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Vitamin C Content of Representative Plant Food Used by Horticulturalists in the Zaire Basin and its Evaluation

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Abstract

About 30 plants, that were frequently consumed by the horticulturalists in Wamba, a village in the Zaire basin, were analyzed for vitamin C (ascorbic acid) content by the indophenol method (2,6-dichloroindophenol). Field surveys were conducted periodically in 1980, 1984, and 1986, and each study period was 6 months. The representative plant samples analyzed were cassava leaves (*Manihot esculenta*), both raw and cooked tuber of sweet cassava, a nut of *Anthrocaryon micraster*, leaves of African spinach (*Amaranthus hybridus*), Ceylon spinach or country spinach (*Bassella rubra*), shoots of *Megaphrynium macrostachyum*, various fruits, etc. The analysis was focussed especially on cassava leaves, since these were used almost every day in a recipe called "pondzu". Cassava leaves sprout alternately with long petiole from a branch. The younger leaves had low vitamin C content. The local people took at least 70mg of vitamin C from cassava leaves alone in a single day. Vitamin C is well known as an antistress medicinal. The role of cassava leaves contributing to the intake of vitamin C suggests that the leaves may also protect the forest people from many diseases and should be evaluated and stressed at this point.

Key words: cassava, cassava leaves, vitamin C, food habit, plant food, Zaive

Introduction

Vitamin C or ascorbic acid has been well known as an essential nutrient as a result of its curative effect on scurvy, caused by a deficiency of vitamin C since 1747 in the treatise by the Scotish physician James Lind (MaCollum, 1957). In the 1970s, vitamin C was used commercially because of its antistress properties, and its curative effect on the common cold (Pauling, 1970).

Animals either have or have not the ability to synthesize vitamin C in the body, according to their phylogenic order from invertebrates to mammals (Chatterjee, 1969; Chaudhuri and Chatterjee, 1973), in which man, non-human primates, guinea pigs and bats lack the synthetic ability.

Plant food, especially fresh vegetables and fruits, are well recognised as rich sources of vitamin C. However, amounts of vitamin C in plant food vary according to their freshness, or by the cooking process and so on. Because of such variations, the freshness of the samples is taken into account in the analysis of vitamin C content.

Food consumed varies from place to place, and especially between different customs and

environment. Studies of food varieties have been conducted in the field of anthropology (Sato, 1984 ; Takeda, 1990 ; Takeda and Sato, 1993). This paper aims to discuss the food habit not only from the food varieties, but also from the nutrient content of vitamin C present. Based on these, we analyzed the vitamin C content of plant food utilized in the Zaire basin in Central Africa. The analysis was mainly focused on cassava leaves.

Methods

1) Study period and area

The field surveys were conducted periodically in 1980, 1984 and 1986. Each survey period was 6 months. The survey area was Wamba, a village of the Ngandu people. They are a subtribe of the Bantu people and considered to be horticulturalists (Sato, 1984 ; Takeda, 1990). Administratively Wamba village belongs to the Njolu zone, Equateur, Republic of Zaire. It is located at 22.5°E longitude and 0.5°N latitude (for the map, see Idani *et al.*,1994 ; Kano, 1992). Wamba village is known for being the study site of the bonobo (*Pan paniscus*), and other anthropological studies (Sato, 1984 ; Takeda, 1990 ; Kano, 1992 ; Takeda and Sato, 1993).

2) Collection of food

The villagers of Wamba generally supply their own food except for items such as rock salt, sugar, cookies, cans of sardines and other commercial goods. They live in favorable circumstances with an abundance of plant food. The plant samples for analysis were supplied by the villagers. Freshness was taken into account during the analysis.

3) The equipment and reagents

The equipment and reagents for the analysis of vitamin C, such as Erlenmeyer flasks, test tubes, burettes, graduated cylinders, graduated flasks, filter papers, *etc.* were purchased in Japan and taken in packages to the survey area by air plane and truck. The reagents for the analysis were metaphosphoric acid, vitamin C and 2,6-dichloroindophenol as the analytical dye.

4) Analysis of vitamin C

The vitamin C content of the food was analysed using the indophenol method (Giza *et al.*, 1962 ; Mitsuda, 1961). About 5 to 10g of the food samples were mashed and homogenized in 5% metaphosphoric acid solution until the final concentration of acid reached 2%, and a further 15 to 20ml of 2% metaphosphoric acid solution were added to the homogenized solution. The samples were then filtred and the filtrates were used for the analysis. The analysis was performed by titration using 2,6-dichloroindophenol solution. The reagents used were dissolved in distilled water obtained from the rain or from river water using Liebig's cooling aparatus (see Fig. 1). Four miligrams of vitamin C powder in a small plastic vessel to make the standard was dissolved in 100ml of 2% metaphosporic acid solution. If more than 5 days passed after the preparation, the standard solution of vitamin C was discarded and prepared anew. The titration was finished at the point when the red color of the dye (its water solution is blue but turns to red in presence of acid) disappeared to become transparent.

5) Preparation of distilled water

In the remote area where we stayed, there was no water supply system nor elctricity. To undertake such chemical analysis, distilled water is essential. Therefore we had to prepare distilled water by using Liebig's cooling aparatus. For the preparation, the

cooling water was circulated from the drum container as shown in Fig. 1. The circulating water was collected in a bucket and when full, returned by a handpump to the drum. The round bottomed flask containing the water was placed in a pot and protected in the sand from physical shock and smoke from the wood fire.

Results

Table 1 shows the results of vitamin C content of the plant food analyzed in Wamba village. The identification of the plants in the local names and scientific names was based on the list we made under the cooperation of the Zairean scientists, especially Dr.H. Brayn of the National University of Zaire (The Ryudai Zaire Expedition Group, 1985 ; Idani *et al.*, 1994). The contents are shown in miligrams(mg) per 100g of the edible portion of the foods. As shown in the table, about 30 plant foods were analyzed for their vitamin C content. The plant food for analysis were grouped into nuts or seeds, vegetables, pith or shoots, tubers, and fruits.

Nuts: Three nuts and one seed were anal yzed. Two nuts and one seed had low vitamin C content. But a nut of *Antrocaryon micraster*, locally called "kongo", had a high content of vitamin C. Its edible portion is scattered as grains in the nut. The grains are milky white and rich in fat. Its vitamin C content was 327mg. This value is extraordinarily high for nuts, since vitamin C content in nuts is generally less than 20mg, one exception would be sweet acorn, in which registers 110mg (The Resources Committee, 1982).

Vegetables: Cassava leaf was frequently

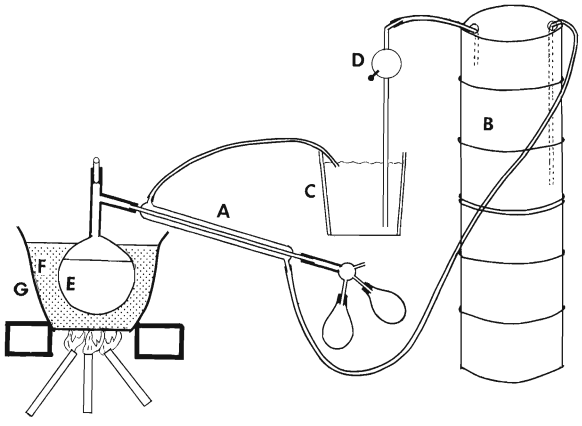

Fig.1 Schematic of equipment required for preparation of distilled water where no supply of tap water is available. Distilled water was prepared by using the Liebig's cooling aparatus (A). The cooling water was stored in a drum (B) set higher. The circulating cooling water was collected in a bucket (C). When the bucket was full, it was returned by a hand-pump (D) to the drum. The round bottomed flask (E) containing the water to be boiled was placed in the sand (F) in a pot (G) to protect it from physical shock and smoke from the wood fire.

Table 1. Vitamin C content of representative plant food utilized in Wamba village in the Zaire basin.

Food group and food	mg/100g[*1]	Notes[*2]
Nuts or Seeds		
Antrocaryon micraster	327	kongo
Dioscoreophyllum sp.	4	losio
Panda olesa	4	bokana
Treculia africana	4	bimbo
Vegetables		
Amaranthus hybridus	131	mboka, African spinach
A. hybridus (cooked)	11	
Bassella rubra	113	masingu, Ceylon or country spinach
Manihot escalenta	198	cassava leaves, see Fig. 2
Manihot esculenta	91	cassava leaves (boiled), pondzu
Hibiscus sp.	127±5(3)	londende
Leonardoxa romii	7	young leaf, bokumbo
Scorodophloeus zenkeri	40	young leaf, bofili
Pith or Shoot		
Aframomum sp.	4±2(2)	bosomboko
Ancistorophyllum secundiflorum	2	bokau
Megaphrynium macrostachyum	8±2(4)	beya
Saccharum officinarum	2±0(2)	sugar cane
Tuber		
Manihot esculenta	0	cassava flour
Manihot esculenta	62	sweet cassava (raw) bekufo-a-lotela
Manihot esculenta	49	sweet cassava (fried)
Fruits		
Aframomum laurentii	4±1(3)	ndake
Ananas Comosus	14±2(4)	(13) [*3] Pineapple
Percia americana	7±4(2)	(15) avocado
Musa sapiensis	3±2(2)	(10) banana
Citrus paradisi? (*C.*sp. 1)[*4]	70±15(3)	limo ya madeleine
Citrus sp. 2	24±5(3)	limo ya citron
Citrus sp. 3	30	lilala ya ntaba
Citrus sp. 4	28±2(2)	lilala ya ngaingai
Citrus sp. 5	36±9(4)	pomu ya rouge
Dialium corbisieri	3	keke
Dialium zenkeri	4±1(2)	elimilii
Landolphia owariensis	1±1(5)	batofe
Landolphia sp.	3±1(2)	batofeokila
Landlophia sp.	13±7(3)	beese
Pancovia laurentii	5±1(3)	ntende
papaya	79±23(10)(65)	*Carica papaya*
Pentadiplandra brazzeana	47	nkaho

[*1]: Values are mean±SD (sample number from different sources) in 100g of edible portion. Single values are from one sample.

[*2]: Vernacular, scientific or English name, and others (The Ryudai Zaire Expedition Group, 1985)

[*3]: Value in bracket shows that from the reference (The Resources Commitee, 1982).

[*4]: *Citrus* spp. contain 30 to 60mg of ascorbic acid (The Resources Commitee, 1982).

consumed by the villagers as "pondzu" or "pondu". To cook pondzu, the mashed cassava leaf was boiled with meat or fish, and seasoned with red pepper and rock salt. The better pondzu was cooked with plenty of red palm-oil from the African oil palm (*Elaesis guineensis*). The vitamin C content of cassava leaves in the raw state collected at random was 198mg. When cooked as pondzu, it contained 77mg with and 91mg without red palm oil. The higher amount indicated suggests that the antioxidant substance such as carotene contained in the oil may protect vitamin C from oxidation.

Cassava leaves sprout alternately with a long petiole from a stem or branch (see Fig. 2). The vitamin C content was different according to their sprouted site. The younger leaf at the top contained 125mg, and the second one from the top contained 197mg. The content was the highest in the leaves of the third petiole, 305mg, and thereafter the contents decreased, but still containing significant amounts of more than 250mg, which were higher levels than that of the first and the second leaves.

A leaf of *Amaranthus hybridus*, known as African spinach (locally called mboka) and that of *Bassella rubra* (Ceylon spinach or country spinach ; locally called masingu) were also frequently consumed by the villagers. These contained high amounts in the raw state, 131mg for the former leaf and 113mg for the latter. The leaf of *Amaranthus hybridus*, however, was boiled to remove harshness before cooking. As a result, the vitamin C content in the boiled leaf was very low with 11mg, after the boiled water was discarded.

A *Hibiscus* sp. of Malvaceae (locally called

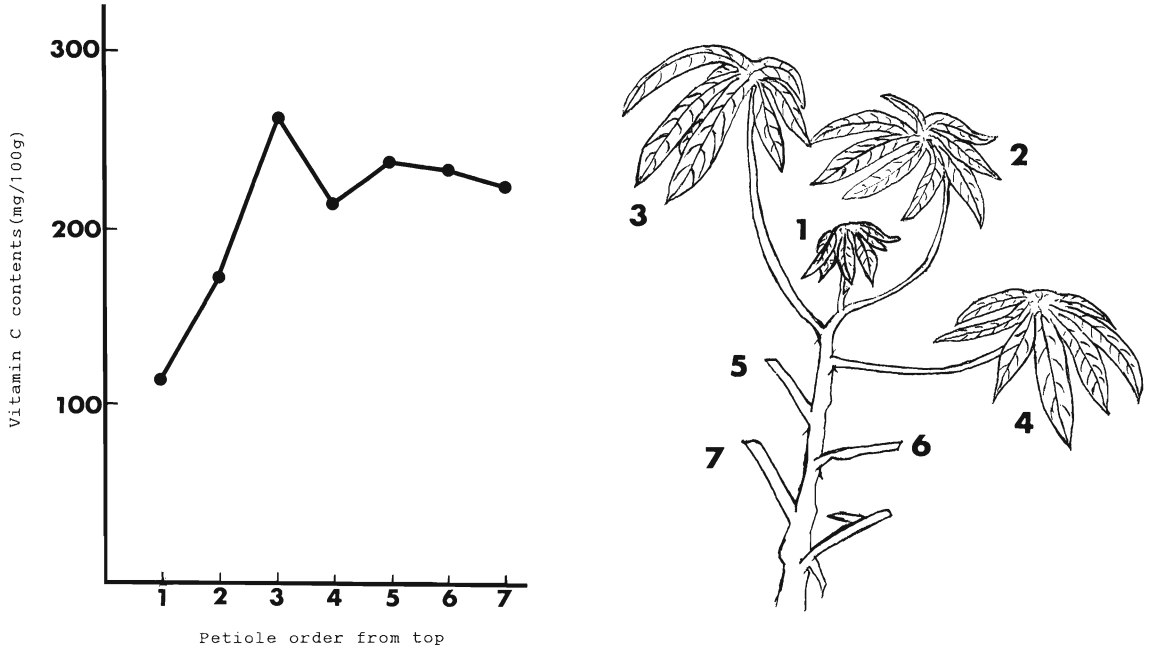

Fig. 2. Vitamin C contents of cassava leaves attached to different petioles. The values of the ordinate show the vitamin C contents in mg per 100g of raw cassava leaves. The abscissa shows the petiole order from the top of the cassava tree illustrated at the right.

londende) and its similar varieties were also often consumed. It grows semiwild. Its vitamin C content was high, 127mg.

Pith or shoot: In general, vitamin C content in pith was low as seen in the Table. Beya, also called macaroni Zairois because of its likeness to the shape of macaroni, a pith or shoot of *Megaphrynium macrostachyum*, was a favorite food of the people. It also contained a low amount of vitamin C, 8mg. Bokau pith (*Ancistrophyllum secundiflorum*) was eaten raw and was palatable, containing 2mg. Sugar cane also contained 2mg in its pith.

Tubers: Three samples of tubers were analyzed. They were all cassava. Cassava flour had no vitamin C content, for it was drained into water during the depoisoning process. However, raw sweet cassava had high Vitamin C content, 62mg, and when fried, the content was not greatly reduced, 49mg.

Fruits: There were plenty of varieties of fruit, some of which were uncommon to our home market. Four *Citrus* spp., collectively called lilala (plural, malala; singular) or limo, were analyzed. Vitamin C content ranged from 24 to 70mg, well reflecting the analyzed values of the citruses, ranging from 30 to 60mg (The Resources Committee, 1982). Other common fruits such as avocado, banana, papaya and pineapple had similar values to the reference values. The fruits uncommon to our home market, batofe (*Landolphia owariensis*), batofeokila (*Landolphia* sp.), ntende (*Pancovia laurentii*), were favorite fruits of the people. They produced plenty in their season. Their vitamin C contents were, however, low.

Discussion

During our comprehensive investigation, the villagers of Wamba utilized many plants as food. For example, there were more than 20 types of cereals, tubers and starches, about 30 vegetables and about 40 fruits (see Appendix; Asato, unpublished data; Takeda, 1990). However, in Table 1, about 30 plant foods were mentioned, because these were important in the localities, in their consumed frequencies, and in the food habit of the villagers.

Vegetables such as leafy onion, tomato, egg plant, okra, and red pepper, which were familiar to us, were also utilized by the villagers. The analyzed contents of these are not mentioned here, for these were almost the same as in the food composition tables (The Resources Committee, 1982). The bulb onion was not cultivated in the study area. Even if its seeds were planted, they did not mature. The tomato plant was small sized. It is consumed after boiling, since it causes nausea or stomachache when eaten raw.

To analyze the total contents of the hydro and dehydro form of ascorbic acid, which are both physiologically active, the hydrazine method can be adopted (Mitsuda, 1961), for which a photometer with an electric supply is needed. On the other hand, the method of indophenol titration (2,6-dichloroindophenol) can be used easily because of its simplicity and no large apparatus is required, although it cannot detect the dehydro form (Mitsuda, 1961). However, as the hydro form of ascorbic acid exists in greater amounts in food than the dehydro form (Mitsuda, 1961), the indophenol method can well reflect the vitamin C content of food. It might be confirmed in the analysis of fruits, as the values obtained in our studies, especially those in *Citrus*

spp., reflected similar results to those in the reference (The Resources Committee, 1982).

The tuber of the bitter cassava (*Manihot esculenta* or *M. utillissima*) is a staple food for the villagers. It is eaten after first being depoisoned by sinking the tuber in water for three or four days. The cassava flour made from it contained no vitamin C in our analysis as was expected (The Resources Committee, 1982). In the village, however, they also cultivated the nonpoisnous sweet cassava (*Manihot esculenta*, sometimes expressed as *M. dulcis*), the tuber is known as bekufo or bekufoalotela and the plant as botomba (bitomba; plural). The raw tuber contained 62mg of vitamin C, and when fried, the content decreased to 49mg, indicating that sweet cassava would be a good source of vitamin C. In Wamba, other tubers such as sweet potatoes, yams and taros were also readily available, though we did not conduct an analysis. However, since these tubers are common, the contents would be similar to the reference (The Resourses Commitee, 1982).

According to the villagers, there were 7 types of bitter cassava. These were named as follows; bolangiti (belangiti: plural in brackets hereafter), bombanda (bebanda), bowala (bewala), elololoko (bililoloko), eluwaluo (biluwaluo), iloloatoko (biloloatoko), and likiteelu (bakiteelu). Among them, bombanda, iloloatoko and likiteelu were mostly used for the preparation of pondzu. Figure 2 shows the leaf of likiteelu.

Even though the younger leaf contained a lower content of vitamin C, it was still higher compared to those of other plant food. The leaf stem also contained a high content of vitamin C; the first from the top contained 46mg, though it is not taken as food. From the above analyses, cassava may have a high ability of synthesis of vitamin C in tuber, stem and leaves. Otherwise, one part may produce it and transfer it to the other parts.

Although cassava leaves were cooked as pondzu, its vitamin C content remained considerably high. The villagers consumed many of cassava leaves as food, approximately 80g a day (Sato, 1984). It means that the villagers took about 70mg of vitamin C from pondzu alone. The recommended daily allowance of vitamin C is different from one country to another, ranging from about 30 to 100mg (The Ministry of Public Health and Welfare, 1984) Considering cassava leaves and other plant food consumed daily such as fruit and vegetables, especially papaya and citruses with high vitamin C content, the villager's intake of vitamin C may be considerably high. This may protect them against frequent attacks of diseases, taking into consideration the role of vitamin C (Pauling, 1970).

For antistress, not only vitamin C is effective, but other nutrients have an effect. For instance, considering that antibodies are proteins, the role of proteins to this end would be well understood. In such ways nutrients are complementary to each other in antistress cases. In this paper, however, it was just mentioned from the standpoint of vitamin C alone.

The low vitamin C content in younger leaves were also observed as in pith or shoots of other plants. The shoots of *Megaphrynium macrostachyum* (locally called lokongo) named "beiya or beya" is a favorite food. It also contained very low levels of vitamin C. The pith of *Ancistrophyllum secundiflorum* of Palmaceae named bokau also contained a low amount. It is also true in soybean sprouts and green gram sprouts as in the reference (The Resources Committee, 1982). They

contain 8 and 16mg, respectively. In our diet, younger leaves are preferable to the mature ones. In this regard, when the food habit is discussed, however, the low vitamin C content of young leaves should always be remembered.

Amaranthus hybridus contained a high amount of vitamin C, but when cooked, the content was low. Another way of cooking should be recommended to maintain the high content. This plant is now drawing the attention of some agriculturists and is being cultivated as a new source of vegetable in America (Hosiai,1993). In this regard, *Bassella rubra,* which also contains high vitamin C levels, is also one such vegetable (Koyama,1991). Cultivation studies not only concerned with vegetables, but also for some fruits such as batofe (*Landolphia owari ensis*), should be recommended on a commercial basis, because of palatableness and ease of growing.

Nuts generally contain low amounts of vitamin C. However, the nut of *Antrocaryon micraster* was exceptional. Its content was 327mg and extraordinarily high. It may arouse great interest to those who are concerned with the physiological contents of such medicinal substances in plants.

So far, as above, we mentioned plant food concerning vitamin C. From the ecological-anthropological point of view, however, a description of the approximate number of food utilized in Wamba may be worthwhile. The number of food names we collected were as follows ; 25 for cereals, tubers and starches, 25 for vegetables, 30 for fruits, 85 for fishes, 60 for animals, 14 for reptiles, 45 for birds, 25 for insects and larva, 20 for fungi, and 20 for beverages, seasonings and oils (Asato, 1987, 1992). In food, some duplicate names were used as in cassava. Subsequently, the number of food items in the Appendix does not reflect the total number above.

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ザイール盆地の森林農耕民の代表的植物性食物のビタミンC含有量とその評価

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ザイール盆地のワンバ村において頻繁に消費されている約30種の植物性食物について，そのビタミンC(アスコルビン酸)含有量をインドフェノール法を用いて分析した．調査は1980，'84，'86年に間歇的になされたもので，一回の調査期間は6ケ月であった．分析した食物はキャッサバの塊根およびその葉，アマランス(ヒユ)やセイロン・スピナッチ(ツルムラサキ)，およびその他野菜類，果実類，堅果実等である．分析の焦点は，村人により頻繁に摂取される「ポンズ」料理の主原料であるキャッサバの葉に当てた．若葉ほどビタミンC含有量は低かった．一般的に葉は100gにつき198mgのビタミンCを含有していた．キャッサバの葉のみから村人は1日70mgのビタミンCを摂取していると算出された．ビタミンCは風邪薬，抗ストレス剤としてよく知られている．その面からも考察を加えた．

Appendix. The Plant Food in Wamba.

Plant foods	Scientific name (Family name)	Notes**
[cereals and tubers]		
bekuho*	*Manihot dulcis* (Euphorbiaceae)	sweet cassava. There were several types ; botomba*, litoke*, lokanga*, lombambo*, and loponjo*.
bohekiheki*	*Dioscorea smilacifolia* (Dioscoreaceae)	The tubers of Dioscorea spp. are known as yam.
efusu*	*D. minutflora*	Sometimes called esambu*.
fufu*	*Manihot esculenta* (Euphorbiaceae)	Pounded product of the flour by adding boiled water.
kwanga*	*Manihot esculenta*	Steamed flour of the tuber (depoisoned) in the leaves of Zingiberaceae. There were different types of kwanga*; bokakiya*, bomita*, bongolo*, engwele*, inyale*, kale*, and ntuku*.
lilungu*	*Dioscorea* sp.	
lisaka*	*D. bulbifera* or *D. preussii*	
lito*	*D. dumetorum*	
sweet potato*	*Ipomoea batatas* (Convolvulaceae)	limenge*(imenge* in pl.)
rice	*Oryza sativam* (Gramineae)	cultivated in dry land. loso*.
maize	*Zea mays* (Gramineae)	Mainly used for liquor with cassava flour. masangu*
[leaves and vegetables]		
pondu	*Manihot esculenta*	The pounded cassava leaves were cooked with meat or fish, seasoned with salt, pepper and plenty of red palm oil. The following different types of leaves were recognized; bombanda*, bowala*, boyenge*, eloloko*, eluwaluo*, iloloatoko*, and likitelu*.
bangwelengele*	*Talinum triangulare* (Portulaceae)	water leaf (English name).
benje*	*Hymnocardia ulmoides* (Euphorbiacea)	leaf
beya* or beiya*	*Megaphrynium macrostachym* (Marantaceae)	shoot*
bohe*	*Histiopteris incisa* (Dennstaedtiaceae)	fern. young leaves or Lonchitis curori
bokau*	*Ancistrophyllum secundiflorum* (Palmae)	pith.
Ceylon spinach	*Bassela rubra* (Basselaceae)	masingu*, country spinach
Chinese water spinach	*Ipomoea aquatica* (Convolvulaceae)	
egg plant	*Solanum* sp. (Solanaceae)	green type
kumbokumbo*	*Brachystegia laulentii* (Caesalpiniaceae) or *Leonard romii* (Caesal.)	young leaves. used mainly for seasoning. The dried form is also used as a spice.
londende ya mai*	*Hibiscus* sp.(Malvaceae)	leaves. The other Hibiscus spp. such as londendealose* (pl. ; ndende*), londende imenge*, and londende isongo*, are used.
losio*	*Dioscoreophyllum* sp. (Menispermaceae)	seeds
matungulu*	*Allium* sp.(Liliaceae)	leafy onion.
mboka*	*Amaranthus hybridus* (Amaranthaceae)	african spinach. amaranth.
okra	*Hibiscus esculentus* (Malvaceae)	

Appendix. (continued)

red pepper	*Capsicum anuum, C.frutescens* (Solanaceae)	collectively called pilipili*. There are some types ; pilipili ya-teenge, -lobolobo, and mwasi ndoki (the hottest).
tomato	*Lycopersicum esculentum* (Solanaceae)	tomatsu*. The raw tomato causes nausea.
[fruits]		
avocado	*Persea americana* (Lauraceae)	sambuka*
banana	*Musa sapientum* (Musaceae)	etabe*(bitabe in pl.)
batofe*	*Landolphia owariensis* (Apocynaceae)	
batofeokila*	*Landolfia* sp. (Apocynaceae)	
bimbo*	*Treculia africana* (Moraceae)	
bokaso*	*Kolobopetalum chevaliert* (Menispermaceae)	
breadfruit	*Artocarpus communis* (Maraceae)	
citrus fruits	*Citrus* spp. (Rutaceae)	Citrus fruits are collectively called lilala* (malala*, singular) or limo*. Lilala ya kai* (-ngaingai*; bitter), -madeleine*, -kunjuata*, etc, are found.
elimilimi*	*Dialium pachyphyllum* (Caesalpiniaceae)	
kaho*	*Morinda morindoides* (Rubiaceae)	
keke*	*Dialium excelsum* (Casalpiniaceae)	
kongo*	*Antrocaryon micraster* (Anacardiaceae)	
mango	*Mangifera indica* (Anacardiaceae)	lomanga*
ndake*	*Aframomum laurentii* (Zingiberaceae)	bosomboko*
ntende*	*Pancovia laurentii* (Sapindaceae)	
papaya	*Carica papaya* (Caricaceae)	paipai*
pineapple	*Ananas comosus* (Bromelaceae)	ananasi* or linanisi*.
plantain banana	*Musa paradisiaca* (Musaceae)	bokau* (the same name as other food) or makemba*.
plasan?	*Nephelium mutabile?* (Sapindaceae)	A related species of rambutan.
puapumbo*	*Grewia* sp. (Tiliaceae)	Its tree is called bofumbo*.
sateelu*	?	
sou*	*Dacryodes edulis* (Burseraceae)	
[others]		
cacao	*Theobroma cacao* (Sterculiaceae)	kakao*.
coffee	*Coffea arabica* (Rubiaceae)	robusta type. kawa*.
lemon grass	*Cymbopogon citrarus* (Gramineae)	used as herb tea.
madesu*	(Leguminosae)	Legumes or beans are collectively called madesu*. There were some kinds.
masanga*		alcholic beverage, lotoko*, made by fermenting the mixture of cassava and maize flour.
palm wine	*Elaesis guineensis* (Palmae)	made from the sap of the tree. sese*.
peanut	*Arachis hypogaea* (Leguminonaceae)	groundnut
red palm oil	*Elaesis guineensis* (Palmae)	mafuta*. The water-oil emulsion is called mosaka*.
sugar cane	*Saccharum officinarum* (Gramineae)	pith. koko*.

*: Names with asterisk(*) are the vernacular names.
**: Edible portion, vernacular names or other comments.