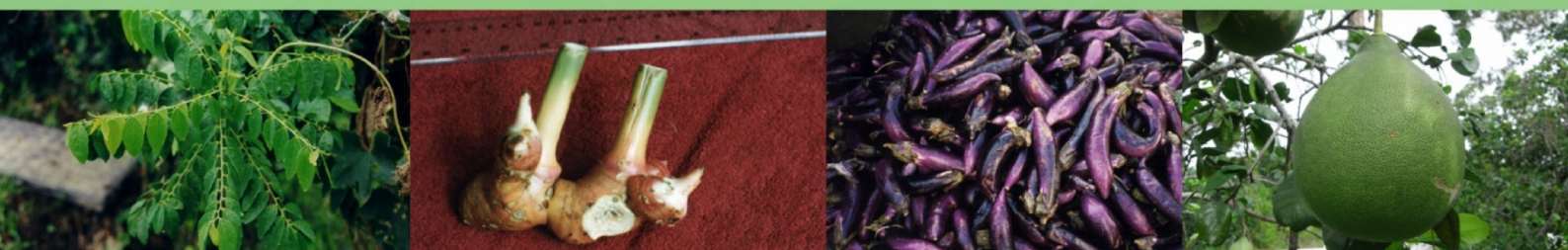


# Potentially Important Food Plants of Indonesia



**FOOD PLANT  
SOLUTIONS  
ROTARIAN ACTION GROUP**

*Solutions to Malnutrition  
and Food Security*



PRISCILLA HALL  
MEMORIAL FOUNDATION

A Project of the Rotary Club of Devonport North,  
District 9830 & Food Plants International

[www.foodplantsolutions.org](http://www.foodplantsolutions.org)



# PRISCILLA HALL MEMORIAL FOUNDATION



The Foundation in the last 10 years has observed the difference that could have been made for children's health if they had improved nutrition. We welcome the opportunity of partnering with Food Plant Solutions to bring this Field Guide to Indonesia. The program fits with our Vision Statement:

“To provide direct and on-going assistance to Indonesian children in need, with a focus on meeting their basic nutritional, shelter and educational requirements”

.



[www.PriscillaHall.org](http://www.PriscillaHall.org)

We gratefully acknowledge one of the Priscilla Hall Memorial Foundation partners – Yayasan Usaha Mulia (YUM), who have provided both the support and resources for an in-country review of this guide.

[www.yumindonesia.org](http://www.yumindonesia.org)



# Potentially Important Food Plants of Indonesia

## **Dedication**

This book is dedicated to the 3 billion hard working farmers and families around the world who cultivate these, and other, food plants for their own subsistence, and who help conserve them in their rich diversity for other people to enjoy.



## **Preface**

This guide is based on information from the Food Plants International (FPI) database developed by Tasmanian agricultural scientist Bruce French. The source material and guidance for the preparation of the book has been made possible through the support of Food Plants International, the Rotary Clubs of District 9830, particularly the Rotary Club of Devonport North who founded Food Plant Solutions, (previously the Learn ♦ Grow project), and many volunteers who have assisted in various ways.

The selection of plants included in this guide has been developed by Sam Lolicato working in a voluntary capacity using the selection criteria developed by Food Plant Solutions. These selection criteria focus on the local plants from each of the main food groups with the highest levels of nutrients important to human nutrition and alleviation of malnutrition. It is intended as a **Draft Guide only** to indicate some important food plants that serve as examples for this purpose. Other important nutritious plants may be equally useful, and it is recommended that the FPI database be used to source information on the full range of plants known to occur in Indonesia. This guide has been developed with the best intention to create interest and improve understanding of the important local food plants of Indonesia, and on the understanding that it will be further edited and augmented by local specialists with appropriate knowledge and understanding of local food plants.

Food Plant Solutions was initiated by the Rotary Club of Devonport North to assist in creating awareness of the edible plant database developed by Food Plants International, and its potential in addressing malnutrition and food security in any country of the world. In June 2007, Food Plant Solutions was established as a project of Rotary District 9830, the Rotary Club of Devonport North and Food Plants International. The primary objective of the project is to increase awareness and understanding of the vast food resource that exists in the form of local plants, well adapted to the prevailing conditions where they naturally occur, and how this resource may be used to address hunger, malnutrition and food security. For more information, visit the website [www.foodplantsolutions.org](http://www.foodplantsolutions.org). More detailed or specific information on plants, including references to material by other authors, is available on DVD on request.

**Disclaimer:** This Field Guide has been produced using information from the “Edible Plants of the World” database compiled by Bruce French of Food Plants International. Although great care has been taken by Food Plants International and Food Plant Solutions, neither organisation, or the people involved in the compilation of the database or this Field Guide:

- makes any expressed or implied representation as to the accuracy of the information contained in the database or the Field Guide, and cannot be held legally responsible or accept liability for any errors or omissions
- can be held responsible for claims arising from the mistaken identity of plants or their inappropriate use
- assume responsibility for sickness, death or other harmful effects resulting from eating or using any plant described in the database or this Field Guide

Always be sure you have the correct plant, and undertake proper preparation methods, by consulting with specialist scientists or local users of the plant. The Food Plants International database, from which the information in this Field Guide is drawn, is a work in progress and is regularly being amended and updated.

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## ***Introduction***

This book is designed as a simple introduction to the more common food plants of Indonesia. It is hoped people will take greater pride and interest in these plants and become confident and informed about how to grow and use them. Many of the local food plants that occur in every country are very good quality foods. Unfortunately, people often reject traditional food plants and grow more introduced vegetables in preferences. For example, ballhead cabbage does not have the same food value as many traditional, tropical, dark green, leafy vegetables.

### **Growing food**

Growing food to feed a family is, without doubt, one of the most important things anyone can do. The more interest you take in your garden and the more you learn about plants and how to grow them well, the more interesting and fun food gardening becomes.

### **A country with very special plants**

The local food plants of most countries have not been promoted and highlighted in the way they deserve. Visiting a local food market will quickly show what a rich variety of food plants can be grown in this country. Good information about these plants is often still in the minds and experience of local farmers, and has not been written down in books. This can make it hard for the next generation of young people to find out how to grow them.

In many countries, some of the traditional food plants are only harvested from the wild and others are only known in small areas. Others have hundreds of varieties and are the main food for people in different regions. Information on these plants, and in many cases, their food value and the pest and diseases that damage them is available in the Food Plants International database.

### **Getting to know plants**

People who spend time in gardens and with their food plants get to know them very well. It is a good idea to learn from someone who grows plants well. Each plant grows best in certain conditions and there are often special techniques in getting it to grow well. For example, sweet potato will not form tubers if the soil is too wet, but it may still grow lots of green leaves. Taro will grow in light shade, but sweet potato will not. Ginger can grow in fairly heavy shade. Pruning the tips of betel leaf or pepper vines will cause more side branches to grow and therefore, produce more fruit. Stored yam tubers need special treatment if you want them to put out shoots early. There are lots of unique things about every plant and learning about these helps a good gardener produce more food.

## **Naming of plants**

Many food plants have local names, as well as a common English name. Every type of plant also has its own scientific name. Although the scientific name might not be widely recognised, this is the link by which people in different countries and with different languages can recognise the same plant. We know that many plants are grown in many different countries, but relying on local or common names, we might not recognise the same plant grown in different places. By using scientific names to accurately identify plants, we can get useful information from people in other countries. Wherever possible, plants in this book are named by their common English name and their scientific name.

## **Local food plants are often very good**

People sometimes think that local food plants are not very special and that any food plant that is new or comes from another country must be a lot better. This is often not true. Many of the newer or introduced food plants, such as the round or ballhead cabbages, have very little food value. Many traditional tropical green, leafy vegetables and ferns have 10 times or more food value as ballhead cabbage or lettuce. It is important to find out more information about the food value of different foods if we want to eat well. Citrus fruit, such as lemons and oranges, are often grown for vitamin C that helps keep people healthy. These fruits do not grow well in the tropics - the common guava fruit has three times as much vitamin C and is loved by children. This is just one example showing there are often much better choices of local foods with higher levels of important nutrients.

## **An Important Note**

The principle behind Food Plant Solutions is to encourage the use of local plants. Some of these may be major agricultural crops that are already well known. Examples include:

- Rice
- Oats
- Mango
- Wheat
- Maize/corn
- Banana

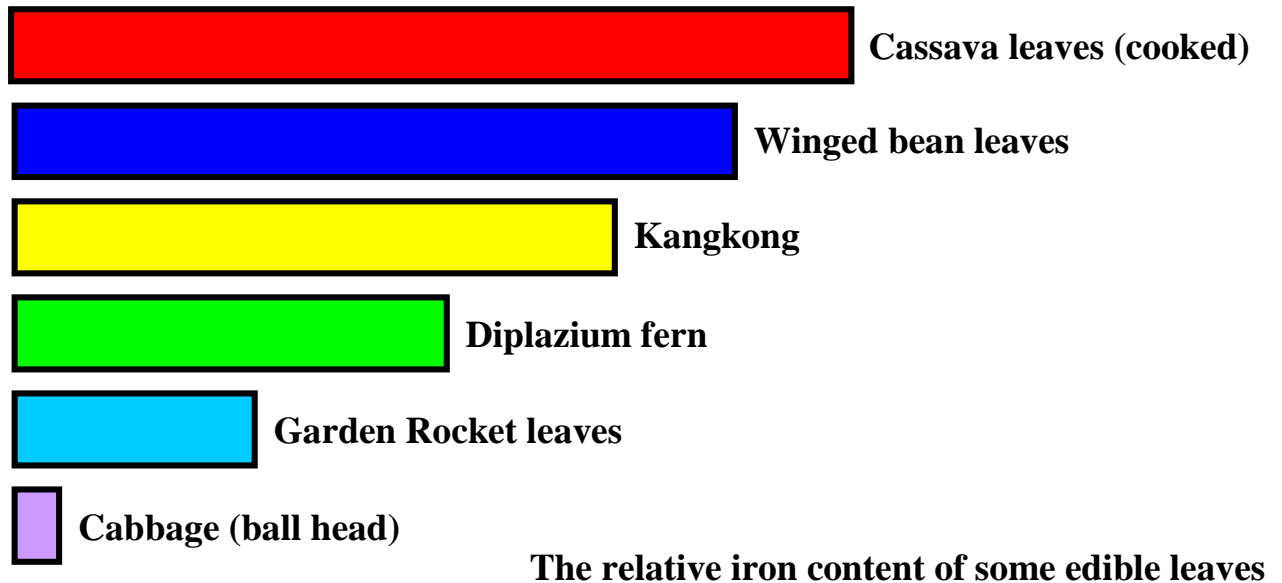
There are others, but these serve as examples.

As a general principle, these types of plants should not be included in a field guide, as they are well known, and in some cases (e.g. corn), are relatively high input crops. The purpose of the Food Plants Solution project is to look beyond these types of crops, and focus on plants that are less well known and, as noted above, often have superior food value and lower input requirements.

It is also important to note that while some plants have extremely high levels of some nutrients, many of these are used as flavouring foods (condiments), and are generally used only in small amounts. Therefore, the nutritional contribution they make to the diet will be relatively small. Typical of these types of plants are coriander, parsley etc. Once again, these should not be considered as major food sources. A few may be included in the *Nuts, Seeds, Herbs and other foods* section of the field guide.

## Nutrient Value

Our bodies need a variety of food plants to enable us to grow, stay healthy and have enough energy to work. Different foods are needed to provide energy, protein, vitamins and minerals. The following diagram highlights the iron content value of some traditional edible, tropical plant leaves, compared with cabbage. Iron is a nutrient that is very important for our bodies and especially our blood. People who are short of iron become anaemic and lack energy.



## A healthy balanced diet

Good nutrition, or eating a healthy balanced diet, is really very simple. If people eat a wide range of food plants, their bodies will normally get a balanced amount of all the different nutrients they require. If a nutrient is lacking in one food plant, then they are likely to get it from another plant if they are eating a range of food plants. For this reason, everybody should eat a range of different food plants every day. The food group that is especially important for young people is the dark green leaves. Everyone should eat a good serving of dark green leaves every day. They have many vitamins and minerals, as well as protein. There are many spices or flavouring plants that can improve the taste of foods, but taste should be considered separately from food value.

## Learning to cook well

Even though some nutrients in food can lose some of their value during cooking, it is normally much safer to cook all food plants, at least for a short time. Bacteria, which cause diarrhoea, can occur in gardens and on food plants. These are killed during cooking. Many plants in the tropics develop cyanide, a chemical that makes them bitter and poisonous. This happens often with cassava (tapioca, manioc) and beans, but can also occur in many other plants. Boiling the food for two minutes normally destroys cyanide and makes the food safe to eat. Some of the nutrients our bodies need (such as vitamin A for good eyesight) only become available when food is cooked in oil.

## **Learning to grow “wild” food plants**

Many plants grow wild in the bush and are not cultivated by people. We can normally find someone who has taken an interest in them and has learned to grow them. This may be people from a different language group. It may be that in their area they have found better types than the ones that simply grow wild.

## **Saving better types of plants**

If we simply allow plants to grow from seed, the improvements that have been made in finding sweeter or better types may get lost. Some fruit trees are like this and the fruit produced may not be sweet at all. It is often necessary to take cuttings from a tree to be sure the new plant is exactly the same as the old one. If the plants won't easily grow from cuttings simply by sticking a piece of the branch in the ground, (and keeping it watered), there are other ways of helping these plants to form roots and start to grow. One good way is to make a small cut in the bark of a young branch and then wrap soil around the cut and cover it with plastic. With plants like guava, new roots will start to grow from this cut and grow into the soil wrapped around the branch. It can then be cut off and planted. This is called air-layering. A similar method is used with the roots of breadfruit. A shallow root is uncovered and a small cut made from which a new sucker will start to grow. This can be cut off and replanted.

## **Growing from cuttings and suckers**

Many food plants are grown from cuttings and suckers. This is very important, as it allows all the different kinds of yams, taros, bananas, sweet potato and sugarcane to be continually grown and ensures the varieties are preserved. Each plant has its own special propagation method. It is important to use healthy planting material, as diseases can be spread in planting material. In many cases, small tubers of yams, taro etc. are stored for planting for the next crop. This is not always good practice, as the small tubers could be the result of diseases (such as viruses) in the plant. A good rule is to take cutting or save tubers from the best plants for re-planting.

## **Saving seed**

Some food plants are grown from seed. Sometimes this is very easy as the seeds are large, store well, grow easily and grow the same as the original plant. It is more difficult with other plants. Many large fleshy seeds, such as breadfruit, need to be planted while still fresh as they do not store easily. Other seeds do not “breed true” or do not grow into new plants that are the same as the original plants. With many of these plants, it may be necessary to find ways of growing them from cuttings or other methods such as grafting. Some plants “inbreed” and get smaller or poorer. This happens when a plant self-pollinates or receives pollen from a close relative. Corn grown in small plots normally does this and the plants grown from seed grown in this situation get smaller and smaller each year. The seed needs to be saved from several different plants with different history and then mixed together before sowing. All the seeds on one cob are related and will inbreed. Some seeds develop a hard seed coat and need to be scratched, soaked in water, or even put into hot water, before they will start to grow. Saving local seeds is often a good idea as they are already adapted to



local conditions. For example, seed saved from pumpkins grown locally will produce plants with less pest and disease damage than those grown from imported seed. *If you can't get seeds or planting material from local gardens – it is probably not a suitable local plant! Once again saving seed from the better plants helps ensure that you have better crops the next time you plant.*

### **Growing a garden of mixed plants**

In nature, one variety of one plant never grows alone. There are always lots of different plants of different kinds and sizes, all growing together. Anyone who has ever walked into a tropical jungle will know this very well. Growing plants in a food garden in a way similar to how they grow in nature, as a mixed group of plants, is very good agriculture. Mixing plants in a garden usually gives more reliable food production, as any disease from one plant will wash off in the rain onto a different plant, where it cannot survive. Small plants fill the gaps and reduce the need for weeding.

### **Different types of plants for food security**

There is another reason for growing a range of food plants in a local garden or around a village. If something goes wrong, like extreme insect damage to plants, some disease occurring in the garden, or a poor growing season, some plants will be more damaged than others. With a variety of plants, there will still be some food to eat until the other plants recover and grow again. Also, a wide variety of plants will mean that different ones will be maturing at different times, which helps ensure a continuous supply of food. There are shrubs that can be planted as edible hedges around houses, and fruit and nut trees that need to be planted as a gift for your children, several years before they will be able to enjoy them. Some nuts can be stored and eaten when other foods are not available. Most yams will store well for a few months.

### **Looking after the soil**

Gardeners in traditional tropical agriculture usually move their gardens often by shifting to a new piece of land. There are usually three reasons for this:

- In the tropical lowlands, weeds can become a very big problem. There are usually a lot fewer weeds in the first year or two after clearing and burning the land, but weeds increase in the following years.
- Some of the nutrients in the soil are used each year and the soil becomes poorer and plants do not grow as well. There are ways of reducing this loss of nutrients.
- Very small worms called nematodes build up in the soil after a few years and get into the roots, especially of annual vegetable plants, and stop their roots working properly. For example, root knot nematode will cause the roots of plants like tomatoes and beans to become twisted resulting in poor growth of the plant.

## **Building up the soil**

When a new garden has been cleared, it has lots of leaf mulch and other old plant material. This provides plant nutrients for new plants to grow. There is a simple rule for growing plants and improving the soil - "If it has lived once, it can live again." Any old plant material can provide nutrients for new plants to grow, but it must be allowed to rot into mulch or compost for this to happen. If this plant material is burnt, some nutrients, especially phosphorus and potassium ("potash"), get left behind in the ashes for new plants to use, although it also allows these important nutrients to be lost by being washed away by rain. But with burning other important nutrients, such as nitrogen and sulphur, get lost in the smoke and disappear from the garden and soil. These last two plant nutrients are especially important for growing green leaves and when their levels are low, plants grow small or pale green. When nitrogen is lacking, the old leaves of the plant go pale and fall off early, and when sulphur is lacking, the young leaves go pale. Wherever possible, old plant material should be covered with some soil to allow it to rot down and not simply dry out or get burnt. Cutting it into small pieces will help it break down more quickly into usable compost.

## **Poor soils where crops won't grow**

When soils are very acid (or sour), plants cannot get the necessary nutrients. Natural chemicals in the soil that are toxic to plants when present at higher levels become soluble, get into plants, and stop them growing. Adding limestone to these soils can improve them. Using compost will not make them less acid, but will keep the plant nutrients in the soil in a more readily available form that plants can use.

## **Soil nutrients**

Plants need 16 different kinds of plant food or nutrients in different amounts to grow properly. A plant that has already been growing will have these nutrients in them and probably even have them in a balanced amount. That is why composting old plant material is so important. Plants usually show some signs or symptoms if any of these nutrients is running out.

One of the most common and important nutrients for plant growth is nitrogen, which actually comes from the air, but gets into plants through the soil. When plants are short of nitrogen, their older leaves often become yellow or pale. When grass family plants, like sugarcane and corn, are short of nitrogen, the centre of the oldest (lowest) leaves starts to develop a dry or dead V-shape. The plant cannot find enough nitrogen in the soil so it gets it from an old leaf to grow a new leaf. This causes the old leaf to die, forming a characteristic V-shape in the centre of the leaf. The plant does not get any bigger as an old leaf dies each time a new leaf is produced. Village farmers often walk through grassland before they clear it for gardens, looking to see if the grass leaves are dry and dead, because they know gardens on this soil won't grow well. It is necessary to use compost or legumes (such as beans) to put nitrogen back into the soil. Growing plants from the bean family (legumes) is the most efficient way to increase the level of nitrogen in the soil.

Corn is a good plant for indicating which nutrients are running short in the soil. If the older leaves go dry along the edges, the soil is running out of potash. If leaves that are normally green develop a bluish colour, the soil is short of phosphorus. Generally, leafy crops need lots of nitrogen, and root crops need lots of potash.

### **Making compost**

Compost is old plant material that has been allowed to rot down into a fine, sweet smelling mulch that is full of nutrients that can be put back on the soil to grow new plants. Compost returns nutrients to the soil, improves the soil's ability to retain moisture and also helps improve soils that are acid or saline.

Making good compost is very simple. A simple heap of plant material can be made in the corner of a garden or near a house. Cutting the plant material (especially stems), into small pieces no longer than about the width of a finger, will help it break down quicker. If possible, make layers of plant material, then a small layer of soil, and then scatter fire ash on top. Keep repeating this process to make a heap. A good compost heap should be warm inside. Be careful with diseased plant material. This should be burnt, otherwise the disease may be spread when you use the compost at a later date.

The composting process is carried out by small bacteria that live in the soil and feed on decaying plants. They break down old plant material into compost. These bacteria are living, so they need air, water and food. A good compost heap must have air, so don't cover it with plastic or put it in a container. This makes a foul smelling compost, as different bacteria that don't need air turn it into an acid mixture that preserves it. Good compost must have moisture, so keep the heap damp, but not too wet. The compost bacteria like a balanced diet, which means that both green material and dried material is needed to balance the carbon and nitrogen in the compost pile. If the compost material gets too dry and brown, it will not break down, and if it gets too green, it will go slimy. Using a little bit of compost from an old heap will make sure the right bacteria are there to start the whole process off.

As soon as the plant material is broken down to a fine mulch it can be put onto the garden. It is best if it is dug in, but if it is regularly put onto the surface of the garden, worms will mix it into the soil.

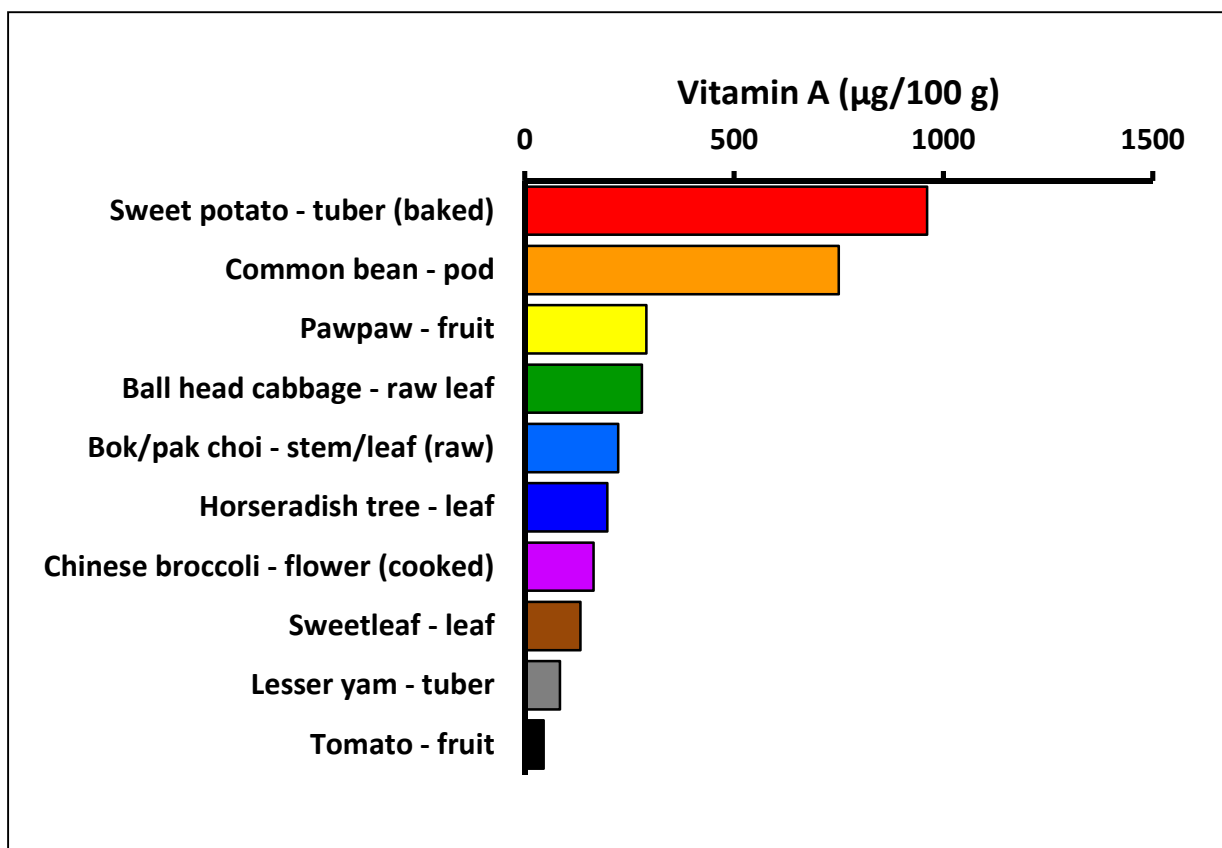
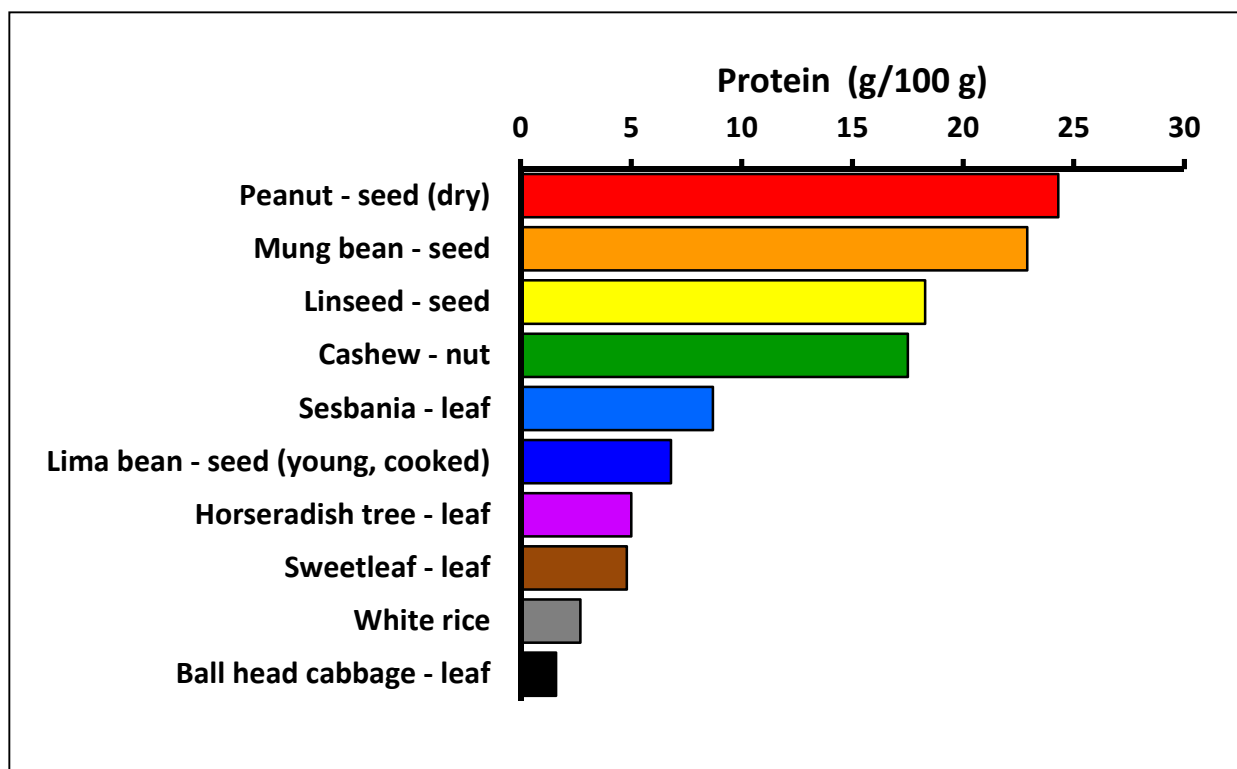
## **Pests**

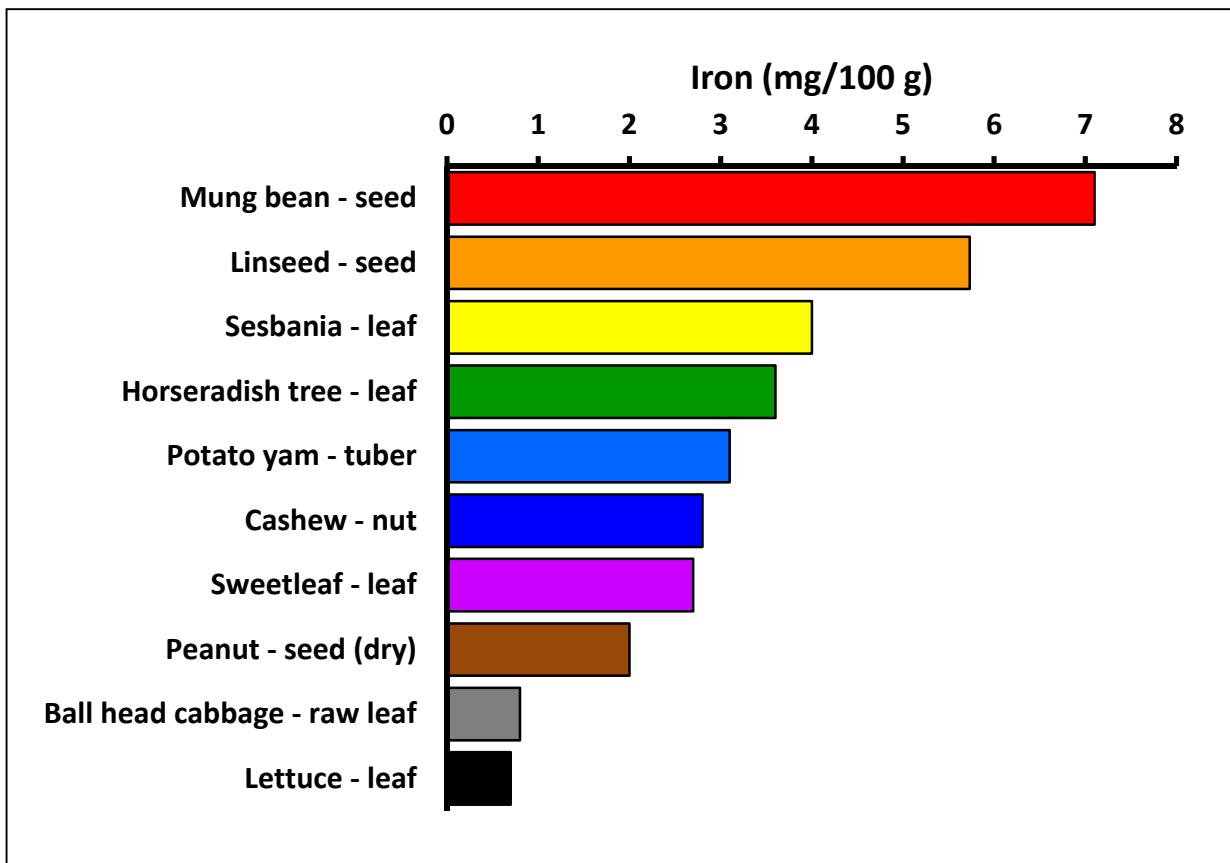
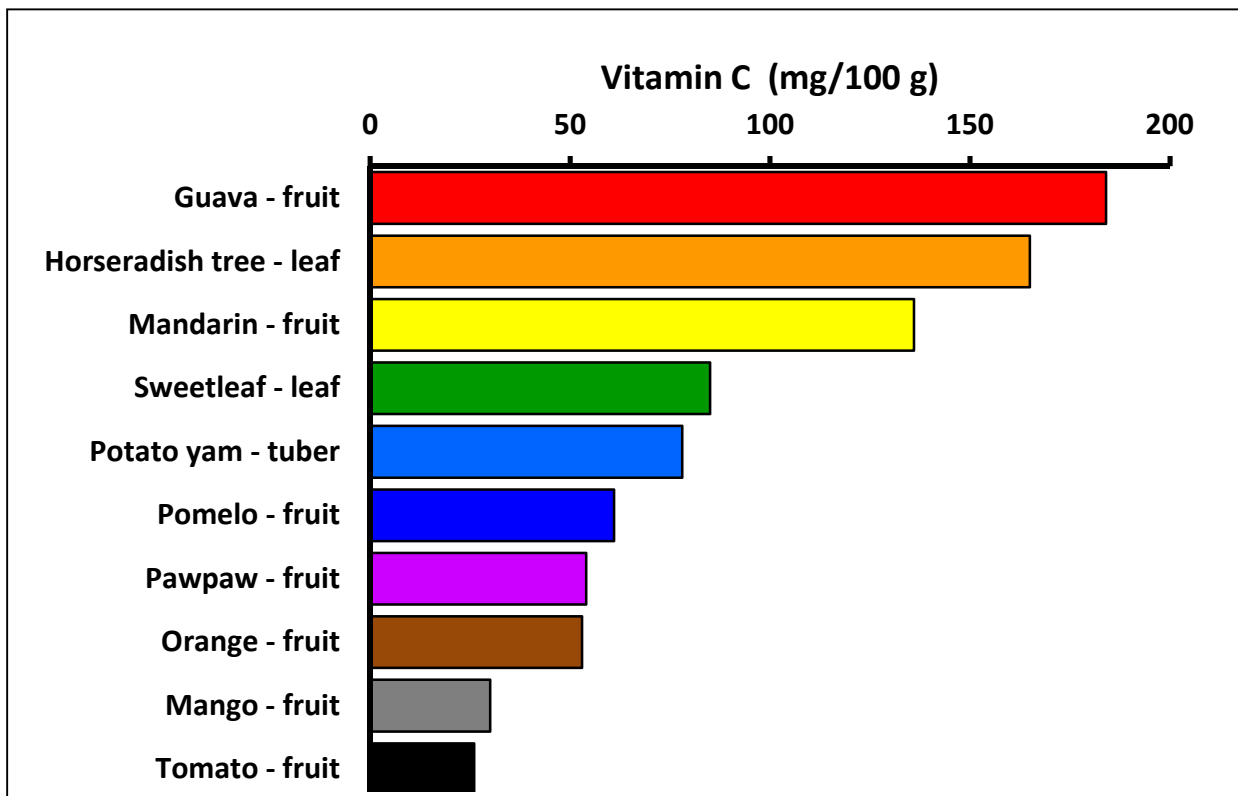
There are a large number of insects that enjoy sharing our food with us! We should not try to kill all these insects as they have an important role to play in keeping everything in nature in balance. What we need to do is to learn to manage these insects so we can all get some food to eat! Some insects are attracted to lights, and if the garden is near village lights some insects can cause a lot of damage. If large areas of one particular crop are planted, insects can breed more quickly and cause a lot of damage. As an example, insects called armyworms can breed up in large numbers on the shade trees of cacao and then move “like an army” into gardens. Some insects are large and breed slowly and can be picked off and removed. The large, green grubs with pointy tips that hide under taro leaves are best controlled by simply picking them off. Some insects, like taro beetles, can be a serious problem, but the young curl grubs of this insect are tasty if you catch and cook them. Some insects do not like sunlight. The very small moth that damages banana fruit is like this. Simply pulling off the leafy bracts over the banana fruit reduces the damage, as this lets sunlight in and the insect flies away. The best rule for reducing pest damage is to grow healthy plants, as they suffer less damage. Spiders, ladybirds, hover flies and many other insects also feed off the insect pests that attack our crops and should be encouraged.

## **Diseases**

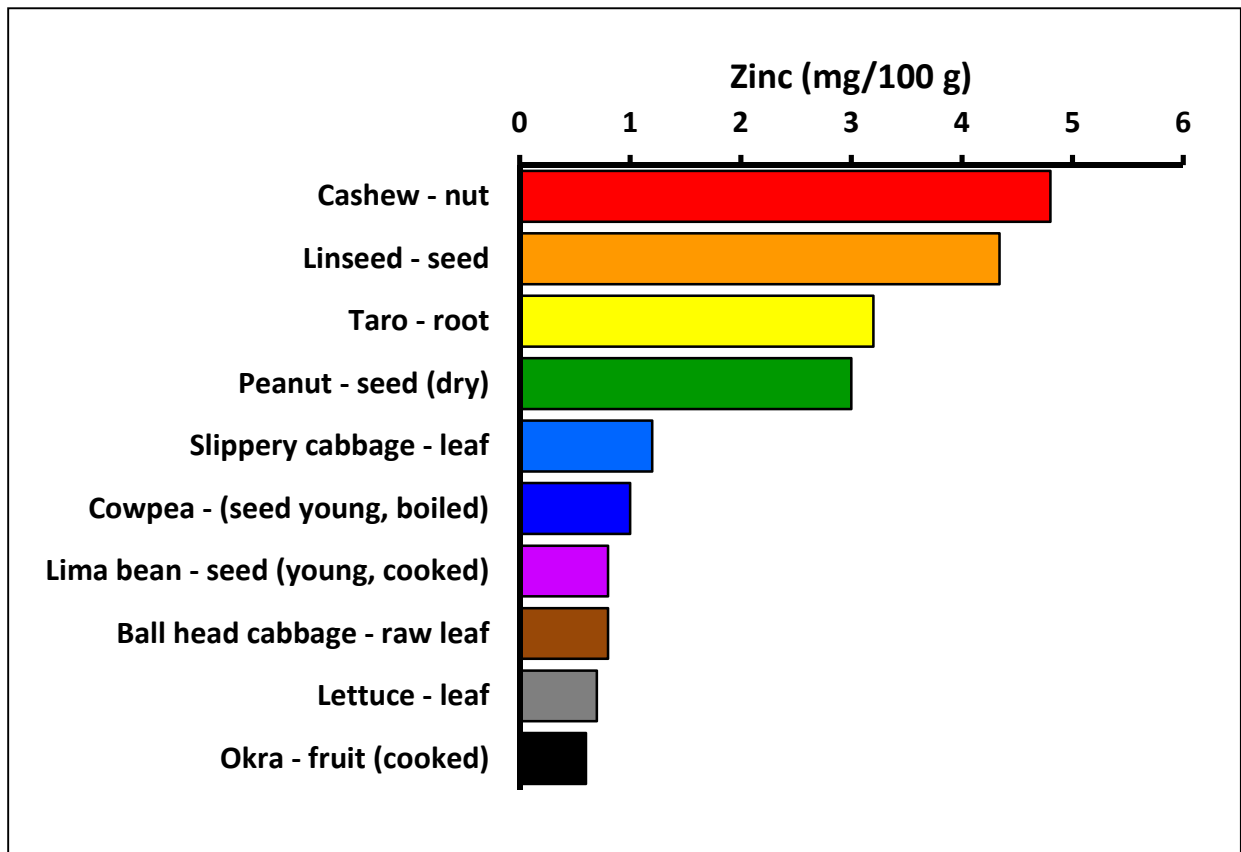
The living organisms that cause disease are much smaller than insects. These disease organisms can often only be seen with a microscope. There are three main kinds of disease organisms - fungi, bacteria and viruses. Fungi are like the mushrooms we eat, only very much smaller. They usually make distinct dry spots on leaves and other plant parts. Fungi have spores that often blow in the wind. Bacteria are often smaller and live in damp places. They usually make plants go soft and squashy, and they may cause a smell. Bacteria are mostly spread with rain and in water. Viruses are very, very small and usually make irregular stripes and patterns on leaves and other plant parts. Viruses usually spread in planting material or in the mouths of small sucking insects. Plants infected by viruses are often yellow, and may be stunted, or have curled or unusual shaped leaves. One common fungus disease on sweet potato causes the leaves to become wrinkled and twisted. It usually gets worse in old gardens and where soils are running out of nutrients. It doesn't affect all kinds of sweet potato to the same extent. The answer is not to stop the disease, but to improve the soil. The general rule is that healthy plants that are growing well will suffer less damage from disease.

## Food value charts for a selection of plants from Indonesia









**Note regarding plant selection:** In compiling these field guides, we acknowledge that some staple foods and commercial crops which are grown widely in the target country may be omitted. Such foods are often in the starchy staple category (e.g. rice, corn). This does not mean that they are not useful, but merely reflects a desire for the Food Plant Solutions program to concentrate on plants that are less well known and/or underutilised.

## ***Starchy staples***

**English:** Sweet potato

**Local:** Ubi jalar

**Scientific name:** *Ipomoea batatas*

**Plant family:** CONVOLVULACEAE

**Description:** This is a root crop which produces long creeping vines. The leaves are carried singly along the vine. Leaves can vary considerably from divided like fingers on a hand to being entire and rounded or heart shaped. Purple trumpet shaped flowers grow at the end of the vine. Under the ground fattened tubers are produced. There are a large number of varieties which vary in leaf shape and colour, tuber shape, colour, texture and in several other ways.



**Distribution:** A tropical and subtropical plant. They grow from sea level up to about 2,700 m altitude in the tropics. Plants can grow with a wide range of rainfall patterns and in different soils. Plants are killed by frost and can't stand water-logging. Plants grow well with temperatures between 21 - 26°C. It can grow with a pH between 5.2 - 6.8. Sweet potato are not tolerant to shading. Under shaded conditions, both foliage growth and storage root production are decreased. Some cultivated varieties can be selected for increased production under mild shade but not heavy shade. The survival of cuttings at planting is also reduced under shaded conditions. Under shaded conditions plant become more climbing and with fewer leaves which are however larger. With increasing shade less tubers are produced and these grow more slowly. Sweet potato tends to be responsive to potassium fertiliser. Cultivated varieties are often selected for yield under low fertility conditions. Under lowland conditions in the tropics sweet potato tubers undergo active tuber enlargement from 6 - 16 weeks. Weed control is essential especially during early stages of growth. The rate of ground coverage by foliage varies greatly with growing conditions and cultivar but once ground coverage has occurred weed control is less of a problem. Sweet potato tuber initiation is subject to aeration in the soil. Either heavy clay soils, waterlogged conditions or other factors reducing aeration can result in poor tuber production. For this reason sweet potatoes are often grown on mounded beds. It suits hardiness zones 9 - 12.

**Use:** Tubers are boiled or baked. They can be steamed, fried, mashed or dried. They can be fermented into alcoholic drinks. They can also be used in pies, cakes, puddings and candies and jams. They can be used in noodles. The chopped and dried tubers can be boiled with rice or ground into flour and mixed with wheat flour to make cakes or bread. The young leaves are edible.

**Cultivation:** Vine cuttings are used for planting. In grassland soils it is grown in mounds, ridges or other raised beds. In bush fallow, it is mostly planted in undug loose soils. It needs a sunny position. Tubers won't form if the ground is waterlogged when tubers start to develop. Sweet potato is grown by cuttings of the vine. About 33,000 cuttings are required per hectare. These weigh about 500 kg. Vine lengths of about 30 cm are optimum. As long as the vine is adequately inserted in the soil, the length of vine inserted does not significantly affect yield. Fresh sweet potato seeds germinate relatively easily and lead to continuous production of new cultivars under tropical conditions. Excess nitrogen restricts storage root initiation and therefore excess leaves are produced without significant tuber yield. Dry matter percentage increases with increasing age of the crop. Higher dry matter tubers are normally preferred.

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**Production:** The time to maturity ranges from 5 months to 12 months depending on the variety planted and the altitude at which it is being grown. Yields range from 6 - 23 t/ha.

**Food Value:** Per 100 g edible portion

<b>Edible part</b>	<b>Moisture %</b>	<b>Energy kJ</b>	<b>Protein g</b>	<b>proVit A ~g</b>	<b>proVit C mg</b>	<b>Iron mg</b>	<b>Zinc mg</b>
tuber (baked)	72.9	431	1.7	961	24.6	0.5	0.3
tuber (raw)	70.0	387	1.2	709	25	0.7	0.4
tuber (boiled)	72.0	363	1.1	787	15	0.6	0.3
leaf	86.3	168	3.9	105	58	2.9	-

## Starchy staples

**English:** Banana

**Local:** Pisang

**Scientific name:** *Musa sp* (A &/or B genome) cv.

**Plant family:** MUSACEAE

**Description:** These are the main group of cultivated bananas. They can be classed into diploid, triploid and tetraploid kinds with various amounts of the A or B parents. They grow 2 - 9 m high. They are large non woody herbs with broad long leaves. Most kinds have several suckers. Bananas grow a soft firm false stem from an underground corm. The fruiting stalk eventually emerges from the top of this false stem and normally curves over pointing towards the ground. Fruit occur in clumps or hands along this stem. The male flowers are in a red bud at the end of the flower stalk. The colour of the stem, bracts, bud and fruit varies considerably depending on the variety. The fruit can be 6 - 35 cm long depending on variety. They can also be 2.5 - 6 cm across.



**Distribution:** A tropical and subtropical plant. They grow from sea level up to about 2,000 m altitude in the tropics. They are rarely an important food above about 1,600 m. In Nepal they grow to about 1,800 m altitude. They do best in warm and humid tropical climates. Temperatures need to be above 15°C. The best temperature is 27°C. The maximum temperature is 38°C. Bananas grow best in full sun. For best growth, a rainfall of 200 - 220 mm per month is needed. A deep friable soil is best. They can tolerate a pH between 4.5 - 7.5. It suits hardiness zones 10 - 12. It is widely grown in many countries.

**Use:** Fruit are eaten raw or cooked depending on variety. Male buds and flowers are eaten on some varieties. They are cooked as a vegetable. The central pith of the false stem and the underground rhizome are also sometimes eaten.

**Cultivation:** They are planted from sword suckers. Diploids need re-planting annually but many triploids can be re-suckered from the base on the same site. Spacing depends on variety. A spacing of 1,000 – 3,000 plants per hectare is used depending on variety. Suckers are usually put 30 cm deep.

**Production:** Time to maturity varies from 6 - 18 months depending on variety and altitude. Triploids have larger bunches than diploids. Tetraploids are very large plants.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
fruit (cooking)	65.3	510	2.0	113	18.4	0.6	0.1
fruit (sweet)	70.7	365	1.7	-	2	0.9	0.4
flower buds	91.3	109	1.6	-	-	1.0	-

## Starchy staples

**English:** Fe'i banana

**Local:** Pisang tongkat langit

**Scientific name:** *Musa troglodytarum*

**Plant family:** MUSACEAE

**Description:** A large herb that forms clumps. It keeps growing from year to year. It grows 4 - 5 m tall and has a stout false stem. This often has a purple tinge. It secretes blood red sap. The leaves are long and dark green. The flower is erect and bears thick, blunt, fleshy fruit. These may have a few or no seeds. The fruit are orange to orange-red when ripe and are 10 - 20 cm long. There are 5 - 30 fruit in a cluster.



**Distribution:** A tropical plant that suits the hot, wet tropical lowlands.

**Use:** The starchy fruit are eaten cooked.

**Caution:** The yellow flesh turns the urine red.

**Cultivation:** Plants are grown by division using suckers.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
fruit	70	526	1.6	12	0	0.5	0.3

## Starchy staples

**English:** Cassava

**Local:** Singkong

**Scientific name:** *Manihot esculenta*

**Plant family:** EUPHORBIACEAE

**Description:** A plant which can re-grow year after year from the thickened roots. It has several stems. The stems are woody and have some branches. Plants grow up to 3 metres tall. Stalks have distinct scars where leaves have fallen. The leaves tend to be near the ends of branches. The leaves are divided like the fingers on a hand. The leaves have long leaf stalks. The leaves have 3 - 7 long lobes which can be 20 cm long. These are widest about 1/3 of the distance from the tip and taper towards the base. The colour varies. It produces several long tubers. These can be 50 cm long by 10 cm across. The flowers are on short stalks around a central stalk. They are produced near the ends of branches. The female flowers are near the base of the flower stalk and the male flowers higher up.



**Distribution:** A tropical plant. Plants grow from sea level up to about 1,650 m. In Fiji they grow to 900 m. They can grow in poor soil and can survive drought. It is native to tropical America. It grows between 25°N and 25°S and needs a rainfall above 750 mm. It suits hardiness zones 10 - 12.

**Use:** The tubers are eaten after thorough cooking. They are boiled, roasted or made into flour. The starch is used in puddings, soups and dumplings. Young leaves are edible after cooking. They are also sometimes dried and stored. Seeds are also eaten.

**Caution:** Bitter kinds of cassava contain poison but this is destroyed on heating. This kind of cassava should be cooked, sun dried, soaked and cooked again.

**Cultivation:** Cassava is planted from sections of the stalk. Sections about 15 - 20 cm long of the more mature woody stem are cut and stuck into the ground. They can be completely buried or put at almost any angle and it affects the growth little. Soon roots form and leaves start to sprout from the stalk. Cassava seeds need a soil temperature of 30°C for their germination. Flower and fruit production is more common under lower temperatures such as in highland or less equatorial conditions.

It is not necessary to dig a hole to plant cassava and on many soils where the soil is loose it can be planted without digging the soil first. Cassava does not suit waterlogged soils and preferably they should not be too shallow or stony.

Cassava can be planted at any time of the year but to get started it needs moisture so is often planted near the beginning of the wet season. The crop once established can survive for several months without rain. The ability to tolerate drought varies significantly with cultivar. During drought less and smaller leaves are produced and leaves die off more quickly but storage roots can be increased in the short term.

Because cassava can still grow satisfactorily in poorer soils it is often put last in a rotation after others crops have already been grown on the piece of land. Cassava is more responsive to nitrogen and potassium than phosphorus under many field situations. Nitrogen can increase cyanide levels. Under very acid conditions with high soluble aluminium levels, cassava has been able to achieve and maintain top growth but with significantly reduce root yields. When drainage is good and soil moisture is adequate, cassava stalks can be planted at any orientation from horizontal to vertical, but in very sandy soils horizontal planting is best and in heavy clay soils vertical planting is best.



Because of the slow growth in early establishment stages, soil loss from erosion with heavy rains can be significant. To avoid this planting should be timed so that the maximum vegetative growth is occurring during the heaviest rains. A leaf area index between 2.5 - 3.5 is optimal for cassava yield. The critical period for weed control is the time from 2 - 8 weeks after planting. Cassava tuber bulking is delayed under shaded conditions. Yields are also reduced. In mixed cropping situations using crops which mature early, allowing the cassava time to recover, is one possible strategy. For optimum production shading should be avoided.

Cassava takes about 10 - 12 months to produce mature tubers in the lowlands tropics although some varieties produce a smaller yield earlier. Yields in the range of 20 - 45 t/ha have been recorded for 12 - 14 month crops. The plants can be left growing and the tubers stored in the soil for considerable time. Crops of 24 months duration occur. Once the tubers have been dug they do not keep for more than a few days. Pre-harvest pruning of plants increases the storage time of tubers after harvest.

Spacing and plant density varies with soil climatic conditions and variety. Plant densities from 10,000 to 30,000 plants per hectare are used. Plants from the higher density crops have been shown to have quick post-harvest deterioration. Mulching has given significant yield increases in some conditions. It also reduces the incidence and damage of some root boring insects.

**Production:** Plants can be harvested after 10 months in the lowlands. There are some faster growing varieties. Yields in the range of 20 - 45 t/ha have been recorded for 12 - 14 month crops.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
tuber	62.8	625	1.4	30	15	0.23	0.48
leaf	82.0	382	7.1	57	275	7.6	-

## Starchy staples

**English:** Taro

**Local:** Talas

**Scientific name:** *Colocasia esculenta*

**Plant family:** ARACEAE

**Description:** This plant has large flat leaves on the end of upright leaf stalks. It grows up to 1 m high. The leaf stalk or petiole joins the leaf towards the centre of the leaf. The leaves are 20 - 50 cm long. Near the ground a thickened rounded corm is produced. Around this plant there is normally a ring of small plants called suckers. Many different varieties occur. If left to maturity, a lily type flower is produced in the centre of the plant. It has a spathe 15 - 30 cm long which is rolled inwards. The flowers are yellow and fused along the stalk. There are many named cultivated varieties. Taro comes in two basic forms. The Dasheen type *Colocasia esculenta* var. *esculenta* and *Colocasia esculenta* var. *antiquorum* or the Eddoe type.

The basic difference is the adaptation of the Eddoe type to storage and survival in seasonally dry places, while the dasheen type needs to be maintained in a more or less continuously growing vegetative stage.



**Distribution:** It is a tropical plant. Taro grows from sea level up to about 2,300 m altitude in the tropics. It grows well in humid places. It can stand damp soil and grow under light shade. It suits hardiness zones 9 - 12.

**Use:** The corms, petioles and leaves are all edible after cooking. The leaves are also dried and stored. Fresh leaves can be stored for 4 - 5 days.

**Caution:** Some varieties burn the throat due to oxalate crystals.

**Cultivation:** Taro can be planted from cormels or from the top of the central corm. Other sections of the corm could also be used but this is not commonly done. Flowering of taro and seed production can lead to new cultivars. Flowering can be promoted by the use of gibberellic acid. The general growth pattern is for an increase in top growth, in terms of leaf number, leaf area and petiole length, to continue for about 6 months under tropical lowland conditions then for each of these to decrease and tuber storage to continue to increase. Corm weight increases significantly from 5 - 11 months. Starch content also increases with time but protein content declines over the corm development period.

Taro can be grown under flooded conditions but root rots develop if the water becomes stagnant. For flooded cultivation, the land is cleared, ploughed, cultivated and puddled. The aim is to get a field that is flat with embankments allowing the impounding of water. Planting is done into 2 - 5 cm of standing water.

For dry land taro, the soil is prepared by digging, unless a fresh bush fallow is used where the natural friability of the soil allows plants to be put into the undug soil in a small hole that is prepared. Plants are put into a hole 5 - 7 cm deep or deeper. Mulching to conserve moisture and reduce weed growth is beneficial. Setts from corms normally give higher yield than that from cormels. The greater leaf area and root production may be responsible for this. Sets of about 150 g are optimum.

The time of planting is primarily determined by the availability of moisture. Planting is done shortly after the rainfall has become regular, if seasonally distinct wet and dry occur. Higher rainfall, higher temperatures, and higher hours of sunlight, enhance production and determine seasonality of production.

Evapotranspiration for flooded taro averages about 4 mm per day, ranging from 1.5 - 7.2 mm, with a total of about 1,200 mm for the crop. Intermittent moisture can result in irregular shaped corms. Flooding has been found to be more effective than sprinkler irrigation, or furrow irrigation. Increased suckering, giving greater leaf area, seems to be the reason for this.

Taro is sensitive to weed competition throughout most of its growth, but it is more critical during early growth up to 3 - 4 months. About 7 - 9 weedings are required, to keep the crop clean under tropical lowland conditions, where flooding is not used. Due to the decrease in height and leaf area towards the end of the growth cycle when starch accumulation in the corms is maximum, weed competition and weed control are again significant. Mechanical weeding needs to be shallow to avoid damaging the superficial taro roots. A range of herbicides have been recommended in various situations.

Taro produces the highest dry matter yield under full sunlight, but it can still grow under moderate shade. Under shaded conditions it grows more slowly and develops fewer cormels. They require good moisture conditions and have little tolerance for drought. Taro residue has an allelopathic factor which can reduce the germination and growth of other plants, for example, beans.

Taro tends to demand high fertility, and is responsive to additional NPK fertiliser. Higher doses of K increases starch content and higher doses of N increases protein content. Both N and K applications increase oxalic acid content of the tubers.

Spacing affects total yield, and marketable, harvestable yield, of corms. Close spacing increases the corm yield per area, and the shoot yield per area, but decreases the corm yield per plant, and the contribution of sucker corms, to the yield. Where spacings of 30 cm x 30 cm are used, giving about 110,000 plants per hectare, a very large amount of planting material is required, which reduces the net return per unit of planting material. A spacing of 60 cm x 60 cm is more common. Wider spacings of 90 cm x 90 cm reduces overall yield.

**Production:** Crops mature in 6 - 18 months. Yields of 5 - 15 tonnes per hectare are probably average.

**Food Value:** Per 100 g edible portion

<b>Edible part</b>	<b>Moisture %</b>	<b>Energy kJ</b>	<b>Protein g</b>	<b>proVit A ~g</b>	<b>proVit C mg</b>	<b>Iron mg</b>	<b>Zinc mg</b>
root	66.8	1231	1.96	3	5	0.68	3.2
leaf	85.0	210	5.0	57	90	0.62	0.7
leaf stalk	93.0	101	0.5	180	13	0.9	-
leaf (cooked)	92.2	92.2	2.7	424	35.5	1.2	0.2

## Starchy staples

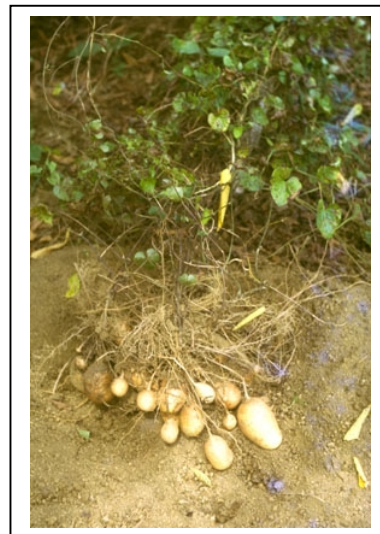
**English:** Lesser yam

**Local:** Gembili

**Scientific name:** *Dioscorea esculenta*

**Plant family:** DIOSCOREACEAE

**Description:** A prickly, climbing yam with a spiny vine. It can climb 1.2 - 2.4 m high and spread 1.8 m across. The vine twines to the left. The leaves are round with a gap where the leaf stalk joins. They are almost heart-shaped. The leaf is about 12 cm long. This yam produces a cluster (5 - 20) of tubers under the ground. The tubers are often sticky when cut. In many varieties, there are sharp thorns just under the ground. The flowers are green, 4 mm across and borne on long slender spikes. These are singly in the axils of leaves. There are many different varieties.



**Distribution:** It grows in many tropical countries, from sea level up to about 1500 m, but mostly below 800 m. It cannot tolerate water-logging and needs a reasonably long rainy season and a loose, fertile soil. It does poorly on sandy soils and becomes misshapen in heavy clay soils. High levels of organic matter promote growth. It suits hardiness zones 9 - 12. Lesser yam is an important root crop for the tropical humid lowlands.

**Use:** The tubers are cooked and eaten.

**Cultivation:** Normally, small tubers (50 - 75 g) are planted, but cut portions of a tuber can be used. Using either the top or the bottom section of a tuber gives better establishment and yield than middle portions. Using larger tubers gives larger individual tubers and higher yields for individual plants. With a spacing of 30 cm between plants and 100 cm between rows, about 2,000 kg of planting material are used if 70 g tubers are used. Tubers are planted 8 - 12 cm below the ground. Plants can be grown from stem cuttings where a leaf and node are propagated under mist. This method is normally only used for increasing the amount of planting material of a selected variety. Planting in mounds assists drainage, improves aeration and makes harvesting easier. A spacing of 80 - 100 cm between plants is suitable. Planting is normally adjusted to fit in with the beginning of the rainy season. The growing season of 9 - 10 months is long and an extended wet season is therefore desirable. Stakes 2 m long are required. Lesser yams compete poorly in shade. Weed control is most critical during the first 3 months. As early growth of the plant is sustained from the tuber, fertilisers can be applied after planting. Added nitrogen fertiliser is more effectively used when plants are staked. Nitrogen is of more benefit for leaf growth in the early stages of plant development. Potassium is beneficial, although phosphorus applications often do not give significant responses, as lesser yams are efficient at extracting it from the soil.

**Production:** High yields can be obtained. Plants take about 9 months to reach maturity. In some varieties and under some conditions, leaves do not die-off and tubers must be harvested to avoid tubers rotting as new growth commences. Tubers need to be harvested and handled carefully. They must often be cut from the vine and can be washed and dried. Tubers will store for about 3 months under ventilated conditions above 15°C. Fungal growth and rots easily occur on cut or damaged surfaces under damp conditions. Tubers need to be peeled either before or after cooking.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
tuber	74.2	470	2.1	84	20	0.75	0.5

## Starchy staples

**English:** Potato yam

**Local:** Gembala/Gembolo

**Scientific name:** *Dioscorea bulbifera*

**Plant family:** DIOSCOREACEAE

**Description:** A yam with a long smooth stemmed vine, round in cross section and without spines. The vine winds to the left, can climb into trees and grow to long lengths. The large leaves (14 - 30 cm across and slightly longer than wide) have pointed tips and round bases. About 7 veins arise from the tip of the leaf stalk. It produces often flattened bulbils (potatoes) in the leaf angles along the vine. They can be grey brown or purple. The smaller tuber underground is normally covered with roots. The flowers are large. The male flowers are in spikes up to 20 cm long. The female spikes are usually in pairs. The winged fruit are about 2.5 cm long by 1.5 cm across. The seeds have wings. The bulbils normally have few fibres through the tissue compared to some yam tubers. Many varieties have yellow flesh.



**Distribution:** An annual tropical plant. It will grow from the coast up to about 1,700 m altitude in equatorial zones. It is common near the edge of grassland and forest at mid altitudes. Both wild and cultivated forms occur. It is common near secondary forest at low and medium altitudes.

**Use:** The cooked tubers are eaten. More commonly the cooked aerial bulbils are eaten. Some kinds are bitter and inedible or at least require special processing and cooking. Some varieties are poisonous.

**Cultivation:** Either the vine bulbils or the underground tubers are planted. It is convenient to train the long vines up trees. The bulbils need a set storage time before sprouting. The leaves die off for 1 - 4 months each year before re-sprouting from the tuber. Bulbils only grow shoots from one end unless the bulbil is cut into pieces. If the larger bulbils are cut, the cut surfaces should be dried and healed in a shady place for 2 - 3 days before planting. Bulbils are planted 8 - 12 cm below ground at a spacing of about 100 cm by 100 cm. Normally nitrogen and potassium fertilisers give greater responses than phosphorus. Friable well drained soils are most suitable. Often little cultivation or mounding is done. A high level of organic matter improves yield. Strong staking is required with branched 2 m stakes, or with trees or living stakes. Vine and tuber growth can be extensive and heavy.

**Production:** Bulbils or aerial yams are produced as leaves begin to unfold, continue until plant maturity, and often fall. Harvesting can start 3 months after planting but immature tubers have less starch. Underground tubers are normally not harvested until leaf die back. Wounds and damage to the tubers normally heal naturally given dry aerated conditions. Some varieties have seasonally dormant aerial tubers which only grow after an extended storage period. Others germinate quickly.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
tuber	70.8	357	2.7	-	78	3.1	0.4
bulbil	79.4	326	1.4	-	-	2.0	-



## Starchy staples

**English:** Greater yam

**Local:** Uwi

**Scientific name:** *Dioscorea alata*

**Plant family:** DIOSCOREACEAE

**Description:** A long angular vine with square stems that twine to the right around support sticks. The stem does not have spines and is often coloured green or purple. The leaves are heart shaped and borne in pairs along the vine. The leaves vary in shape, size and colour with different varieties. Leaves can be 10 - 30 cm long by 5 - 20 cm wide. The leaf stalk is 6 - 12 cm long. The flowers occur in the axils (where the leaf joins the stem) of the upper leaves. The male flowers are in small heads along branched stalks. These can be 25 cm long and green. The female flowers are in shorter spikes. Many cultivated varieties do not produce fertile seed. The fruit are 3-winged and 2.5 cm long by 3.5 cm wide. The seeds, when they occur, have wings right around them. One large, but often irregular-shaped, tuber occurs under the ground. There are many different varieties. The tubers can vary in shape, size, colour, texture and other ways. Some varieties produce bulbils, or small bulbs, along the vine.



**Distribution:** It grows in many tropical countries, growing from sea level up to about 1,800 m in the tropics. Yams are most important in seasonally dry areas. They need a well-drained soil with reasonable fertility and are, therefore, often planted first in rotations. The maximum temperature is  $>30^{\circ}\text{C}$  while the minimum is  $20^{\circ}\text{C}$ . The best temperature range is  $25 - 30^{\circ}\text{C}$ . Rainfall is often seasonal in yam areas and the maximum needs to be 14 - 20 weeks rain, with the best being 1,150 mm during the growing season. Yams can tolerate drought, but give best yields with high rainfall. The critical rain period is during the first 5 months. They cannot tolerate water-logging. Yams are influenced by the number of hours of sunlight. Short days (less than 10 - 11 hours of sunlight) favour tuber development. Yams suit hardiness zones 10 - 12.

**Use:** The tubers are boiled, baked or mumued (cooked in the ground).

**Cultivation:** For general food production, use top pieces of the tuber after they have sprouted, use a branched stick for supporting the vine, space plants about 1 m apart and choose a smooth round variety of yam. This makes harvesting easier, and peeling and food preparation quicker. Varieties that get less leaf spot disease and are less damaged by virus diseases give a more reliable yield. Tubers which are cut and stored in shady places until they form sprouts give improved yields over tubers that are left whole then cut into setts at planting. Because yam tubers have a period of dormancy, tubers do not normally commence regrowth for up to 5 - 6 months. This means they store, but cannot easily be used for out of season replanting. Dormancy, or inactivity, of the yam tubers can be broken using Calcium Carbide treatment for 5 hours, or by covering tubers with leaves of *Croton aromaticus* or *Averrhoa bilimbi*.

In some kinds, the bulbils that grow along the vine can be used for planting. By using staggered plantings of male and female plants, and then hand-pollinating the flowers, it is possible to get seeds to develop and these can be used to establish new plants. It is common practice in many areas to plant the yam piece upside down. The probable reason for this is to give the shoot and roots time to develop and get established away from the sun and wind so that the plant does not dry out. People in yam areas have their varieties classified as to whether they are planted at the top or the bottom of the hole, and whether the shoot is pointed up or downwards. A planting depth of 15 cm is best. Normally top pieces give a higher yield than middle pieces of the tubers and these are better than bottom pieces. Top pieces of the yam tuber give earlier and more reliable shoots and the yams mature earlier. These top pieces are also the less attractive part of the tuber for eating, so they are preferred for planting.



The larger the sett, the earlier it develops shoots and the larger the yield. Putting plants more closely gives smaller yams, but more total food. Closer spacing is normally used on lighter soils.

Yams should also have sticks to climb up. It is best to have a stick that is twisted or branched because the vine can slip down a very straight stick. Normally, a stick 2 m tall is sufficient. It needs to be a strong stick, firmly fixed in the ground. Yam varieties have varying types of vine growth. This affects where the stick needs to be placed. The fat, irregular yams can have the sticks near the mound, as a thick clump of vines and leaves soon develops. But, if a the stick is put beside the mound of one of the long ceremonial yams, the vine will often reach the top of the stick before it has produced more than a couple of leaves and will then fall back down to produce its leaves on the ground. The stick for these varieties often needs to be put at some distance from the yam hole. The tip can be picked off the vine if branching is wanted earlier.

Light influences the growth of the tubers. If the tubers have light on them often, due to cracks in the soil on hillsides, tubers are smaller. Compact soil or stones means the tubers may be exposed to sunlight. This needs to be avoided as it reduces yield. Yams must have plenty of air in the soil, so they will not normally grow on heavy clay soils or in areas with a lot of soil moisture. The soil can be improved for yam growing by putting leaves and other plant material in the planting hole, by making a mound above the hole, or by planting on a hillside. In some very loose sandy soils, yams can just be planted in flat unmounded soils without digging a special yam hole, but these situations are not common.

**Production:** In most places, the yam growth and time to maturity is linked to seasonal rainfall patterns. They are mostly planted just before the first rains, where an 8 - 10 month rainy season exists. They give better yields in 6 - 8 month rainy season areas, where they are planted 3 months before the rains. Earlier planting requires larger sett size to withstand drying out. In drier grassland areas, mulching the mounds at planting means fewer plants die and more food is produced. The time to maturity ranges from 5 months on the coast, to 9 - 10 months at higher altitudes. Yams will store well for over 6 months in a dry, dark, well-ventilated shed. Greater yam is an important root crop of the seasonally dry, hot humid, tropics.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
tuber	76.6	323	2.0	18	10	0.8	0.39

## Legumes

**English:** Peanut

**Local:** Kacang tanah

**Scientific name:** *Arachis hypogea*

**Plant family:** FABACEAE

**Description:** Peanuts grow on spreading bushy plants up to about 40 cm high. The leaves are made up of 2 pairs of oppositely arranged leaflets. Flowers are produced in the axils of the leaves. Two main kinds of peanuts occur. The runner kind (Virginia peanut) has a vegetative or leafy branch between each fruiting branch and therefore produces a spreading bush. The bunch type (Spanish-Valencia peanuts) produces fruiting branches in a sequence one after the other along the branches. They grow as a more upright plant and grow more quickly. Pods are produced on long stalks which extend under the ground and they contain between 2 - 6 seeds. The stalk or peg from the flower grows down into the soil and then produces the pod and seed under the ground. The flowers need to be no more than 18 cm from the soil surface for the seed pod to develop underground.



**Distribution:** Peanuts grow in tropical and subtropical areas. They grow well from sea level up to about 1,650 metres in the equatorial tropics. They require temperatures of 24 - 33°C. Plants are killed by frost. They need a well-drained soil and cannot stand water-logging and often require raised garden beds. Peanuts need 300 - 500 mm of rain during the growing season. Dry weather is needed near harvest.

**Use:** The seeds can be eaten raw or cooked. They are boiled, steamed, roasted, salted or made into peanut butter or flour. The young leaves and unripe pods are edible after cooking. Sprouted seeds can be eaten. An edible oil is extracted from the seeds. The remaining meal can also be eaten.

**Cultivation:** Peanuts require soil with good levels of calcium and boron or they produce empty pods. Peanuts have nitrogen fixing root nodule bacteria and therefore can give good yields in soils where nitrogen is low. The nuts are normally removed from the shell before planting and are sown 2 - 3 cm deep, with 10 cm between plants and 60 - 80 cm between rows. The soil needs to be weeded and loose by the time the flowers are produced to allow the peg for the seed pods to penetrate the soil.

**Production:** Flowering can commence in 30 days and it takes 3.5 - 5 months until maturity. Peanuts are harvested by pulling out the plant when the top of the plants die down. After harvesting, they should be left to dry in the sun for 3 - 4 days. Virginia peanuts have a longer growing season and the seeds need to be stored for 30 days before they will start to re-grow.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
seed (dry)	4.5	2364	24.3	-	-	2.0	3.0
seed (fresh)	45	1394	15	-	10	1.5	-
leaf	78.5	228	4.4	-	-	4.2	-

## Legumes

**English:** Lima bean

**Local:** Kacang kratok, kacang jawa atau kekara

**Scientific name:** *Phaseolus lunatus*

**Plant family:** FABACEAE

**Description:** A perennial climbing bean. It is often a tall, vigorously climbing plant which can keep growing for some years. The leaves are slightly rounded at the base and pointed at the tip. The flower is white or yellow. The keel of the flower is twisted which helps tell the difference between this bean and Lablab bean. The pods are long (10 cm), flattened and curved and have 3 - 4 seeds which are highly variable in colour. The seeds are large. The seeds have a short round hilum where the seed is attached to the pod. The seeds also have lines going out from this point across the bean seed.



**Distribution:** It suits warm and subtropical areas. In the tropics it is common from 500 - 2,100 m altitude but grows to the limit of cultivation (2,700 m). For germination it must have a soil temperature above 15.5°C and cannot withstand frost. In very hot weather seeds often do not set. It does best in a temperature range 14 - 21°C. It is sensitive to a pH less than 6. It can grow in arid places.

**Use:** The leaves, young pods and seeds are all eaten. The seeds are eaten fresh or after drying. They are also fried in oil. Dried beans are boiled or baked. They can be used in soups and stews. The seeds are sometimes grown as bean sprouts then cooked and eaten.

**Caution:** Some kinds have poison (hydrocyanic acid). This is destroyed by thorough cooking. The beans contain a protein inhibitor but this is also destroyed by cooking.

**Cultivation:** It is grown from seed. Coloured seeds are often hard to get to grow but white seeded kinds start growing easily. Sow 3 - 4 seeds in a hill and put a stick 2 - 3 m tall in the middle. Hills should be about 1 m apart. Seeds should be 2 - 4 cm deep.

**Production:** Harvesting can begin after about 100 days. Dried beans can be stored for several months. Yields of 0.12kg of seed per square metre have been obtained. The yield of pods can be 1kg per square metre.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
Seed	12.0	1407	19.8	tR	0	5.6	-
seed (young, cooked)	67.2	515	6.8	37	10.1	2.5	0.8
seed (young, raw)	70.2	473	6.8	30	23.4	3.1	0.8

## Legumes

**English:** Common bean

**Local:** Kacang buncis

**Scientific name:** *Phaseolus vulgaris*

**Plant family:** FABACEAE

**Description:** There are many bush and climbing varieties of this bean. Climbing forms can be 2 - 3 m tall. Bush types are 20 - 60 cm tall. The leaves have three leaflets, one after another along the stem. The leaf stalk has a groove on the top. The side leaflets are unequal in shape, and can be 8 - 15 cm by 5 - 10 cm. The flowers are in the axils of leaves (where the leaves join the stem) and occur in a loose form. Flowers are white to purple. Pods are smooth, slender and 8 - 20 cm long by 1 - 1.5 cm wide. They are straight or slightly curved with a beak at the end and often have 10 - 12 coloured, kidney-shaped seeds.



**Distribution:** It is a temperate plant that grows in many temperate and subtropical countries, including Solomon Islands. It mostly grows from 700 – 2,000 m altitude in the tropics. It suffers from pest and disease damage in the lowlands, but can be grown to sea level. It is not suited to the wet tropics. It is shallow-rooted and damaged by excess moisture near the roots. A crop lifecycle needs about 350 mm of water. It is sensitive to frost and high temperatures. Flowers will not form below 9.5°C. Night temperatures above 37°C cause flowers to drop. The best temperature range is 15 - 21°C. It does not suit very acid soils. It suits hardiness zones 8 - 11.

**Use:** The young pods, leaves and mature seeds are edible. Dry seeds are soaked in water and boiled until soft.

**Cultivation:** Plants are grown from seed, preferably sown in raised beds. Seeds remain viable for 2 years. Germination is normally good if seed has been well stored. Climbing types need stakes. Plants are self-fertilised. These beans are intercropped with other plants in many places. If grown on their own, bush types can be spaced at 25 cm x 25 cm. They can be sown closer together in rows wider apart to make weeding and harvesting easier. For dried beans, once the pods are mature and turning yellow, the whole plants are pulled, then dried and threshed. About 50 - 75 kg of seed will sow a hectare. Flowering in most French bean varieties is not affected by day length.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
seed (dry)	10.0	1386	25.0	10	1	8.0	2.8
seed (young)	92.0	142	3.0		20	0.8	0.2
pod	88.0	151	2.5	750	27	1.4	0.2
sprout	90.7	121	4.2	0	38.7	0.8	0.4

## Legumes

**English:** Mung bean

**Local:** Kacang hijau

**Scientific name:** *Vigna radiata*

**Plant family:** FABACEAE

**Description:** An upright hairy bean plant which can grow to 1 m tall. It has many branches. The leaves have 3 leaflets, are dark green and grow on long leaf stalks. There are oval stipules at the base of the leaf. Flowers are pale yellow and small. They occur in bunches of 10 - 20 on the ends of long hairy flower stalks. Pods are black and straight. They do not have a beak. Pods contain 10 - 20 seeds which are usually green or golden yellow. They are smaller than black gram. The beans can be black. They have a flat white hilum. There are 2,000 varieties.



**Distribution:** A tropical and subtropical plant. The plant will grow from sea level up to about 2000 m in the tropics. It is drought resistant but can't stand water-logging. Plants are damaged by frost. They cannot stand salinity. Rainfall at flowering is detrimental. It requires a deep soil. Both short day and long day varieties occur. It can grow where annual temperatures are from 8 - 28°C. It can tolerate a pH from 4.3 - 8.1. It suits a drier climate and can grow in arid places. It suits hardiness zones 10 - 11.

**Use:** Seeds are eaten ripe, raw or roasted. They are added to soups and stews. They are also fermented. Young pods and leaves can be eaten. The seeds can be germinated for sprouts and used in salads and stir-fried dishes. The seeds are ground and used for starch to make noodles.

**Cultivation:** Plants are grown from seed. In some areas these are broadcast while for small plots often 2 - 3 seeds are sown in holes 50 - 60 cm apart. Seeding rates of 6 - 22 kg per ha are used in different locations. It normally requires phosphorus fertiliser for adequate growth. Seeds germinate in 3 - 5 days.

**Production:** Green pods are ready after about 2 months and ripe pods may take another 1 - 2 months. For ripe beans the whole plant is harvested and dried before threshing. Yields of 450 - 560 kg/ha of seeds are common.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
seed	11.0	1432	22.9	55	4	7.1	-
seed (cooked)	-	439	7.0	2.4	1.0	1.4	-
seed (sprouted)	90.4	126	3.0	2	13.2	0.9	0.4



## Legumes

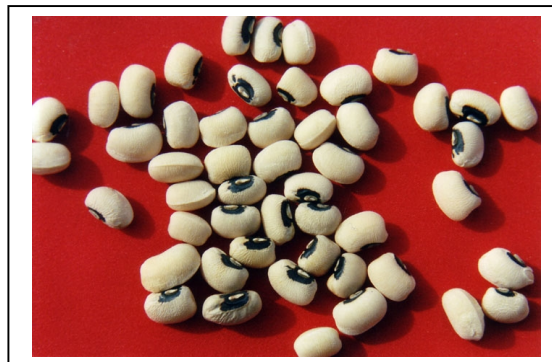
**English:** Cowpea

**Local:** Kacang tunggak

**Scientific name:** *Vigna unguiculata subsp. unguiculata*

**Plant family:** FABACEAE

**Description:** A creeping bean type plant with straight firm pods. There is a deep tap root and many branches occur from it in the surface of the soil. The root nodules are large and round. The leaves have 3 leaflets. The end leaflet can be 12 - 16 cm long. The side leaflets are asymmetrical. The stipules at the base of the leaf are large and with spurs at their base. Flowers occur often in pairs on the end of long flowering shoots. Only 2 - 4 flowers in each stalk produce pods. Flowers are white, yellow or blue. They are large and showy. The pods are about 15 cm long. The seeds are white except for a dark scar.



**Distribution:** It grows in tropical and subtropical climates. It grows from sea level to 1,800 metres altitude in the tropics. Plants can stand high temperatures. Some kinds can tolerate drought. They are sensitive to cold and killed by frost. Plants germinate with a temperature between 11.5 - 15.5°C. The best growth occurs between 20 - 35°C. They can grow on a range of soils providing they are well drained. They are a short day plant. They do well in the semiarid tropics. It will not tolerate acid or alkaline soils. It grows in areas with an annual rainfall between 280 - 410 mm. It can grow in arid places.

**Use:** The young leaves, young pods and ripe seeds are all eaten. They can be steamed, boiled, stir-fried etc. The leaves can be dried and stored. The dried seeds are used in soups and stews. They are ground into flour or fermented. The seeds are also used for bean sprouts. Roasted seeds are used as a coffee substitute.

**Cultivation:** It is grown from seeds. Seeds remain viable for several years if carefully stored. A seeding rate of about 20 kg per ha is suitable and seed are sometimes broadcast then thinned.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
seed (dry)	11.2	1189	23.5	-	1.5	6.4	-
(seed young, boiled)	75.5	406	3.2	79	2.2	1.1	1.0
leaf	88.4	143	4.2	36	35	4.7	0.3
young pod + seed (boiled)	89.5	142	2.6	45	17.0	0.7	0.2
leaf (boiled)	91.3	92	4.7	29	18	1.1	0.2

## Leafy greens

**English:** Slippery cabbage

**Local:** Daun gedí

**Scientific name:** *Abelmoschus manihot*

**Plant family:** MALVACEAE

**Description:** A branched shrub up to 2 m or more high. It has rounded twigs that are green and smooth. The leaves are simple and smooth, and have 3 - 5 lobes. The leaves are large and can vary in shape. The leaves are normally very dark green, but occasionally, pale green types occur. The leaf stalks are 6 - 13 cm long. The stalks can be green or have red colours on them. The flowers are borne singly and are yellow with dark purple centres. They are produced on mature bushes and the flowers are hibiscus-like. The fruit pods are rather stiff or have bristly hairs. They are a dry capsule with many small seeds. Plants can last for a year or for several years.



**Distribution:** It is grown in many Asian and Pacific countries. It is well-suited to the tropical lowlands, but grows only poorly at an altitude of 1,800 m. It needs fertile soil. Plants will withstand occasional short periods of temperatures, down to about -5°C, so long as they are in a very well-drained soil. It suits areas with high humidity. It suits hardiness zones 10 - 12.

**Use:** Young leaves are cooked and eaten. They are slimy unless steamed or fried. It is a very nutritious plant.

**Cultivation:** It is normally grown from cuttings. Lengths of about 25 cm (2 or 3 leaf joints or "nodes") of fresh, green, stem cuttings are used. These are simply stuck in the ground. It can be grown from seeds. The narrow-leafed types tend to compete less well with weeds. In some areas, people tend to put the narrow-leafed types in the middle of the garden cropped amongst sweet potato, and the broad-leafed types near stumps or logs and around the edges of gardens. The pale, green-leafed types only grow very slowly. A fertile soil is needed. Therefore, it can be planted in good soil in a newly cleared garden site or it can be planted near houses where the soil fertility can be built up by adding food scraps, compost and ashes. The growth and colour of the leaves can be improved greatly by spraying the leaves each 2 - 3 weeks with a very small amount of the nitrogen fertiliser called urea, dissolved in water (0.5% solution). This uses less fertiliser than putting it on the ground where it can wash away in the rain. Picking out the tips off branches of the plants encourages the plant to produce more branches and therefore, more leaves. Too many leaves should not be picked off the one bush at the one time when harvesting. This is because it slows down the growth of more leaves. If the soil is very fertile, older bushes which are only growing a few leaves can be chopped off. The stump left in the ground can then regrow into a new bush. It is a very fast growing and productive food plant in the hot, humid tropics.

**Production:** Leaves are ready to harvest after about 80 days. Yields of 6.7 - 7.3 t/ha/crop have been recorded.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
leaf	88	120	3.4	1.0	7.0	1.5	1.2

## Leafy greens

**English:** Sesbania

**Local:** Turi

**Scientific name:** *Sesbania grandiflora*

**Plant family:** FABACEAE

**Description:** A shrub or small tree up to 5 - 10 m tall. The trunk has rough bark and the branches often droop. The trunk is thick. The branches are hairy when young. The leaves are made up of 41 - 61 leaflets. These are narrow and oblong. They are 2.5 - 4 cm long by 0.5 - 1.4 cm wide. They have a sharp point at the tip. The flowers are large and white to red. The flower petals can be 5 - 10 cm long. They are produced as 2 - 4 flowers on flowering branches 2 - 5 cm long. It has long narrow pods with up to 30 - 50 small brownish seeds. The seeds with their stalk can be 2.5 - 4.5 cm long in pods 20 - 25 cm long by 7 - 9 mm wide.



**Distribution:** A tropical plant. It grows in tropical and subtropical climates. It grows in places with an average rainfall of 900 - 1,200 mm and a temperature range of 17 - 25°C minimum and 25 - 37°C maximum. It is cultivated in coastal towns. It does well in both dry and moist areas. It probably grows up to about 1,500 m altitude in tropical places. It does best in rich moist soils. It needs a sunny location. It is damaged by frost. It can grow in arid places. It suits hardiness zones 10 - 12.

**Use:** The leaves and flowers are used as a vegetable. The young pods are also eaten. The young leaves are stripped from the stalks and lightly boiled or steamed or served as a vegetable in curries. The edible flowers of the white variety contain a considerable amount of sugar and iron and are said to taste like mushrooms. Flowers of the red-flowered variety are bitter and hence, are only used as an ornamental. The flowers are boiled, fried or used in curries, soups and stews.

**Caution:** The seeds are toxic and need to be fermented before use.

**Cultivation:** Trees are grown from seed. The seed often need seed treatment to break the hard seed coat. Seeds germinate best with temperatures above 19°C. It can be grown from cuttings.

**Production:** It is a quick growing, short-lived, tree. Trees flower in their second year. A tree can provide 6 - 9 kg of leaves per year. The leaves can be harvested 120 - 150 days after sowing. Repeat harvests can be made each 30 days.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
Leaf	82.3	323	8.7	66	60	4.0	-
Flower	89.0	92	1.8	0	59	0.6	-
Seed	10.4	-	68.2	-	-	-	-



## Leafy greens

**English:** Sweetleaf

**Local:** Katuk

**Scientific name:** *Sauropus androgynus*

**Plant family:** EUPHORBIACEAE

**Description:** A low-growing shrub with small red flowers. It continues to grow from year to year. It grows 0.8 - 2 m tall. It can grow 6 m tall. It tends to grow upright, then falls over due to its weight. It branches little. Compound leaves on the sides of the stems bear flowers along their underside. The fruit are purple and about 1 cm across. They open and drop their seed at maturity.



**Distribution:** An Asian vegetable now grown in Australia, Papua New Guinea and Solomon Islands. It occurs commonly in South East Asia. It can grow in partial shade or full sun. It suits the hot, humid lowlands. It will grow in heavy clay soils and acid soils.

**Use:** The young tips, young leaves, flowers and small fruit are eaten raw. Older leaves are cooked. Leaves are often singed before being added to soups. The fruit can be used to make jam.

**Cultivation:** It is easily grown from cuttings. Pruning encourages more upright shoots. It can also be grown from seed. Seed only remain viable, or usable, for a few months. It is often grown as a hedge. Cuttings for this are placed 10 cm apart. Adding shade (shade cloth) and fertiliser can be used to force the leaf tips to grow rapidly. , Bushes are normally planted about 60 cm apart.

**Production:** Young leaves can be harvested 4 months after planting. The top 15 cm of young leaf tips are picked. It gives a high yield of leaves and production continues year round. Shrubs last a long time.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
leaf	81	244	4.8	133	85	2.7	-

## Leafy greens

**English:** Chinese broccoli

**Local:** Kailan

**Scientific name:** *Brassica oleracea* var. *alboglabra*

**Plant family:** BRASSICACEAE

**Description:** A cabbage plant with a single fleshy stem. Although it keeps growing from year to year it is normally grown as an annual. It grows 45 cm high and spreads 40 cm across. The leaves are dark green and rounded on long stems. Plants start to flower when 10 leaves are present. Flowers are white but there are varieties with yellow flowers. There are several named cultivars.



**Distribution:** It does best in a fertile soil. The soil needs to be well drained. It prefers a soil pH of 6 - 7. Temperatures during the day of 18 - 28°C are best. It can tolerate frost. It grows well in tropical regions but cool temperatures are necessary for flowering.

**Use:** The flower stalk, flower heads, buds and tender leaves are all eaten. The stems are steamed or braised and often served with oyster sauce. They are also used in soups.

**Cultivation:** Plants are grown from seed. Seed can be sown direct or put in a nursery then transplanted. Seed is sown about 0.5 cm deep and germinate in 3 - 10 days. A spacing of 15 cm is suitable. Wide spacing causes stems to become thick and tough. Because plants are shallow rooted, they need regular watering.

**Production:** Chinese broccoli is fast growing. Flower heads are harvested after about 9 weeks. Heads are harvested individually to allow others to form. Harvesting is done before buds start to open.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
flower (cooked)	93.5	92	1.1	164	28.2	0.6	0.4

Picture sourced from <http://thedahliafarm.blogspot.com.au/2010/06/gai-lohn-or-chinese-broccoli-or-chinese.html>

## Leafy greens

**English:** Bok/pak choi

**Local:** Sawi

**Scientific name:** *Brassica rapa* subsp. *chinensis*

**Plant family:** BRASSICACEAE

**Description:** A leafy cabbage grown as an annual. It grows 40 - 60 cm high. The taproot is not fleshy. The stem is short. The leaves are arranged in spirals. They are simple and broadly oval. They can be 30 cm long by 10 cm wide. The leaves form a rosette. They do not form a head. The leaf stalk is thickened. It forms a half cylinder in cross section and does not have wings. The leaf blade is entire and can have a wavy edge. Flowers are small and yellow with 4 petals. The fruit is a pod 3.5 cm long. The seeds are black and 2 mm long. Several different kinds occur.



**Distribution:** A tropical plant. More common in lowland areas but will grow in the highlands. It suits cool seasons but will not tolerate frost.

**Use:** The stems and leaves are cooked and eaten.

**Cultivation:** Plants are grown from seed and often transplanted. A spacing of 40 cm x 40 cm is suitable. Seeds are sown direct. They are sown 1 cm deep. They germinate in about 7 days with soil temperature of 21°C. Plants are thinned to about 20 cm between plants.

**Production:** The whole plant is harvested after 2 - 3 months.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
stem/leaf (raw)	95	55	1.5	223	45	0.8	0.2

## Leafy greens

**English:** Celery

**Local:** Seledri

**Scientific name:** *Apium graveolens* var *dulce*

**Plant family:** APIACEAE

**Description:** A herb that grows up to 1 m high. It has leaf stalks with ridges, and they are like a half circle when cut across. The plant is smooth and hairless and has a strong smell. The leaves are divided into a compound leaf. The wild plant has leaves in tufts from the base or spread along creeping stems. The flowers are white and in small, compound arrangements, where each flower is on a stalk from the same point.



**Distribution:** It is a warm temperate plant. It is mainly grown in the highlands in the tropics. It grows up to about 2,100 m altitude. It is damaged by frost. It often grows naturally in swampy conditions. In the tropical lowlands, it grows as a small leafy plant, but can be used for flavouring. It requires a rich, sandy loam soil. Because celery has shallow roots, it needs plenty of moisture and does best in humus-rich soils.

**Use:** The leaf stalks are eaten raw or used to flavour foods. The leaves can also be used for flavouring. The dry, ripe fruit can be used for flavouring, e.g. in salt.

**Cultivation:** Plants are mostly grown from seed and transplanted. Soil is mounded up around the plant, or it is wrapped up, to exclude sunlight to produce white stalks. Newer varieties will naturally form whiter stalks. Plants should be grown close together to keep sunlight off the stalks. This applies especially for the naturally whitening (blanching) varieties. The stalks are cut before the plant flowers.

**Production:** Leaf stalks take about 9 months from seed until harvest.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
stalk	94.6	67	0.8	13	7	0.4	0.1
leaf	95.7	88.2	0.6	13	5	0.4	0.1

## Leafy greens

**English:** Cabbage

**Local:** Kubis

**Scientific name:** *Brassica oleracea* var. *capitata*

**Plant family:** BRASSICACEAE

**Description:** A short, leafy plant with a thick stalk. In cold areas, it forms a thick, tightly-packed ball of leaves called a "head". If the plant is left growing in the ground, it will later produce a flower stalk. The flowers are yellow. There are 3 main types - the white cabbage, a purple kind and one with wrinkled leaves.



**Distribution:** It is grown in most temperate countries and in many tropical countries as well. It is a temperate crop. It does best at altitudes over 1,000 m in the tropics where there is a greater difference between day and night temperatures. Seeds germinate when soil temperature is between 13 - 16°C. It does not grow well when temperatures are above 26°C. New varieties grow in warmer places. They are frost-resistant. It suits hardiness zones 8 - 11.

**Use:** The leaves can be eaten raw or cooked. They have very little food value and are too bulky to be used as a food in poorer subsistence diets.

**Cultivation:** Plants are normally first grown from seeds, but in most places they are re-grown from cuttings or sprouts that develop on the cut stalk.

**Production:** Cabbages take 5 - 7 months to be ready for harvest.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
leaf	93.6	92	1.0	6.6	20	0.2	0.1



## ***Fruit***

**English:** Pawpaw

**Local:** Pepaya

**Scientific name:** *Caricapapaya*

**Plant family:** CARICACEAE

**Description:** Pawpaw is a well-known tropical fruit that grows 3 - 5 m tall and only occasionally has branches. The stem is softly woody and has scars from fallen leaves along it. There is a clump of leaves at the top of the plant. The leaves are large (50 cm wide) deeply lobed and on leaf stalks up to 90 cm long. Trees can be male, female or bisexual. Male flowers are small and white and on long stalks. Female and bisexual flowers are on short stalks. These have no fruit, round fruit and long fruit respectively. There are three forms of long fruit. The seeds are black.



**Distribution:** It is a tropical plant that grows from sea level up to about 1700 m altitude in the equatorial tropics. In cooler regions they have to be planted but in humid tropical regions are commonly self-sown. Sunlight allows germination when forest is cleared. It cannot stand frost. It needs a night temperature above 12°C and don't tolerate water-logging. Plants die after 48 hours in standing water. It needs a pH between 5 – 8 and suits hardiness zones 11 - 12.

**Use:** Fruit can be eaten ripe and raw. Green fruit can be cooked as a vegetable. The young leaves can be eaten cooked, but are bitter. The flowers and the middle of the stem can be eaten. Papayas contain papain which is a meat tenderiser. The dried seeds can be used as a spice.

**Cultivation:** Pawpaw seeds grow easily and plants grow quickly. Fresh seeds can be used. If dry seeds are used they should be soaked before planting. Seeds should be sown when temperatures are 24 - 30°C. They need a reasonably fertile soil. Seeds can be sown directly or the seeds can be put in a nursery and the seedlings transplanted. Seeds in a nursery should be sown 1 - 2 cm deep. Seedlings can be transplanted when they are about 20 cm high. Plants should be about 3 m apart. Continuous fruit production depends on fertility, temperature and moisture being adequate to maintain active growth. The fruit is produced year round but the growth and development rate decreases with temperature. The size and quality of fruit declines at lower temperatures. Pollination is by wind and insects and is not normally limiting. Normally cross and self-pollination both occur. Seeds are dispersed by birds, bats and people and remain viable for a few months.

**Production:** Seeds emerge in 2 - 3 weeks. Vegetative growth before flowering is 4 - 8 months. One or more fruit grow per leaf axil, about every 1 - 2 weeks under good growing conditions. With good growth, 100 fruit can be produced from one plant in a year. Pollination to maturity is about 2 - 3 months. On the coast in tropical equatorial regions, pawpaw's start producing fruit after about 4 - 5 months, but in the highlands this may take 12 - 18 months. The first fruit are ready 6 - 11 months from planting. Tree life is about 2 - 3 years, although they may live for 10 - 12 years.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
leaf	75.4	378	8.0	-	140	0.77	-
fruit	88.0	163	0.5	290	54	0.4	0.18
fruit (unripe)	92.1	109	1.0	-	-	0.3	-

## Fruit

**English:** Pineapple

**Local:** Nanas

**Scientific name:** *Ananas comosus*

**Plant family:** BROMELIACEAE

**Description:** A perennial herb with a rosette of long, thick, spiky leaves, up to 1 m high and spreading 1 - 1.5 m. The leaves are arranged in spirals. Some kinds have thorns along the edges of the leaves. The plant produces suckers, both near the base of the stem and also higher up the stem near the fruit. These are called slips, or suckers, and are broken off and used for planting. The main plant dies after producing a fruit, but the suckers keep growing. The plant produces a flower and fruit at the end. The fruit is made up of about 150 berry-like fruitlets that are almost fused together. There is a small crown of leaves on top of the fruit. The fruit can be 25 cm long and weigh 0.5 - 4 kg. There are two main types of pineapples. The rough-leaved variety has spines on the leaves and produces a smaller but sweeter fruit. The smooth leaf variety has spineless leaves and larger fruit.



**Distribution:** The plant has been taken to most tropical and subtropical places. It is a tropical plant. It grows up to 1,800 m altitude near the equator. It can survive brief periods down to freezing, but cold retards growth, delays fruiting, and causes fruit to be more acid. A loose, well-drained soil with high organic matter is best. It can survive drought, but adequate soil moisture is necessary for good fruit production. Pineapples need an annual average temperature of 17.2 - 26.9°C. Growth ceases below 20°C. In the equatorial tropics, this is mostly between sea level and 1,800 m altitude. Pineapples need well-drained and fertile soil. It suits an acid soil and can develop roots in soils where lime has been added. The soil acidity can be between pH 3.3 - 6.0. The best range is pH 4.5 - 5.5. Soils which are not sufficiently acid can be treated with sulphur. It suits hardiness zones 9 - 10.

**Use:** The fruit is eaten fresh or used for juice. Unripe fruit are also cooked and eaten. The young, heart-leaves can be eaten. It is an attractive and popular snack food.

**Cultivation:** The suckers, slips, and the top of the fruit, can be used for planting. The time to maturity is the fastest for the suckers near the bottom of the plant and slowest when the top of the fruit is planted. Therefore, use suckers that grow from the stem near the ground for earliest yield. Pineapple flowering hormone can be used for fruit production with thorny varieties and calcium carbide for smooth varieties. Fruiting is less seasonal in the highlands than in the lowlands. Pineapples can be planted with 35,000 - 43,000 plants/ha or 3 - 4 plants per square metre. If plants are spaced more widely, they produce more suckers. Fruits become more acid where plants are closely spaced. If too many suckers are left growing from the main plant, then smaller fruit will be produced. They can grow in partial shade and, in this situation, the plants are normally more green. The red colouring of pineapple leaves is due to a deficiency of the nutrient nitrogen. This shows up more quickly in plants in full sunlight. When the plant is sufficiently large, it responds to changes, such as less available nutrients or water, and starts to produce a flower, then a fruit. The number of hours of sunlight, as well as reducing temperature and reduced sunlight, also help the flowers form. The result of this is that flowering and fruiting is often seasonal. This can easily be changed by using a fruiting hormone which allows fruit to be produced at times to suit the grower. Pineapples can grow in semi-arid conditions because the leaves can store some water. They also tend to lose only small amounts of water from evaporation through their leaves, but they can grow well with plenty of water. The roots are very sensitive to water-logging, so the soil must be well-drained. Pineapples do not cover the soil well, so it is good to use a mulch of plant material to help weed control, provide some nutrients and to stop soil erosion.

**Production:** Plants usually produce for about 4 years. Fruiting is less seasonal in the highlands than in the lowlands in the tropics. The growth rate for pineapples slows at cooler temperatures. Plants grown in the highlands, or at higher latitudes, take longer to mature. It takes 60 days from when the flower starts to form until the fruit appears, then a further 5 months until the fruit is ready for harvest. The time from planting to harvesting ranges from 11 - 32 months, depending on temperature. The fruit are smaller, poorer shape and more acid where the temperatures are lower or there is less sunlight.

**Food Value:** Per 100 g edible portion

<b>Edible part</b>	<b>Moisture %</b>	<b>Energy kJ</b>	<b>Protein g</b>	<b>proVit A ~g</b>	<b>proVit C mg</b>	<b>Iron mg</b>	<b>Zinc mg</b>
Fruit	84.3	194	0.5	60	25	0.4	0.1



## Fruit

**English:** Mandarin

**Local:** Jeruk keprok

**Scientific name:** *Citrus reticulata*

**Plant family:** RUTACEAE

**Description:** A small, evergreen tree that grows 4 - 8 m tall and 2 m across. The stem is erect, branching and thorny. The leaves are dark green, and long and narrow in shape. They are 3 - 4 cm long. There is only a narrow wing on the leaf stalk. It has a few or no spines. The flowers are white and star-shaped. They are 2.5 - 4 cm across and have a scent. Fruit are almost round and the skin peels off easily. The fruit are 4 - 8 cm long. The flesh is red, juicy and sweet.



**Distribution:** It is grown in many tropical countries. It is the hardiest of the citrus. It grows from sea level up to 2,300 m altitude in the tropics. It does best between 800 m and 1,200 m altitude. A well-drained soil is needed. It also prefers a drier climate. It is drought and frost resistant. It needs a temperature above 3 - 5°C. It suits hardiness zones 9 - 11.

**Use:** The fruit are eaten fresh.

**Cultivation:** Trees are often grown from seed. Some breed true from seed. Seedling trees take a long time to start producing fruit. Budded trees are best. A spacing of about 8 m between trees is suitable. Several seedlings can grow from one seed. Using seedlings of seeds with three or more shoots helps produce trees true to type. Cuttings or layering can also be used.

**Production:** Fruit tend to be produced seasonally. The season is often from April to August in the southern hemisphere.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
fruit	87.6	184	1.5	42	136	0.8	

## Fruit

**English:** Lime

**Local:** Jeruk nipis

**Scientific name:** *Citrus aurantifolia*

**Plant family:** RUTACEAE

**Description:** A small, much-branched evergreen tree with short, sharp spines. It grows up to 5 - 6 m tall and spreads to 3 m across. The leaves are small and dark green. There are narrow wings on the leaf stalk. The leaf blade is oval and about 5 cm long by 3 cm wide. The leaves have a sweet smell when crushed. There is a thorn at the base of each leaf. (Thorn-free kinds are known). The flowers are yellowish-white. They are 2.5 cm across and have 5 petals. The flowers are produced in the leaf axils or at the ends of branches. The fruit is small, round, 3 - 4 cm across and becomes pale orange to yellow when ripe. The fruit is thin-skinned. The flesh of the fruit is green.



**Distribution:** It grows in most tropical countries. It needs a warm climate and is most common in coastal regions in the lowland tropics. It suits humid areas and can survive in poor soils. Light to medium well-drained soils are best. It is drought and frost-sensitive. It can grow in alkaline soil. It suits hardiness zones 11 - 12.

**Use:** Fruit are mainly used for juice and drinks. They can be used in pickles.

**Cultivation:** They are often grown from seed but are better if grafted. Plants can be grown by cuttings. A spacing of 4 - 5 m is suitable. When grown from seed, several shoots may develop from the one seed, which means the seedlings may be identical to the parent. It is a citrus that does reasonably well in the tropics.

**Production:** Trees can start producing fruit quickly. They fruit in 5 - 6 years. They normally produce fruit all the year round. Fruit drop when mature. Black limes are sun-dried limes. They are 2.5 - 4 cm across.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
fruit	91.0	133	0.7	4	40	0.25	0.1

## Fruit

**English:** Pomelo

**Local:** Jeruk bali atau Jeruk besar

**Scientific name:** *Citrus grandis*

**Plant family:** RUTACEAE

**Description:** A spreading, spiny tree. It grows up to 15 m tall. The leaves are large and the leaf stalks have wings. Young shoots and stems have fine hairs on them. Flowers are large (2 cm) and creamy white. The flowers are produced in bunches from woody shoots. The fruit is very large (20 cm), with a thick skin. The skin is dotted with oil glands and is light green or pale yellow. The flesh can be white, pink or red. Each segment of the fruit is covered by a strong membrane. Some kinds have many seeds, while others are almost seedless.

**Distribution:** It grows in many African, Asian and Pacific countries. A tropical plant that thrives in warm, lowland areas in the tropics. It can grow from sea level up to 900 m. It tolerates brackish and salty conditions and suits humid climates.



**Use:** The fruit can be eaten fresh or made into marmalade. The peel can be candied. It is a tropical citrus that is often enjoyed by children.

**Cultivation:** They are mostly grown from seed, but do not breed true. The seed only produce one seedling, unlike many citrus. Trees are often produced by aerial-layering (part of the plant cut and wrapped in dirt so it produces new shoots), but budding, or grafting, can be used. Air-layered trees from sweet-fruited plants give sweeter fruit. Trees start producing after about 9 years. Trees need to be about 9 m apart. Trees grown away from other pomelo trees often produce almost seedless fruit.

**Production:** Fruit is produced almost all the year round. The time from flowering to ripe fruit is about 6 months. Fruit can be stored quite well.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
fruit	89.1	159	0.76	0	61.0	0.11	0.1

## Fruit

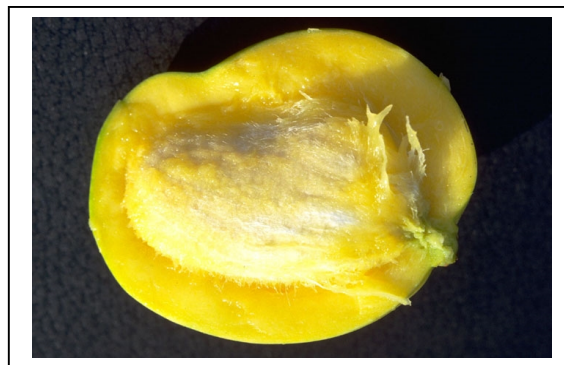
**English:** Mango

**Local:** Mangga

**Scientific name:** *Mangifera indica*

**Plant family:** ANACARDIACEAE

**Description:** An erect, branched evergreen tree. It can grow to 10 - 40 m high and is long lived. (Trees grown by vegetative means are smaller and more compact.) Trees spread to 15 m across. It has strong deep roots. The trunk is thick. The bark is greyish-brown. The leaves are simple and shaped like a spear. Some kinds of mangoes have leaves with a wavy edge. They can be 10 - 30 cm long and 2 - 10 cm wide. They are arranged in spirals. The leaf stalk is 1 - 10 cm long and flattened. Leaves are often brightly coloured and brownish-red when young. These tender leaves which



are produced in flushes become stiff and dark-green when mature. The flower stalks are at the ends of branches. They are 10 - 50 cm long and branching. Up to 6,000 flowers can occur on a stalk. Most of these are male and up to 35% have both male and female flower parts. Fruit are green, yellow or red and 2.5 - 30 cm long. The fruit hang down on long stalks. The outside layer of the seed is hard and fibrous and there is one seed inside. Several embryos can develop from one seed by asexual reproduction. The fruit shape and colour vary as well as the amount of fibre and the flavour. India has many varieties and they cannot tolerate humidity.

**Distribution:** A tropical and subtropical plant. It grows in the lowlands. It grows from sea level up to 1300 m altitude in the tropics. It does best in areas below 700 m and with a dry season. Rain and high humidity at flowering reduces fruit set. It thrives best where temperatures are about 25°C but will grow with temperatures from 10 - 42°C. Temperatures of 0°C will damage young trees and flowers. Low temperatures (10 - 20°C) at flowering time will reduce fruiting. As temperatures get lower due to latitude or altitude, fruit maturity is later and trees become more likely to only have good crops every second year. Mangoes can grow on a range of soils. In wetter areas soils with less clay are better. They can withstand occasional flooding. A soil pH of 5.5 - 6.5 is best. Soils with pH above 7.5 cause plants to develop iron deficiency. It grows in the Sahel. It can grow in arid places. It suits hardiness zones 11 - 12.

**Use:** Ripe fruit are eaten raw. Unripe fruit is pickled. Seeds can be eaten cooked. They are boiled or roasted. They are made into meal by powdering. Young leaves can be eaten raw or cooked. Amchur is made from the dried unripe fruit. This is used in curries, and pickles and chutneys. The seed kernels are used for famine food in India. They are boiled, roasted or soaked to remove the bitterness.

**Caution:** The sap from the tree or fruit can cause skin problems with some people.

**Cultivation:** Trees are grown by planting fresh seed and they can be transplanted. Mangoes vary in their ability to breed true from seed. When more than one seedling emerges from the seed some of these are asexual and breed true. Clean seed germinate best if they are treated at 50°C for 20 minutes, then planted on their edge with the round bulge upwards and near the soil surface. The husk around the seed should be removed. Seeds germinate in 3 - 6 weeks. The strongest growing seedlings from this seed are used and the others thrown away. The seedlings from the folds of the seed are vegetative while the seedling from the centre of the seedling near the stalk end may be sexual and show variation from type. Other seeds only produce one seedling and these normally vary and can be different from the parent tree. Plants can be propagated by budding, or by grafting using in-arching. This is not easy and care is required. In wetter places, flowers need to be protected with fungicides to enable fruit to form. If organic manure is used this should not be directly in the planting hole nor immediately against the new plant. Young transplanted seedlings need regular watering. A spacing

of 6 - 12 m between plants is used. Wind protection is advisable to prevent fruit rubbing and getting damaged. Trees should only ever be lightly pruned as fruit develop on new growth and heavy pruning can reduce flowering. Flowering can be brought about by foliar sprays of potassium nitrate.

**Production:** Seeds germinate after about 20 days. Seedling trees produce after 4 - 6 years and increase in production up to 20 years. Trees often bear better each second year. Rain at flowering reduces fruit setting. Fruiting is at the end of the year. Fruit take 4 - 5 months to mature. Fruit vary in weight from 200 - 1,000 g. Trees can produce one million flowers but only 500 fruit. Trees last for many years.

**Food Value:** Per 100 g edible portion

<b>Edible part</b>	<b>Moisture %</b>	<b>Energy kJ</b>	<b>Protein g</b>	<b>proVit A ~g</b>	<b>proVit C mg</b>	<b>Iron mg</b>	<b>Zinc mg</b>
fruit	83.0	253	0.5	54	30	0.5	0.04
leaf	82.1	226	3.9	-	60	2.8	-

## Fruit

**English:** Purple passionfruit

**Local:** Markisa

**Scientific name:** *Passiflora edulis*

**Plant family:** PASSIFLORACEAE

**Description:** A vine which grows for several years. The main vine becomes woody and can be 6 - 7 m long. It climbs by tendrils. The leaves are shaped like the fingers on a hand, with three lobes. They are 5 - 10 cm long. The vine can set flowers, which are white and often tinted purple, at each leaf. They are 5 cm across. The fruit are oblong and have a hard skin thickly dotted with purple when ripe. They have a sweet smell. The black seed occupy most of the inside with a small amount of orange, edible flesh. The flowers open in the morning.



**Distribution:** It grows in many countries throughout the tropics and subtropics. It is a subtropical plant, cultivated up to 2,000 m altitude in the tropics. The purple variety grows in the highlands up to 3,000 m. The yellow variety grows in the lowlands. Its normal range is 700 – 2,300 m. Fruit set is often poor in wet conditions. Wind breaks are important for protection. Vines can tolerate very light frosts. Heavy rain at flowering can reduce fruit set through poor pollination. Soils should be fertile, moist and well-drained. Plants cannot tolerate waterlogging. A soil pH in the range 5.5 - 6.5 is best. It grows satisfactorily between 20 - 30°C. It suits hardiness zones 8 - 11.

**Use:** The fleshy portion of the fruit is eaten raw. The seeds are edible. Passionfruit are also used for flavouring in juices, and with other foods.

**Cultivation:** Plants are grown by seeds or cuttings. Seeds germinate in 15 - 45 days. Seedlings can be grafted. When the end shoots of the mother plant are the same thickness as the seedling stem, shoot tips 8 cm long can be used for grafting. The leaves should be removed from the grafted cutting. Uniform light and high humidity allows these grafted plants to be ready in a few weeks. Plants are put in a hole 30 cm deep with organic matter added. A spacing of 3 - 4 m apart is suitable. Plants need a trellis to climb over. A trellis 2 m high is often used. The side shoots are normally picked off until the vine reaches trellis height. The tip is then picked out to promote branching. Mulching around the plant helps retain moisture, adds nutrients and controls weeds. Hand-pollination can improve fruit set. The fruit turns purple, wrinkles, and drops off, when ripe. Use of balanced fertiliser to promote healthy growth is important. Deficiencies of magnesium, iron, zinc, copper and boron can occur in some places. Regular pruning keeps vines vigorous but should not be done with old plants.

**Production:** Plants produce after about 12 - 18 months and keep producing for 4 - 5 years. Good production is related to keeping the vine growing well by avoiding low temperatures and lack of water. Plants are pollinated by insects, so it is important to not kill these with insecticides. They can also self-pollinate. Fruit mature 60 - 100 days from pollination.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
fruit	73.3	280	2.8	10	20	1.3	0.1



## Fruit

**English:** Guava

**Local:** Jambu biji

**Scientific name:** *Psidium guajava*

**Plant family:** MYRTACEAE

**Description:** A small evergreen tree 8 - 10 m tall with smooth, mottled bark which peels off in smooth flakes. It branches close to the ground and is shallow rooted. The branches are four-angled. The leaves are opposite, dull green, and somewhat hairy. They are oval and somewhat pointed at both ends, 15 cm long by 2 - 5 cm wide with short leaf-stalks. The showy flowers are white and borne in loose, irregular arrangements of 1 - 3 flowers that grow in the axils of leaves on new growth. The petals are 1.5 - 2 cm long. Both self and cross-pollination occurs. The fruit are rounded and 4 - 5 cm long. They are green, turning yellow when ripe. The outer covering is firm and encloses a pink, or nearly white, sweet-smelling, edible pulp with many seeds. In better selected varieties, the skin and the seeds are fully edible. Fruit vary from very acid to very sweet.



**Distribution:** A native to Central and South America, it grows in most tropical countries. Guava thrives in both humid and dry tropical climates and does best in sunny positions. It grows wild and is also cultivated. It is killed by frost and fruits better where there is a cooler season. Temperatures near 30°C give best production. It prefers a well-drained soil with good organic matter, but can stand some brief water-logging. A soil pH of 5 - 7 is best, but can tolerate a pH from 4.6 - 8.9. Trees cannot tolerate salty conditions. It suits hardiness zones 9 - 12.

**Use:** The fruit are eaten raw and can be used for jams and jellies. Half-ripe fruit are added to help the jelly set. The young leaves are eaten raw or cooked. It is an attractive and nutritious fruit.

**Cultivation:** They are mostly grown from seeds but seedling trees vary in quality. Seeds remain viable for a year or longer. Seeds usually germinate in 2 - 3 weeks, but can take 8 weeks. Selected trees can be propagated by budding or grafting. They can also be propagated by layering, root cuttings or stem cuttings if hormones are used. For stem cuttings, the tips are used and grown under mist at 28 - 30°C with bottom heat. Suckers can also be used. Using vegetative methods of propagation enables better fruit kinds to be preserved. In the lowland tropics, trees are self-sown. As fruit are produced on new season's growth, pruning does not affect greatly fruiting. Trees should be managed to give the maximum number of vigorous, new shoots. Trees can be pruned for shape. Trees can be grown at 2.5 m within rows and 6 m apart between rows.

**Production:** Seedling trees may begin to bear 2 - 3 years after transplanting. Pruning back the tips slightly increases fruit production. Fruit taste best if ripened on the tree. Ripening after picking can be hastened by placing them in a brown paper bag with a banana or apple. Mature fruit which have not changed colour can be stored 2 - 5 weeks at temperatures of 8 - 10°C and relative humidity of 85 - 95%. Mature fruit ripen in 2 - 3 days at normal temperatures and will keep for 7 days.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
fruit	77.1	238	1.1	60	184	1.4	0.2



## Vegetables

**English:** Kangkong

**Local:** Kangkung

**Scientific name:** *Ipomoea aquatica*

**Plant family:** CONVOLVULACEAE

**Description:** Kangkong is a creeping sweet potato-like plant. It has hollow stems and can float on water. The leaves are green and are normally not divided like some sweet potato leaves, but the shape and size varies a little between different kinds. The trumpet shaped flower looks like a sweet potato flower and is normally white. The runners develop roots at the nodes and also branch. This branching increases when tips are picked off. Some variation in leaf shape can be observed. Leaf shape is less variable than in the related sweet potato, but narrow and broad leafed kinds occur. White and green stemmed kinds occur. Green stemmed kinds have more cold tolerance than white stemmed.



**Distribution:** Kangkong is a tropical plant. It grows best in short day, stable high temperature, and moist conditions. Temperatures need to be above 25°C for satisfactory growth. In equatorial regions plants probably grow up to 1,000 m altitude. Below 23°C the growth rate is too slow for economic production, so production is mainly in the lowland tropics. Optimum soil pH is between 5.3 - 6.0. It suits damp places and grows well in swamps. It can grow as a partly floating plant in swamps and lagoons behind the beach along the coast. In some countries they grow the dry land form in gardens.

**Use:** The young tips of shoots are cooked and eaten. They can be boiled, steamed, stir-fried, or added to soups, stews or curries. The young stems can be used in pickles. The young tips can be eaten raw in salads and the roots are occasionally cooked and eaten.

**Cultivation:** Dry land kangkong is normally grown from seed. Sometimes seed are pre-soaked for 12 - 24 hours prior to sowing. Plants can also be grown from cuttings and establishment is rapid. Top cuttings 25 - 40 cm long can be planted beside a pond.

**Production:** Young tips can be harvested 30 days after planting, and subsequent harvests every 7 - 10 days. Production of new shoots probably declines at flowering. Yields up to 60,000 kg/ha have been recorded.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
Leaf	90.3	126	3.9	315	60	4.54	-
leaf (boiled)	92.9	84	2.1	-	16	1.3	0.2

## Vegetables

**English:** Tomato

**Local:** Tomat

**Scientific name:** *Lycopersicon esculentum*

**Plant family:** SOLANACEAE

**Description:** A short-lived, perennial plant. It is upright, but has weak stems. It can grow to 2 m tall with support for the stems. The stems have long hairs. It has a strong smell. The leaves are deeply lobed with an odd number of leaflets. They have irregular teeth around the edge. There are up to 12, star-shaped flowers on each raceme (flower cluster). Flowers are yellow. The fruit are round and red when ripe. Yellow coloured fruit also occur. There are many varieties.



**Distribution:** It is grown in most warm, temperate countries and most tropical countries. It grows from sea level to 2,400 m altitude in the tropics. It needs to be grown in fertile soil. A soil pH of 6.0 - 7.9 is best. For best production, it requires much water, plenty of sunshine and low night temperatures. For germination, it does best between 20 - 30°C. It is frost-susceptible and suits hardiness zones 9 - 12.

**Use:** The fruit are eaten raw or cooked.

**Caution:** Leaves and green fruit are poisonous.

**Cultivation:** Plants are sown from seeds. These are normally sown in a nursery and transplanted. They are transplanted when 40 - 45 days old or 15 cm high. They are spaced about 60 - 90 cm apart. Seeds can also be sown directly in the field. They can also be grown from cuttings. The side branches of upright types are removed to give fewer and larger fruit. Upright plant types need to be tied to stakes. Plants are often grafted into stronger rootstocks.

**Production:** Harvesting commences after about 14 weeks. Yields can be 3 - 4 kg of fruit per plant.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
fruit	93.0	88	1.0	45	26	0.6	0.1

## Vegetables

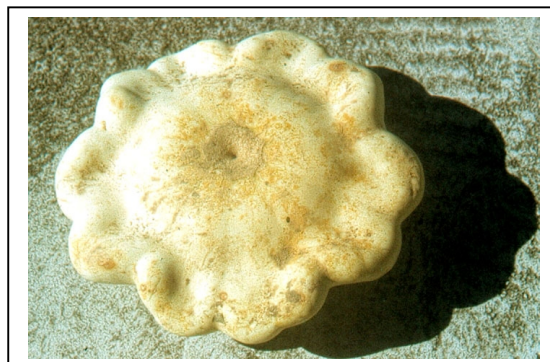
**English:** Marrow

**Local:** Labu

**Scientific name:** *Cucurbita pepo*

**Plant family:** CUCURBITACEAE

**Description:** A bristly hairy annual vine in the pumpkin family. It has branched tendrils. The stems are angular and prickly. The leaves are roughly triangular. The leaves have 5 lobes which are pointed at the end and are toothed around the edge. Male and female plants are separate on the same plant. Male flowers are carried on long grooved flower stalks. Female flowers are borne on shorter more angular stalks. The fruit stalks have furrows along them but are not fattened near the stalk. The fruit vary in shape, size and colour. Often they are oval and yellow and 20 cm long by 15 cm wide. The seeds are smaller than pumpkin and easy to separate from the tissue. The scar at their tip is rounded or horizontal, not oblique. There are a large number of cultivated varieties.



**Distribution:** A subtropical plant. They are more suited to drier areas. They are frost sensitive, and grow best with day temperatures between 24 - 29°C and night temperatures of 16 - 24°C. It suits tropical highland regions. It suits hardiness zones 8 - 11.

**Use:** The young fruit are cooked and eaten. They can be steamed, boiled or fried. They are used in pies, soups, stews and cakes. The young leaves and the ripe seeds can also be eaten cooked. The seeds are dried, salted and toasted and eaten as a snack food. The seeds can also be pressed to produce oil. The sprouted seeds are used in salads. Flowers and flower buds can be eaten boiled. They can be dried for later use.

**Cultivation:** They are grown from seeds. The seeds germinate after one week. They can be grown from cuttings. They are best planted on mounds. A spacing of 2 - 3 m between plants is needed. Hand pollination assists fruit setting. Plants can also be grown from cuttings as plants root at the nodes.

**Production:** The first usable immature fruit are ready 7 - 8 weeks after planting.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
seed (dry)	3.7	2266	29.4	-	-	7.3	-
leaf	89.0	113	4.0	180	80	0.8	-
fruit (mature)	92.0	105	1.6	17	16	2.4	-
fruit	91.3	102	1.1	-	12	0.8	0.2
yellow fruit	92.0	97	1.0	180	8	1.4	-
immature fruit (raw)	92.0	92	1.5	-	9	0.4	0.1

## Vegetables

**English:** Okra

**Local:** Okra

**Scientific name:** *Abelmoschus esculentus*

**Plant family:** MALVACEAE

**Description:** A tropical annual herb that grows erect, often with hairy stems. It mostly grows about 1 m tall but can be 3.5 m tall. It becomes woody at the base. The leaves have long stalks up to 30 cm long. Leaves vary in shape but are roughly heart shaped with lobes and teeth along the edge. Upper leaves are more deeply divided than lower ones. The flowers are yellow with red hearts. The fruits are green, long and ribbed. The seeds are 4 - 5 mm across. They are round and dark green.



**Distribution:** A tropical plant that suits the hot humid tropical lowlands but is unsuited to the highlands. It is very sensitive to frost. It can grow in salty soils. It grows best where temperatures are 20 - 36°C. It can grow well in dry climates with irrigation. It suits hot humid environments. It does best on well drained well manured soils but will grow on many soils. A soil pH of 5.5 - 7.0 is best.

**Use:** Pods are eaten cooked. They are slimy, but less so if fried. Dried powdered seeds can be used in soups as a thickener. They can also be pickled. Young leaves can be eaten cooked. They can be dried and stored. Flowers can also be eaten. Okra is frozen and canned. The seeds are roasted and used as a coffee substitute.

**Cultivation:** They are grown from seeds, which are easy to collect. They need high temperatures for germination (over 20°C) and a sunny position. Often seeds are soaked for 24 hours before sowing to give quick germination. Seeds are sown 1.5 - 2.5 cm deep with 2 - 3 seeds per hole. Later these are thinned out to one plant. Seeds can be sown in nurseries and plants transplanted. Pinching out the tops of plants when 30 cm high encourages branching. A spacing of about 90 x 45 cm is suitable. About 8 - 10 kg of seed are required for one hectare. Most kinds respond to fertiliser. Seeds do not breed true and can cross with other kinds of okra growing nearby. This is not normally a problem but simply means plants and fruit are not all the same.

**Production:** Plants maintain production if the fruits are harvested regularly. Plants are ready to harvest 8 - 10 weeks after sowing. Seed yields of 500 - 800 kg per hectare are recorded. Pod yields of 4 - 6 tonnes per hectare occur. It takes 2 - 4 months from sowing to harvest of young pods. Pods develop 5 - 10 days after flowering. Pod harvests can continue for 1 - 2 months. Leaving pods on the plants stops new pods developing.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
Seed	9.2	1721	23.7	-	-	-	-
Leaf	81.0	235	4.4	116	59	0.7	-
pod (fresh)	88.0	151	2.1	185	47	1.2	-
fruit (cooked)	90.0	134	1.9	58	16.3	0.5	0.6

## Vegetables

**English:** Eggplant

**Local:** Terong ungu

**Scientific name:** *Solanum melongena*

**Plant family:** SOLANACEAE

**Description:** A perennial shrubby herb up to 1 m tall. It is often grown as an annual. It has a deep taproot and branched side roots. The stem is thick and covered with many woolly hairs. The plant has many branches. Often the plant is spiny. Leaves can be 20 cm long and wavy along the edge. Leaves are covered with hairs. Flowers are bluish red and 5 cm across. They are either solitary or in small groups opposite the leaves. They have 5 large woolly lobes which continue to surround the base of the fruit. Fruit are white, blue, green or purple. The fruit colour and shape vary. Sometimes the fruit is spiny. Often the fruit are 10 - 20 cm long and 5 - 8 cm wide. Numerous kidney shaped seeds are in the flesh of the berry. There are many cultivated varieties.



**Distribution:** A tropical plant. Plants grow from sea level up to 2,200 m altitude in the tropics. It suits wet climates but does well in dry climates with irrigation. It needs a long warm growing period. A daily mean temperature of 20 - 30°C is most suitable. They are frost tender. They need a rich, friable, well tilled soil. In the sub-tropics they can be grown as a summer crop.

**Use:** Fruit are mostly fried then eaten. They can also be grilled, baked, stuffed and stewed. They are used in curries. The fruit are also dried and stored. The leaves, although edible, are hairy and not good flavour.

**Cultivation:** Plants are grown from seeds. Seeds germinate slowly. At the best temperature, they germinate in 8 - 12 days. Seed are sown in nursery beds. Seedlings can be transplanted when about 8 cm tall or 4 - 6 weeks old. Plants need to be about 60 - 100 cm apart. Because some cross pollination can occur, seed crops need to have varieties planted 400 m apart.

**Production:** Fruit are ready for harvest after 3 months. They continue to yield for 3 - 4 months.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
fruit	91.8	117	0.83	6	1.3	0.4	0.2
fruit (fresh)	93.4	62	0.7	50	5	0.4	0.3



## Vegetables

**English:** Horseradish tree

**Local:** Kelor

**Scientific name:** *Moringa oleifera*

**Plant family:** MORINGACEAE

**Description:** A small, soft-wooded tree that grows 9 - 12 m tall. The tree loses its leaves during the year. The bark is grey, thick, corky and peels off in patches. The leaves are pale green and the leaf is divided 3 times. The whole leaf is 30 - 60 cm long and the leaflets are usually oval and 1 - 2 cm long. The leaflets are jointed with a gland near the joint. The flowers are pale yellow. They occur in long sprays 30 cm long. Each flower has 5 petals and of these one is erect and 4 are bent backwards. The fruit is a long capsule 30 - 100 cm long by 2 cm wide. The seed capsules are up to 45 cm long. They are roughly triangular in shape. The seeds have 3 wings. Often the fruiting kinds are grown as annual plants.



**Distribution:** A tropical and subtropical plant. They suit the dry lowland areas and grow up to 1,350 m altitude in the tropics. They are not hardy to frost. They cannot tolerate water-logging. A pH of 6 - 7.5 is suitable. It can grow in arid places. It suits hardiness zones 9 - 12.

**Use:** The young tops and leaves are eaten cooked. They are eaten as potherbs or used in soups and curries. They can be dried and stored for later use. The very young long pods are eaten cooked, especially in curries and soup. They are also pickled. The young seeds are eaten roasted or fried. Sometimes the roots are used as a horseradish substitute. A gum from the bark is used as seasoning. The bark is used for tea. The roots, leaves, flowers and fruits are eaten cooked in water and mixed with salt and chili peppers. The oil expressed from the seeds is used in salads.

**Cultivation:** It is best to grow plants from 1 metre long cuttings but they can be grown from seed. They can be used as a hedge and pruned regularly to produce more leaves. Properly dried seed can be stored for a long time in sealed containers in a cool place. Normally perennial types are grown from cuttings and annual types are grown from seed.

**Production:** Trees are fast growing. They can be pruned or topped. With one variety the tree flowers and fruits continuously while with the other variety there are flowers and fruit once per year. The fruit ripens 3 months after flowering. Annual types produce fruit 6 months after planting. Leaves are best dried in the shade to retain more of their Vitamin A.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
leaf	76.4	302	5.0	197	165	3.6	-
flower	84.2	205	3.3	-	-	5.2	-
leaf (boiled)	87	189	4.7	40	31.0	2.0	0.2
pod (raw)	88.2	155	2.1	4	141	0.4	0.5
seed	6.5	-	46.6	-	-	-	-

## *Nuts, seeds, herbs and other foods*

**English:** Cashew

**Local:** Jambu mente

**Scientific name:** *Anacardium occidentale*

**Plant family:** ANACARDIACEAE

**Description:** An evergreen tree, with spreading branches, growing 7 - 14 m tall. The canopy can spread to 12 m. The roots grow deeply and spread widely. The shiny leaves are pale green and large. They are 10 - 15 cm long by 6 - 8 cm wide. They have fine veins. The flowers are produced on the ends of the branches. They are red in colour. The kidney-shaped nut is about 3 cm long and is borne below the "apple" which is really a fleshy stalk.



**Distribution:** It is a tropical plant that suits the lowland tropics but will grow up to about 1,200 m altitude. It only bears well in dry areas because of blight of the flowers. It grows with temperatures between 22 - 26°C. A rainfall of 1,750 mm per year is considered suitable but good yields have been obtained with rainfall of 750 mm. It can grow on poor soils but needs good drainage.

**Use:** The fleshy "apple" is edible but acid until very ripe. It is used for jams and drinks. It is also candied, made into chutney and pickles. The nut is eaten after roasting. The young shoots and leaves are edible. They are picked during the rainy season and eaten fresh with hot and spicy dishes.

**Caution:** The oil of the nut can blister the skin until roasted. The apple is used to make spirits.

**Cultivation:** It is usually grown from seeds. Seeds germinate poorly and slowly. Only nuts which sink in water (or a solution of 150 g of sugar in a litre of water) should be planted. Seeds are sun dried for 2 - 3 days to improve germination. Seeds can be sown in a nursery then transplanted, or more commonly, are sown directly. Trees are spaced 7 - 10 m apart. The crop is cross pollinated mostly by insects. For good production, complete fertiliser or appropriate organic material should be applied. Pruning to shape the tree is often undertaken in the first 2 - 3 years. Cashews are often planted scattered in gardens or amongst other trees. Clearing under the tree prevents fire and makes finding nuts easier. Allowing nuts to fall before harvesting ensures only ripe nuts are collected. Resin in the cashew nut shell can damage hands and discolour the nuts. Roasting the nuts before removing the kernel avoids this.

**Production:** Trees commence bearing after 3 years. Fruit production is seasonal, normally October - January. Mature nuts are produced in 2 - 3 months. Yields of 80 - 200 kg of nuts per hectare are normal. Trees reach maximum production after 10 years and trees last for about 100 years.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
Nut	4.0	2478	17.5	-	-	2.8	4.8
Leaf	69.9	418	5.2	-	-	-	-
Fruit	84.7	213	0.8	0.12	265	1.0	0.2



## Nuts, seeds, herbs and other foods

**English:** Greater galangal

**Local:** Lengkuas

**Scientific name:** *Alpinia galanga*

**Plant family:** ZINGIBERACEAE

**Description:** A herb which grows year after year. It grows to 1.6 m high and spreads to 1 m across. The rootstock creeps under the ground. This is round like a cylinder and branches. This thick rhizome can be 10-12 cm long by 3 cm wide. It grows as a dense clump. The outside of the root is reddish brown and inside is white. The stems lie along the ground. The leaves are long and narrow and sword shaped. The leaf blade is 25-35 cm long by 6-10 cm wide. They taper to the tip. They have a sweet scent. The flower spike is at the end of the shoot. It is hairy and 15-30 cm long. The flower bracts are oval and 2-8 mm long. The flowers are white. They occur in clusters at the ends of stalks. Each bract surrounds 4-5 flowers. The flowers are 1.5 cm long and white with purple lines. The fruit is a round capsule. It is 1 cm across. It is orange-red.



**Distribution:** A tropical plant. It does best in rich moist soils. It prefers a protected shady position. It is drought and frost tender. The soil needs to be well-drained. It can be grown in sheltered sites in cooler climates but needs a heated glasshouse in cold places. In China it grows in grasslands between 100-1300 m altitude in S China. It suits hardiness zones 9-12.

**Use:** The root is used for flavouring curries. They are often sliced then removed before serving the dish. They can be pounded to a paste then added to dishes. They are also pickled. The young shoots and leaves are also eaten. Flower buds and flowers can also be cooked and eaten. They are also pickled. The red fruit are edible.

**Cultivation:** It is grown by dividing the rootstock. A piece about 5-10 cm long with at least 2 undamaged buds is used. Rhizomes are planted just below the surface and 60 cm apart.

**Production:** Young rhizomes have more flavour than older ones.

**Food Value:** Per 100 g edible portion

Edible part	Moisture %	Energy kJ	Protein g	proVit A ~g	proVit C mg	Iron mg	Zinc mg
leaf	-	-	0.5-1	-	-	-	-
rhizome	85.9	213	1.0	-	-	2.1	-

## Nuts, seeds, herbs and other foods

**English:** Flax seed

**Local:** Flaxseed

**Scientific name:** *Linum usitatissimum*

**Plant family:** LINACEAE

**Description:** An annual herb. It has a single stem 70-100 cm high. It branches only in the upper part when flowering. Varieties for flax are single stemmed while varieties for linseed seed are more branched. The leaves are small and hairless. The flowers are blue or white. The petals are 13-18 mm long. The capsule is 6-9 mm wide. It contains 10 seeds. These are flat and oblong.

**Distribution:** It needs a temperate climate. It can grow in moderately fertile soils. Plants have some drought and frost resistance. It has been grown in mountains in Java.



**Use:** The seeds are crushed to make linseed oil. This has occasionally been used as a cooking oil. The oil is high in Omega-3. Flax seed has also been used to make tea. Roasted seeds are used as a coffee substitute. The seeds are also eaten. They are used in bread and cereals and can be sprouted. They can be used as an egg substitute in muffins, cakes and scones. The leaves are also eaten as a vegetable with sour cream and lemon.

**Caution:** Some kinds contain high levels of poisonous alkaloids.

**Cultivation:** Plants are grown from seed. Plants are generally self-pollinated.

**Production:** Plants take 24-27 weeks to mature.

**Food Value:** Per 100 g edible portion

Edible part	Moisture % <sub>1,2</sub>	Energy kJ	Protein G <sub>1,2,3</sub>	proVit A ~g	proVit C mg <sub>1,2</sub>	Iron Mg <sub>1,2,3</sub>	Zinc Mg <sub>1,2,3</sub>
seed	6.96	2234	18.29	-	0.6	5.73	4.34

<sup>1</sup>Flax Council of Canada **Nutrient Analysis of Flaxseed by Medallion Lab**, 1997 Winnipeg

<sup>2</sup>Nutrient Data Laboratory, ARS, USDA **National Food and Nutrient Analysis Program Wave 7h**, 2003 Beltsville MD

<sup>3</sup>J.K. Daun, R. Przybylski **Environmental effects on the composition of four Canadian flax cultivars**, 2000 Proceedings of the 58th Meeting of the Flax Institute of the United States pp.80-91

## *Nutritional values of food plants by plant Family*

Plant Family	Scientific name	Common name (English)	Common name (Indonesian)	Edible part	Moisture %	Energy kJ	Protein g	Vit A ~g	Vit C mg	Iron mg	Zinc mg	Page
Convolvulaceae	<i>Ipomoea batatas</i>	Sweet potato	Ubi Jalar	tuber (baked)	72.9	431	1.7	961	24.6	0.5	0.3	12
Musaceae	<i>Musa sp (A&amp;/orB genome)</i>	Banana	Pisang	fruit (sweet)	70.7	365	1.7	-	2	0.9	0.4	14
Musaceae	<i>Musa troglodytarum</i>	Fe'i banana	Pisang tongkat langit	fruit	70	526	1.6	12	0	0.5	0.3	15
Euphorbiaceae	<i>Manihot esculenta</i>	Cassava	Singkong	tuber	62.8	625	1.4	30	15	0.23	0.48	16
Araceae	<i>Colocasia esculenta</i>	Taro	Talas	root	66.8	1231	1.96	3	5	0.68	3.2	18
Dioscoreaceae	<i>Dioscorea esculenta</i>	Lesser yam	Gembili	tuber	74.2	470	2.1	84	20	0.75	0.5	20
Dioscoreaceae	<i>Dioscorea bulbifera</i>	Potato yam	Gembala	tuber	70.8	357	2.7	-	78	3.1	0.4	21
Dioscoreaceae	<i>Dioscorea alata</i>	Greater yam	Uwi	tuber	76.6	323	2.0	18	10	0.8	0.39	22
Fabaceae	<i>Arachis hypogea</i>	Peanut	Kacang tanah	seed (dry)	4.5	2364	24.3	-	-	2.0	3.0	24
Fabaceae	<i>Phaseolus lunatus</i>	Lima bean	Kacang kratok	seed (young, cooked)	67.2	515	6.8	37	10.1	2.5	0.8	25
Fabaceae	<i>Phaseolus vulgaris</i>	Common bean	Kacang buncis	pod	88.0	151	2.5	750	27	1.4	0.2	26
Fabaceae	<i>Vigna radiata</i>	Mung bean	Kacang hijau	seed	11.0	1432	22.9	55	4	7.1	-	27
Fabaceae	<i>Vigna unguiculata subsp. unguiculata</i>	Cowpea	Kacang tunggak	(seed young, boiled)	75.5	406	3.2	79	2.2	1.1	1.0	28
Malvaceae	<i>Abelmoschus manihot</i>	Slippery cabbage	Daun gedi	leaf	88	120	3.4	1.0	7.0	1.5	1.2	29
Fabaceae	<i>Sesbania grandiflora</i>	Sesbania	Turi	leaf	82.3	323	8.7	66	60	4.0	-	30
Euphorbiaceae	<i>Sauropus androgynus</i>	Sweetleaf	Katuk	leaf	81	244	4.8	133	85	2.7	-	31
Brassicaceae	<i>Brassica oleracea var. alboglabra</i>	Chinese broccoli	Kailan	flower (cooked)	93.5	92	1.1	164	28.2	0.6	0.4	32
Brassicaceae	<i>Brassica rapa subsp. chinensis</i>	Bok/pak choi	Sawi	stem/leaf (raw)	95	55	1.5	223	45	0.8	0.2	32
Apiaceae	<i>Apium graveolens var dulce</i>	Celery	Seledri	stalk	94.6	67	0.8	13	7	0.4	0.1	34
Brassicaceae	<i>Brassica oleracea var. capitata</i>	Cabbage	Kubis	leaf	93.6	92	1.0	6.6	20	0.2	0.1	35
Caricaceae	<i>Carica papaya</i>	Pawpaw	Pepaya	fruit	88.0	163	0.5	290	54	0.4	0.18	36
Bromeliaceae	<i>Ananas comosus</i>	Pineapple	Nanas	fruit	84.3	194	0.5	60	25	0.4	0.1	37
Rutaceae	<i>Citrus reticulata</i>	Mandarin	Jeruk keprok	fruit	87.6	184	1.5	42	136	0.8		39
Rutaceae	<i>Citrus aurantifolia</i>	Lime	Jeruk nipis	fruit	91.0	133	0.7	4	40	0.25	0.1	40
Rutaceae	<i>Citrus grandis</i>	Pomelo	Jeruk bali atau	fruit	89.1	159	0.76	0	61.0	0.11	0.1	41
Anacardiaceae	<i>Mangifera indica</i>	Mango	Mangga	fruit	83.0	253	0.5	54	30	0.5	0.04	42
Passifloraceae	<i>Passiflora edulis</i>	Purple passionfruit	Markisa	fruit	73.3	280	2.8	10	20	1.3	0.1	44
Myrtaceae	<i>Psidium guajava</i>	Guava	Jambu biji	fruit	77.1	238	1.1	60	184	1.4	0.2	45
Convolvulaceae	<i>Ipomoea aquatica</i>	Kangkong	Kangung	leaf (boiled)	92.9	84	2.1	-	16	1.3	0.2	46
Solanaceae	<i>Lycopersicon esculentum</i>	Tomato	Tomat	fruit	93.0	88	1.0	45	26	0.6	0.1	47
Cucurbitaceae	<i>Cucurbita pepo</i>	Marrow	Labu	fruit	91.3	102	1.1	-	12	0.8	0.2	48
Malvaceae	<i>Abelmoschus esculentus</i>	Okra	Okra	fruit (cooked)	90.0	134	1.9	58	16.3	0.5	0.6	49
Solanaceae	<i>Solanum melongena</i>	Eggplant	Terong ungu	fruit	91.8	117	0.83	6	1.3	0.4	0.2	50
Moringaceae	<i>Moringa oleifera</i>	Horseradish tree	Kelor	leaf	76.4	302	5.0	197	165	3.6	-	51
Anacardiaceae	<i>Anacardium occidentale</i>	Cashew	Jambu mente	nut	4.0	2478	17.5	-	-	2.8	4.8	52
Zingiberaceae	<i>Alpinia galanga</i>	Greater galangal	Lengkuas	rhizome	85.9	213	1.0	-	-	2.1	-	53
Linaceae	<i>Linum usitatissimum</i>	Flax seed	Flaxseed	seed	6.96	2234	18.29	-	0.6	5.73	4.34	54

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