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Ethnobotanical study and nutrient potency of local traditional vegetables in Central Kalimantan

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ABSTRACT The Dayak people in Central Kalimantan, traditionally consumed local vegetable, either collected from the wild or traditionally cultivated. Unfortunately, many of the traditional vegetables are approaching extinction, even in their local market. This research is intended to conserve the traditional vegetable by collecting nutritional data and cultural information about the vegetable.

Nineteen traditional Dayak vegetables were observed in local markets and in wild areas. Taxonomic identification revealed that the vegetables were *Passiflora foetida* L. (kemot), *Diplazium esculentum* (Retz). SW. (bajey fern), *Spondias* pinnata (L.f.) Kurtz (kedondong leaves), *Neptunia oleracea* Lour (malu-malu leaves), *Manihot esculenta* Crantz (cassava leaves). *Vigna unguiculata* (L.) Walp. (talak leaves), *Etlingera elatiar* (Jack) R.M. Smith (potok shoots, red and green cultivar), *Calamus* sp. (rotan shoots), *Nauclea* sp. (Taya leaves), *Momordica charantia* L. (paria leaves), *Gymnopetalum cochinense* Kurz (kanjat), *Solanum torvum Swartz.* (segau fruit), *Colocasia esculenta* (L.) Schott (sulur keladi shoots), *Stenochlaena palutris* (Burm.)Bedd. (kalakai leaves; red and white cultivar), lotus shoots (pucuk teratai), and *Cnesmone javanica* Blume (lampinak leaves).

Nutrient analysis revealed that red kalakai (wild fern) has the potential nutrient value. It has a high amount of Fe (41.53 ppm), Cu (4.52 ppm), vitamin C (15.41 mg/100g), protein (2.36%), β-carotene (66.99 ppm), and folic acid (11.30 ppm). Other iron-rich vegetables were sulur keladi (49.25 ppm) and bajey (44.6 ppm). While other vitamin C-rich vegetables were paria leaves (18.34 mg/100 g wb), and bajaj fern (22.05 mg/100g w.b). Sulur keladi and bajey were also rich in folic acid. They had 16 and 6.3 ppm of folic acid respectively. The β-carotene content in bajey was 74.04 ppm while taya was 77.41 ppm.

Key words: Central Kalimantan, Dayak, nutritional value, traditional vegetables.

Conserving the world's biodiversity is very important to support sustainable living. Each plant has already developed its own environmental preferences and resistance to pests and disease, and each plays an important role in supporting the lives of other organisms. If one were to become extinct, the environmental balance, including that of humans, would be disturbed.

Unfortunately, due to improper modernization and globalization, the extinction of the world biodiversity is proceeding, both physically and culturally in many areas of the world. The Nature Conservancy Council (1984) in Dalzell (1994) reported that between 1945 and 1984, 95% of the UK's wildflower-rich-meadows were destroyed due to intensive agriculture practices. A survey on 42 agricultural students in an Indonesian university revealed that among 33 native auxiliary plants presented, 35 students knew less than 50%.

This research was intended to conserve traditional vegetables in Central Kalimantan by conducting an initial survey to collect basic nutrient information about them. Nutrient information is also important to help local health practitioners to create food consumption guidelines for local communities.

Saifullah (2002) mentioned that according to the BKKBN (The Coordination Agency for National Family Planning) survey in 2001, there are 14.7 million of Indonesian families living in poverty. In the year 2000, the number of malnourished Indonesian children (0-5 years old) was 25% of the total 0-5 year old child population of Indonesia (Jahari & Sumarno, 2002). In

this case, traditional vegetables that have adapted to local environments for decades might play an important role in combating nutrient deficiencies in those areas.

MATERIALS AND METHODS

This ethnobotanical study was conducted through direct observations and interviews. In this activity, the availability of each plant species was also noted. Botanists at the Herbarium Bogoriense in Bogor, West Java, identified the traditional vegetables. Nutritional values were determined from fresh vegetables collected at the local market in Central Kalimantan. The vegetables were wrapped in banana leaves, packed into cardboard cartons with ice, and flown to West Java for analysis the next day. Prior to analysis the vegetables were refrigerated (approx 10 °C). The nutritional values analyzed were: moisture content (thermogravimetri; AOAC 1984), fat content (soxhlet method), protein content (micro kjeldahl method), total ash (dry ashing method), crude fiber (H_2SO_4 destruction method), vitamin C (iodine method). The conversion factor from total N to protein is 4.39 instead of 6.25, a consideration based on the survey of Fujihara *et al.* (2001) on the protein content in vegetables.

Folic acid analysis (Balitbio method) was conducted by macerating a 10 g sample in 25 ml acetonitrile for 5 minutes, followed by filtration with Whatman paper No. 45 and vacuum evaporation. The filtrate was diluted with 5 ml of methanol prior to HPLC analysis. The HPLC condition was as follows: column C18, mobile phase methanol: water (60:40). Column temperature 27–28 °C, flow rate 1 ml/min. Detector UV (λ = 254 nm).

Beta carotene analysis (Balitbio method) was conducted by macerating a 5 g sample in 50 ml of KOH-methanol (60 g KOH in 50 ml of water diluted by methanol into 1 l). The suspension was stirred and heated at 60 °C for 1 hour. After that, the suspension was dissolved in 20 ml hexane and 50 ml aquadest. The hexane phase was separated while the aqueous phase was extracted once more with hexane. Furthermore, all of the hexane phase was combined and concentrated with a vacuum evaporator to get the β-carotene extract. The extract was analyzed by HPLC with the following condition: column C-18, mobile phase acetonitrile: methanol: dichloromethane (60:35:5), flow rate 1 ml/min, column temperature 27–28 °C, detector UV (λ = 462 nm).

The vitamin analysis was conducted as soon as the vegetables arrived. Only vegetables in good condition were analyzed.

RESULTS AND DISCUSSION

Plants and availability

During the observation of vegetables in local markets and wild areas, we found 19 traditional Dayak vegetables (Table 1). With the exception of kalakai and bajey, most of the vegetables were rarely found in the market. Pucuk teratai, a traditional vegetable, was only sold by one vegetable seller who had only a very small amount (2 pieces). Meanwhile, large amounts of kalakai and bajey were found in the streets, in agricultural areas, and on open peat areas around Palangkaraya. Another wild plant, kemot, was found in small amounts in an open peat area near Palangkaraya. Figure 1 presents some of the Dayak traditional vegetables.

Most of the traditional vegetables are wild plants. Only paria leaves, senggau (Devil's fig), lampinak (seasonal bush plant), sulur keladi, and malu-malu are cultivated in small amounts. Paria is mostly cultivated for its fruit (bitter gourd), while sulur keladi is cultivated mainly for its tuber (keladi or taro). The wild plant senggau is frequently mistaken for a weed.

Some of these vegetables might function as auxiliary plants as well. Malu-malu is an aquatic plant with spongy tissue to makes it float on water. Its cultivation might be good to support other beneficial wildlife such as fish and frogs that might reduce the populations of agricultural pests. Kalakai, bajey and kanjat are wild plants that frequently grow after forest fires. Figure 1 presents the red kalakai plant that grows in burned soil. The aforementioned plants might be good for soil rehabilitation before other plant germination. Senggau might prevent bacterial wilt on tomatoes and eggplant (Boonkerd *et al.*, (1994) in Siemonsma and Piluek (ed.)).

Pucuk rotan or rattan shoot is an epiphyte, its livelihood is dependent on other trees, especially big trees in the forest. Although it is economically attractive, (for furniture and art works), it is rarely cultivated by local communities. Rattan does play an important role in the protection of wildlife such as the orang utan. Due to its nutritional value and its many other uses, rattan should be integrated into forest rehabilitation programs.

According to the interview, Dayak people also consumed bakung shoots, coconut shoots, palm shoots and arenga shoots. However, these vegetables were not found during the survey.

There are two different kinds of edible rattan shoot; irit and bajungan. Bajungan (Fig. 1) is bigger than irit. Potok also consists of two different types, i.e. red and green potok. Edible kalakai do consists of two different

Table 1. Identification of Traditional Vegetables

Latin Name	Family	Vernacular Name	Part being used
Calamus sp.	Arecaceae	Pucuk Rotan	Shoots
Cnesmone javanica Blume	Euphorbiaceae	Lampinak	Leaves
Colocasia esculenta (L.) Schott	Arecaceae	Sulur keladi	Young shoots
Diplazium esculentum (Retz). SW.	Athyrium	Bajey	Leaves
Etlingera elatiar (Jack) R. M. Smith	Zingiberaceae	Potok (Red and Green Kultivar)	Young shoots
Gymnopetalum cochinense Kurz	Cucurbitaceae	Kanjat	Fruit
Lotus[1]		Pucuk teratai	Young shoots
Manihot esculenta Crantz	Euphorbiaceae	Daun singkong	Leaves
Momordica charantia L.	Cucurbitaceae	Daun paria	Leaves
Nauclea sp.	Rubiaceae	Daun taya	Leaves
Neptunia oleracea Lour	Mimosaceae	Malu-malu (uru mahamen)	Leaves
Passiflora foetida L.	Passifloraceae	Kemot	The whole plant
Solanum torvum Swartz.	Solanaceae	Segau	Fruit
Spondias pinnata (L. f.) Kurtz	Anacardiaceae	Daun kedondong	Leaves
Stenochlaena palutris (Burm.) Bedd.	Pteridaceae	Kalakai (red and white cultivar)	Leaves
Vigna unguiculata (L.) Walp.	Papilionaceae	Daun talak	Leaves

[1] Not identified

types, traditionally called kalakai merah (Fig. 1) and kalakai putih. Kalakai merah is a green kalakai fern with a reddish color, while kalakai putih is a green kalakai fern with a pale green color. Kanjat also consists of two different types: a bitter one and non-bitter one. Both are consumed but the non-bitter one is more common.

Ethnobotanical

Dayak people usually stir-fry the vegetables, or make them into a clear soup or a light coconut-milk soup (juhu). They add a lot of herbs and spices into the soup such as terung asam (*Solanum ferox*), shallots, and garlic. Sometimes, they also use tempuyak (fermented durian fruit) as a spice in the soup. The soup may be cooked with fish, pork or bat meat.

Many of the traditional vegetables are believed to reduce the fattiness of pork or the fishy odor of fish. These are lampinak, pucuk rotan, (cooked with pork or fatty fish heads such as baung fish, patin fish and jelawat fish), taya, potok, kanjat, and bajey. Fig. 2 presents juhu singkah babi, i.e. traditional soup made of peeled pucuk rotan and pork meat, and juhu taya tempuyak (made of taya leaves, fermented durian and pork meat).

Lampinak and pucuk rotan both have a slightly bitter taste. Meanwhile, malu-malu and potok have a mild acidic flavor. After being peeled to get the inside, the potok is chopped and cooked with grilled fish. The fragrant aroma of potok could reduce the fishy flavor of fish. The non-bitter kanjat is also commonly cooked with grilled fish. Kanjat has an ability to absorb bitterness and frequently used as a sweetener. Some vegetables commonly consumed as lalab (Indonesian salad, usually eaten with hot chilly sauce to accompany the main dishes) are paria leaves (steamed or boiled) and senggau (boiled and raw state).

Dayak people usually prepare vegetable dishes to be finished in one day so as to minimize nutritional loss. Among the aforementioned Dayak vegetables, only cassava leaves are commonly consumed in Java and Sumatra (Indonesia). Paria leaves are consumed in small amounts in Bogor. In East and Central Java, it is the fruit that is commonly consumed either as a vegetable or as traditional medicine for diabetes.

Uru Mahamen or malu-malu is also popular in Thailand, but not in Java. According to Barminas *et al.* (1999), it is mostly the taro tuber and the leaves that are consumed, but in Central Kalimantan, the shoot is commonly consumed as a vegetable. This vegetable may cause itching in the consumer's mouth, thus pretreatment with salt is necessary prior to consumption.

Table 2 revealed that compared to the other vegetables surveyed, **paria leaves** have a significant amount of protein (3.26%) (conv. Factor 4.25) and vitamin C (18.34 mg/100g) (Fig. 3). According to Reyes *et*

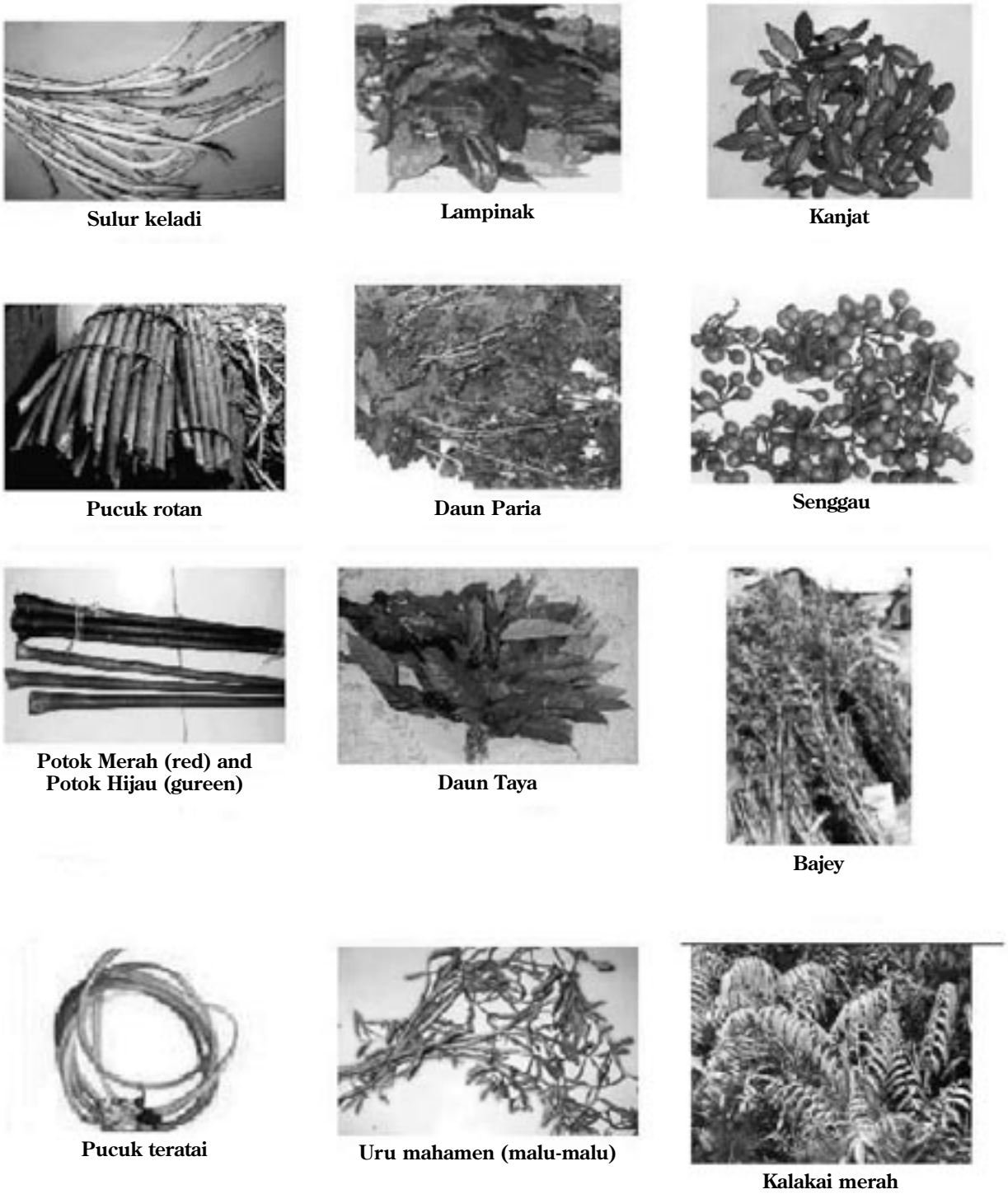
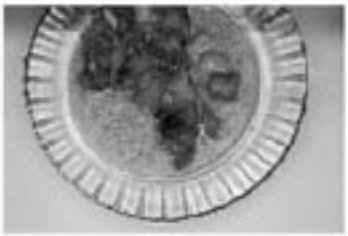
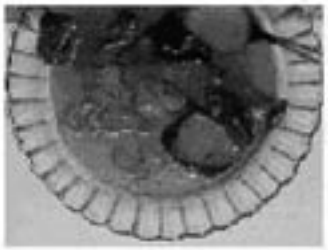


Fig. 1. Some of the Dayak traditional vegetables.



Juhu singkah babi



Juhu taya tempuyak

Fig. 2. Some of Dayak traditional cooking.

al. (1994) in Siemonsma and Piluek (ed), it is also a good source of iron and calcium. Besides, the leaves have a guanylate cylase inhibitor that lessens chemical carcinogen induced increases in guanylate cyclase activity. However, its bitterness could be a hindrance to its utilization as a nutrient source.

Many of the Dayak traditional vegetables are good sources of iron (Table 3). They are sulur keladi (49.25 ppm), bajey (44.6 ppm), and kalakai (41.53 ppm). Sulur keladi has high amounts of Fe, Cu (4 ppm), protein (1.44%) and vitamin C (15.34 ppm). The vegetable might be suitable for overcoming iron deficiency anaemia in Indonesia. Another potential vegetable is red kalakai. It has a high amount of Fe, Cu (4.52 ppm), vitamin C (15.41 mg/100g) (Figure 3) and protein (2.36%).

The correct nutrient combinations are essential, since in blood plasma, copper would linked to ceruplasmin that catalyzes the oxidation of Fe^{2+} into Fe^{3+} thus allowing it to be transported by the transferrin protein to the liver (Belitz & Grosch, 1999). Meanwhile, by increasing enteric absorption of Fe, vitamin C (ascorbic acid) would enhance its bioavailability. This vitamin

Table 2. Proximate analysis of Dayak traditional vegetables

Vegetables	Moisture	Ash	Fat	Protein	Crude fiber
Bajey	90.84	1.38	0.04	2.23	4.82
Green Potok	91.85	1.21	0.19	0.80	4.51
Kanjat	91.39	0.90	0.15	0.77	3.81
Lampinak	81.47	1.65	1.28	2.72	4.30
Malu-malu	78.22	1.81	0.39	2.69	3.50
Malu-malu Paisooksantivatana (1994) in Siemonsma and Piluek (ed.)	89.40	1.20	0.40	6.40	
Paria Leaves	84.38	2.38	0.29	3.26	3.21
Paria leaves Reyes et al. (1994) in Siemonsma and Piluek (ed)	82-86	2.30	0.10	2.30	0.80
Pucuk rotan	89.96	1.52	0.50	2.29	7.93
Pucuk teratai	94.37	0.72	0.05	0.92	1.54
Red Kalakai	89.08	1.19	0.11	2.36	4.44
Red Potok	93.67	1.29	0.13	0.56	4.52
Senggau	83.83	1.03	0.25	2.83	4.79
Senggau Boonkerd et al., (1994) in Siemonsma and Piluek (ed.)	89		0.1	2	
Sulur Keladi	93.54	0.90	0.05	1.44	3.52
Taya leaves	66.98	1.31	0.17	2.71	4.32

Note: unit in g/100 g wb

Table 3. Mineral content of some Dayak traditional vegetables

Minerals (ppm dry weght)	Rattan	Sulur keladi	Bajey	Taya	Kalakai
P	0.09	0.06	0.09	0.1	0.24
K	0.46	0.21	0.24	0.45	1.02
Ca	0.41	0.35	0.39	0.39	0.49
Mg	0.12	0.16	0.14	0.29	0.24
Fe	35.41	49.25	44.6	22.02	41.53
Cu	4.10	4.00	4.24	5.6	4.52

has many other functions such as electron transport, collagen synthesis, drug and steroid metabolism, tyrosine metabolism, metal ion metabolism, antihistamine, immune functions, anticarcinogenicity and antioxidant and prooxidant functions (Combs, 1992).

Kalakai is also traditionally recognized to stimulate the production of breast milk in post-delivery mothers. This fact is supported by nutritional data. However, in order to acquire a more reliable recommendation, it would be beneficial to conduct more detailed research.

Fig. 3 revealed that senggau has moderately high amounts of vitamin C. According to Boonkerd *et al.* (1994) in Siemonsma and Piluek (ed.), it is also rich in phosphorus (3 ppm), and calcium (5 ppm). In addition to its nutritional value, senggau also has a number of roles in traditional medicine, such as a snake and insect bite antidote, stomach pain remedy, poultice for cracked feet, etc. It also contains steroida; alkaloid solasodine which is an ingredient of oral contraceptives.

Some vegetables are rich in β-carotene. These are bajey (74.04 ppm), taya (77.41 ppm), and kalakai (66.99 ppm). Bajey is also a good source of protein (2.23%). According to Handique (1993), young bajey leaves (or *Diplazium esculentum*) contain four free amino acids, three of which are essential. It has very low fat content, and a moderate amount of fiber. The folic acid of fresh bajey is moderately high (6.3 ppm), while its vitamin C is high (21.72 mg/100 g). The value is comparable to tomatoes, which have 21 mg/100g of vitamin C (Opena and van der Vossen in Siemonsma & Piluek (ed.), 1994). Unfortunately, as a vegetable, bajey is quite perishable; therefore it must be handled well during transportation.

According to Paisooksantivatana in Siemonsma and Piluek (ed.) (1994), malu-malu has a low amount of iron (5.3 ppm), but is a good source of both calcium (38.7 ppm) and phosphorus (0.7 ppm). It also contains 0.12 mg/100 g of vitamin B1, 0.14 mg/100 g of vitamin B2 and 3.2 mg/100 g of niacin. In Malaysia it is reported that the stem could be used to treat earache, and the root to treat syphilis (Paisooksantivatana in Siemonsma & Piluek (ed.),

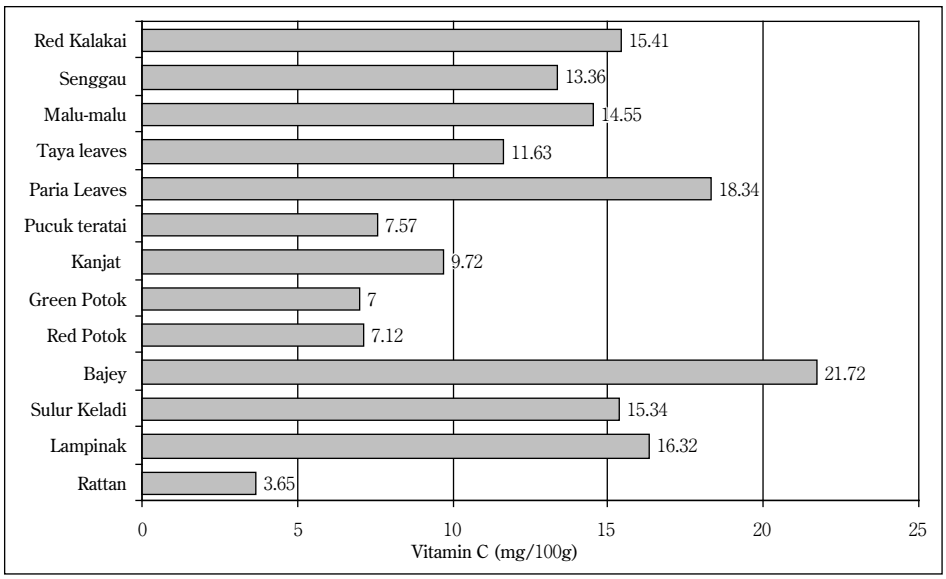


Fig. 3. Vitamin C content in some Dayak traditional vegetables

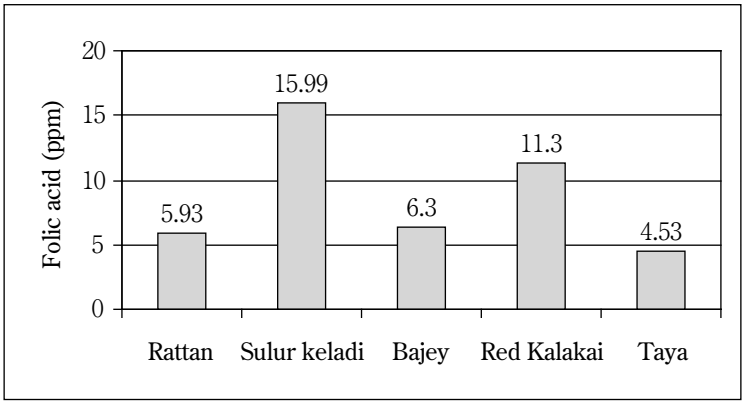


Fig. 4. Folic acid in some of the Dayak traditional vegetable

1994). Meanwhile, Nakamura *et al.* (1996) reported that 6 chlorophyll-related compounds, isolated from the leaves of N. oleracea, could inhibit the activation of tumor promoter induced Epstein-Barr virus (EBV).

Compared to other vegetables, sulur keladi has a high amount of folic acid (15.99 ppm) (Fig. 4). The level is even higher than spinach, which has 0.8 ppm of folic acid (Belitz and Grosch, 1999). Folic acid may prevent congenital malformations such as neural tube defects (Shane, 2002), cleft lips and/or palates (Hernandez-Diaz *et al.*, 2000), heart defects and limb malformations (Shane, 2002). In Indonesia, inborn malformation is quite prevalent especially among the low-income society. In this case, sulur keladi may help to overcome this problem.

Cultivating taro or sulur keladi or *Colocasia esculenta* as a staple food would bring several benefits. Not only the tuber, but also other parts of it, i.e., the leaves and flowers could also be consumed as vegetables with good nutritional qualities. Ejoh *et al.* (1996) mentioned that *Colocasia esculenta* leaves and flowers had high crude protein values, i.e. 30,7 % dw and 14.9 % dw respectively. The amino acid profile of its leaves and flowers were balanced and comparable to the reference FAO pattern. It is also a good source of Fe and Zn.

Based on the preliminary analysis, kanjat, pucuk teratai, and potok do not have any outstanding nutrient qualities. However, they may have beneficial activities. Kanjat, as well as other cucurbitaceae, may have several bioactivities. As a water clearing plant, teratai may have significant amount of minerals. Unfortunately, because of the limited scope of the sample, minerals were not analyzed. In addition, as a *zingiberaceae*, it is possible that potok has some bioactivities that need to be further investigated.

Closing Remark

The aforementioned information of the initial survey of traditional vegetables in Central Kalimantan, showed that some vegetables have great potential to overcome nutritional anaemia among the Indonesian people, especially women. Kalakai, sulur keladi and bajey could be a good source of iron and folic acid. The vegetables might be suggested for woman during the childbearing and post delivery periods. Their nutrient potency will be the subject of further investigation. Some vegetables are not only nutritionally outstanding but might also support sustainable agriculture as well.

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