

The higher nutritional composition of kepayang, melinjau, petai and jering is the result of the kernels being consumed, whereas for the other types of fruit vegetables, the aril or whole fruit is used.

Indigenous shoots and palm hearts

As shown in Table 4,[1] the food value of shoots and palm hearts is generally low except for potassium. Among the nine types analyzed, banjang (*Plagiostachys crocydocalyx*) has the highest energy level at 94 kcal/100 g, as well as comparatively higher mineral contents for potassium, magnesium, iron and manganese. The shoot of this commonly found jungle plant is a good source of potassium (582 mg) and manganese (298 mg). Apong (*Nipa fruticans*) and nibong (*Oncosperma tigillaria*) shoots are also good sources of magnesium (97 and 111 mg, respectively). All of these vegetables are very low in vitamin C, except for banjang (10.2 mg).

Anti-nutritional factors

The anti-nutritional factors like arsenic, cyanide, lead, phytic acid, tannins and presence of alkaloids are shown in Table 5.[1] The figures are given to create an awareness, not to cause alarm among consumers. Arsenic and lead are possibly accumulated by the plant from the soil and the values will vary according to the sites in which they are grown.

Of particular importance is the very high content of hydrogen cyanide in the leaves and fruits of kepayang. They will prove fatal if consumed raw. By boiling for 10–15 min, hydrogen cyanide can be evaporated off completely. In traditional preparation, the kepayang kernel is sliced into thin strips and boiled for a length of time before being soaked in running water, or many changes of water.

The upa lalis (*Plectocomiopsis geminiflora*) shoot, which is a rattan-like climber commonly sold in jungle produce markets, is strongly positive (3+) in alkaloid. The popular fern-top paku miding contains traces of arsenic, phytic acid and alkaloid, and has moderate content of tannins.

Comparison of indigenous fruits and vegetables with common non-indigenous species

Compared with the nutritional status of common fruits and vegetables (Tables 6–8)[2] those of indigenous origin are comparable or superior except with regard to vitamin C content. Apart from durians, all the other species of indigenous origin have much lower contents of vitamin C. Indigenous fruits are generally very sweet and, as such, have higher calorific value than common fruits.

Six of the leafy indigenous vegetables have protein values of over 4%, which is higher than common leafy vegetables except for chekor manis (*Sauropus androgynus*) (7.6%). Potassium levels are, however, generally lower.

The nutritional compositions of indigenous fruit vegetables where the kernels or cotyledons are consumed are higher than those of common fruit vegetables where the whole fruit is consumed. The two common indigenous fruit vegetables timun Dayak (*Cucumis sativus*) and terong Dayak (*Solanum lasiocarpum*) are comparable to cucumber and egg plant, respectively. However, terong Dayak has a better mineral content but lower vitamin C compared with its cultivated relative.

Potential of the indigenous species

For the purposes of this paper only 16 out of approximately 76 species of indigenous fruits found in Sarawak were nutritionally analyzed. Of these 16 species five, namely the durian nyekak, durian kuning, dabai, keranji (*Dialium* sp.) and engkala (*Litsea garciae*), have good economic potential. Though fruits become popular and commercially important mainly due to taste and flavour, these five fruit species are also highly nutritious.

Among the indigenous vegetables, leafy species such as paku ikan and paku miding, as well as fruit vegetables such as timun Dayak, terong Dayak, asam paya (*Eleiodoxa conferta*), petai and jering are already found regularly in the local markets. Shoots of tepus (*Achasma megalocheilos*) and lalis are often seen in jungle produce market but their consumption is confined only to a small section of the native population. Fruits of the melinjau and kepayang are already processed commercially into crackers and keluak, respectively, in Indonesia.

Daun tubu and daun sindu are two distinct possibilities for development as naturally occurring seasonings for food. Teh kampung is interesting due to its high magnesium content.

Many other vegetables of native origin could be popularized to add variety to the diets of the urban residents. Naturally grown, clean, environmentally friendly and pesticide-free are catch words that can be used to promote such vegetables. In promoting these vegetables, care must be taken to inform consumers on how to prepare them given that some do contain anti-nutritional factors.

Table 4. Nutritional composition of indigenous shoots and hearts of palms

Food item	Nutritional composition per 100 g edible portion														
	Proximate composition							Minerals							
	Energy (kcal)	Moisture (%)	Protein (%)	Fat (%)	CHO (%)	Crude fibre (%)	Ash (%)	P (mg)	K (mg)	Ca (mg)	Mg (mg)	Fe (mg)	Mn (p.p.m.)	Cu (p.p.m.)	Zn (p.p.m.)	Vitamin C (mg)
Aping (*Arenga* sp.)	36	89.6	1.5	0.3	6.8	0.6	1.2	44	357	98	34	1.3	3	1.5	6.4	0.0
Apong (*Nipa fruticans*)	14	94.1	0.7	0.1	2.5	0.7	1.9	9	120	50	97	0.6	82	0.2	4.5	0.0
Banjang (*Plagiostachys crocydocalyx*)	94	74.4	2.6	3.0	14.0	2.6	3.4	56	582	90	123	7.8	298	3.1	1.5	10.2
Lalis (*Plectocomiopsis geminiflora*)	36	90.2	3.7	0.7	3.6	0.7	0.9	68	296	27	27	1.3	33	2.4	21.8	0.0
Lengki (*Musa* sp.)	18	93.3	0.8	0.6	2.3	1.2	1.8	22	545	20	20	3.2	36	1.1	3.7	0.3
Nibong (*Oncosperma tigillaria*)	26	91.7	1.5	0.2	4.6	0.7	1.4	39	451	30	111	0.7	9	3.6	40.6	0.5
Pantu (*Eugeissona insignis*)	30	91.9	0.9	0.6	5.2	0.7	0.7	21	198	32	46	5.1	65	1.7	15.8	0.1
Pisang kera (*Musa* sp.)	13	95.4	0.8	0.5	1.3	0.5	1.6	25	470	9	12	3.4	6	0.6	2.1	0.3
Tepus (*Achasma megalocheilos*)	14	94.8	1.0	0.5	1.4	0.7	1.6	27	555	10	16	1.5	98	0.8	0.9	0.0

In order for commercial exploitation to occur, much research into the selection of superior clones, domestication and development of cultural and other agronomic requirements must be conducted. In this respect, the Research Branch of the Sarawak Agriculture Department commenced work approximately 12 years ago. Already selected clones of indigenous fruits and vegetables and information on cultural requirements of the more important species are available. Value added products such as juice, canned slices and sweets of terong Dayak and preserves of asam paya fruits have been developed. In order to popularize these foods, two editions of a book titled "Wild Fruits and Vegetables in Sarawak" have been published.[3]

Ex situ conservation of indigenous fruits and vegetables was initiated in an 80 hectare plot in Layar Station in the Sri Aman Division. Among the other research work conducted between 1994 and 1997, a study on the cultivation potential of wild vegetables and their role as cash or subsistence crops in the farming system was conducted by the University of Copenhagen in collaboration with the Department of Agriculture, Sarawak.[4]

The International Tropical Timber Organization (ITTO) researchers identified a total of 118 indigenous vegetable species and 203 indigenous fruit species in the Lanjak–Entimau Wildlife Sanctuary (LEWS). In 1997, ITTO implemented a pilot project in the buffer zone of the LEWS for cultivation of indigenous fruits, vegetables and medicinal plants among the native community.

Domestication and cultivation of indigenous fruits and vegetables has been successfully undertaken. The Forest and Agriculture Departments have carried out extensive work on the cultivation of indigenous fruits. In addition, the Department of Agriculture carried out both on-station and on-farm trials of indigenous vegetables.

Commercialization of indigenous fruits and vegetables has also been undertaken successfully. There is a good market for paku miding, paku ikan, ensabi (*Brassica juncea*), terong Dayak, petai, melinjau and lalis throughout Sarawak. Indigenous fruits which have been successfully commercialized include the durian (*Durio zibethinus*), langsat (*Lansium domesticum*), mangosteen (G*arcinia mangostana*), dabai and isau (*Dimocarpus longan* var. *malesianus*). Recent evaluation work had shown that durian kuning, nyekak, keranji, kembayau, engkala, pedalai (*Artocarpus sericicarpus*), terap (*Artocarpus odoratissimus*) and embang (*Mangifera pajang*) have great potential for further development.

The promotion of indigenous fruits and vegetables with potential should be intensified to increase the demand and market share of such fruits and vegetables and to add variety to the diets of urban populations. The public should be informed of their pesticide-free status and nutritional value. They should also be taught methods of preparation, in particularly for those containing anti-nutritional factors in order to render them safe for consumption. Technology for cultivation should be disseminated and quality planting materials made easily available. Production should be planned according to demand so that the price will remain stable. Post-harvest handling and processing should be studied to increase the shelf life and value.

Conclusion

The nutritional contents of 16 fruits and 25 vegetables of indigenous origin in Sarawak are provided and compared with commonly cultivated types. The list is by no means exhaustive but it does indicate that these foods are generally highly nutritious. As their more extensive phytochemical profile is documented, their place in human nutrition is likely to be further substantiated. Being easily available in the rural areas, they will continue to be important sources of food to people residing there. Some of these indigenous foods have become popular. Future research and promotion will be needed in order to make many more of these crops become common and commercially available.

Table 5. Anti-nutritional factors in indigenous fruits and vegetables of Sarawak

Food item	Dry weight basis (µg/g)					Alkaloid
	Arsenic	Cyanide	Lead	Phytic acid	Tannins	(qualitative)
Ara (*Ficus* sp.)	NA	NA	0.0	1.58	1.01	NA
Asam paya (*Eleiodoxa conferta*)	NA	0.0	0.0	1.53	NA	NA
Bamboo shoot (*Bambusa* sp.)	0.27	0.0	NA	1.63	NA	1 +
Berangan (*Castanopsis foxworthyi*)	0.25	0.0	NA	NA	NA	1 +
Jering (*Pithecellobium lobatum*)	NA	0.0	NA	1.81	NA	NA
Kepayang (*Pangium edule*)	NA	1834	1.8	NA	0.46	NA
Keranji (*Dialium* sp.)	0.05	0.0	NA	NA	—	—
Nyekak (*Durio kutejensis*)	0.00	0.0	0.0	1.55	0.03	NA
Paku kelindang (*Blechnum orientale*)	0.02	0.0	0.0	NA	2.02	—
Paku miding (*Stenochlaena palustris*)	0.02	0.0	0.0	0.90	1.03	1 +
Pris (*Baccaurea hookeri*)	0.15	0.0	0.0	1.80	NA	—
Sabong (*Gnetum gnemon*)	0.07	0.0	0.0	1.52	0.26	—
Terong Dayak (*Solanum lasiocarpum*)	0.21	0.0	0.0	NA	NA	1 +
Upa lalis (*Plectocomiopsis geminiflora*)	0.16	0.0	0.0	1.50	NA	3 +

Alkaloid determination was only qualitative: 3 +, strong precipitate and contains reasonably high amounts of alkaloid; 1 +, trace amount of alkaloid; —, nil.

Table 6. Nutritional composition of common fruits

Food item	Nutritional composition per 100 g edible portion											
	Proximate composition							Minerals				
	Energy (kcal)	Moisture (%)	Protein (%)	Fat (%)	CHO (%)	Fibre (%)	Ash (%)	P (mg)	K (mg)	Ca (mg)	Fe (mg)	Vitamin C (mg)
Apple	60	84.6	0.6	0.4	13.6	0.6	0.3	16	–	9	1.2	7.7
Banana	103	73.3	1.3	0.4	23.6	0.5	0.9	28	241	11	0.6	17.3
Grape	68	81.5	0.8	0.0	16.3	1.0	0.4	66	640	21	0.5	7.6
Guava	46	81.2	1.0	0.2	10.0	6.8	0.7	15	12	33	1.2	152.0
Orange	49	87.1	0.7	0.5	10.4	0.8	0.5	19	42	40	2.1	39.6
Papaya	35	90.7	1.5	0.1	7.1	0.5	0.1	3	16	11	0.7	71.0
Pear, Chinese	35	89.8	0.5	0.2	7.7	1.5	0.3	6	36	12	0.1	6.1
Pineapple	45	87.8	0.5	0.1	10.6	0.6	0.4	6	40	24	1.4	15.2
Tangerine/ mandarin orange	49	87.1	1.0	0.2	10.9	0.4	0.4	21	1490	28	0.3	28.0
Watermelon	28	92.6	0.6	0.2	6.0	0.2	0.4	11	1530	6	0.2	0.5

Table 7. Nutritional composition of common leafy vegetables

Food item	Nutritional composition per 100 g edible portion											
	Proximate composition							Minerals				
	Energy (kcal)	Moisture (%)	Protein (%)	Fat (%)	CHO (%)	Fibre (%)	Ash (%)	P (mg)	K (mg)	Ca (mg)	Fe (mg)	Vitamin C (mg)
Cabbage common	22	93.1	1.6	0.2	3.4	0.9	0.8	9	103	40	0.6	53.0
Celery	11	95.1	1.0	0.1	1.6	0.7	1.5	40	3050	96	2.0	3.9
Chekor manis	24	79.4	7.6	1.8	6.9	1.9	2.0	64	2610	234	3.1	136.0
Chinese kale	43	87.9	2.8	0.2	7.4	0.6	1.1	60	4910	179	2.0	107.0
Chinese mustard	34	91.7	2.1	0.7	4.7	—	0.8	70	—	147	6.8	89.0
Lettuce	17	94.7	1.2	0.1	2.8	0.5	0.7	25	3545	50	1.5	27.6
Spinach	29	91.3	2.6	0.3	4.0	—	1.8	48	136	69	0.8	56.4
Spring onion	19	95.0	0.6	0.1	3.9	—	0.4	15	—	15	0.4	17.0
Water convolvulus	29	90.9	3.1	0.2	3.6	1.0	1.2	0	78	88	5.2	19.5
White mustard	34	91.7	2.1	0.7	4.7	0.0	0.8	70	—	147	6.8	89.0

Table 8. Nutritional composition of common fruit vegetables

	Nutritional composition per 100 g edible portion											
	Proximate composition							Minerals				
Food item	Energy (kcal)	Moisture (%)	Protein (%)	Fat (%)	CHO (%)	Fibre (%)	Ash (%)	P (mg)	K (mg)	Ca (mg)	Fe (mg)	Vitamin C (mg)
Carrot	35	89.5	1.0	0.1	7.5	1.1	0.8	27	136	138	0.7	9.5
Cauliflower	32	90.0	3.2	0.0	4.9	1.3	0.6	—	—	25	0.9	47.5
Cucumber	16	95.0	0.5	0.0	3.4	0.6	0.5	21	76	14	0.2	—
Egg plant	30	91.2	1.7	0.1	5.6	1.0	0.4	20	55	15	0.6	18.4
Four-angled bean	23	92.0	2.2	0.2	3.1	2.1	0.4	31	—	36	0.8	11.3
French bean	36	89.1	2.3	0.2	6.2	1.5	0.7	6	75	54	1.8	15.8
Gourd, bitter	16	94.5	0.8	0.1	2.9	0.9	0.8	10	116	56	6.1	53.0
Lady's finger	31	90.5	1.7	0.1	5.9	1.0	0.8	42	80	77	1.5	19.3
Long bean	33	91.2	2.1	0.9	4.0	1.4	0.4	33	53	61	0.8	21.9
Radish Chinese	13	95.2	0.7	0.1	2.4	1.1	0.5	14	71	38	0.9	23.4
Red chilli	36	86.3	2.8	0.7	4.5	4.8	0.9	80	—	15	1.8	175.0
Turnip	22	93.0	0.7	0.0	4.9	0.9	0.5	21	2470	40	0.4	29.7

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