Edible Medicinal and Non-Medicinal Plants

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Volume 3, Fruits

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Contents

Introduction

This book continues as volume 3 of a multi-compendium on *Edible Medicinal and Non-Medicinal Plants.* It focuses on edible fruits/seeds used fresh, cooked or processed into other by-products, or as vegetables, spices, stimulant, edible oils and beverages. It covers species from the following families: Ginkgoaceae, Gnetaceae, Juglandaceae, Lauraceae, Lecythidaceae, Magnoliaceae, Malpighiaceae, Malvaceae, Marantaceae, Meliaceae, Moraceae, Moringaceae, Muntigiaceae, Musaceae, Myristicaceae and Myrtaceae. However, not all the edible species in these families are included for want of coloured illustrations. The edible species dealt with in this work include to a larger extent lesser-known, wild and under-utilized crops and also common and widely grown crops.

As in the preceding two volumes, topics covered include: taxonomy (botanical name and synonyms); common English and vernacular names; origin and distribution; agro-ecological requirements; edible plant part and uses; plant botany; nutritive and medicinal/pharmacological properties with up-to-date research findings, traditional medicinal uses other non-edible uses; and selected/cited references for further reading.

Ginkgoaceae is a family of temperate gymnosperms which appeared during the Mesozoic Era, of which the only extant representative and living fossil is *Ginkgo biloba*. *Gingkgo biloba* has both culinary and medicinal uses. Several thousands of scientific papers have been published on the phytochemicals and associated pharmacological and medicinal properties of the aerial plant parts of *G. biloba*. The edible seed is rich in niacin, and vitamin A, phosphorus and potassium. It is a good source of starch and protein, but is low in unsaturated or monounsaturated fats. The seed also contains vitamin B1 (thiamine), B2 (riboflavin), vitamin C and iron, sodium and calcium (USDA 2010). Important bioactive constituents reported to occur in the medicinally used Ginkgo leaves include terpene trilactones, i.e., ginkgolides A, B, C, J and bilobalide, many flavonol glycosides, biflavones, proanthocyanidins, alkylphenols, simple phenolic acids, and polyprenols (van Beek 2002).

Gnetaceae is a representative of tropical gymnosperms. *Gnetum*, a genus of about 30–35 species, is the sole genus in the family Gnetaceae and order Gnetales. They are tropical, evergreen trees, shrubs and lianas and occur in Indomalaysia, tropical parts of West Africa, Fiji and the northern regions of South America. Many *Gnetum* species including *Gnetum gnemon* are edible, with the seeds being roasted, and the foliage used as a leaf vegetable. *Gnetum gnemon* contains bioactive chemicals like flavonostilbenes and stilbenes that play a role in various pharmacological activities. *Gnetum gnemon* is found in Assam, southeast Asia, the Philippines and Papua New Guinea, Fiji, Solomon Islands and Vanuatu.

The large and economically important Juglandaceae, or the walnut and hickory family is a family of deciduous, semi-evergreen, or evergreen, monoecious (rarely dioecious) trees, rarely shrubs in the order Fagales. The family contains 9 genera and 50 or more species, which are

distributed mainly in the north temperate zone but extend through Central America along the Andes Mountains to Argentina and, in scattered stands, from temperate Asia to the highlands of Java and New Guinea. The commercially important nut-producing trees include walnut (*Juglans regia*), pecan (*Carya illinoinensis*), and hickory (*Carya* spp). Walnut, hickory, and gaulin (*Alfaroa costaricensis*) are also valuable timber trees. Both Persian walnut, *Juglans regia*, and pecan nut which are covered in this volume, have culinary, nutritive and medicinal attributes.

The Lauraceae or laurel family contains about 55 genera and over 2,000 species world-wide, mostly from warm subtropical or tropical regions, especially Southeast Asia and Brazil. Most are aromatic evergreen trees or shrubs, a few genera are deciduous, and *Cassytha* is a genus of parasitic vines. The Lauraceae are economically important as sources of medicine, timber, nutritious fruits (e.g., *Persea americana*), spices (e.g. *Cinnamomum aromaticum*, *C. verum, Laurus nobilis* covered in later volumes), and perfumes and essential oils. Avocados are important oil-rich and nutritious fruit with health and medicinal properties, that are now planted in warm climates across the world. *Litsea garciae* is another edible tropical fruit but is lesser-known and under-utilised. The hard wood of several species is a source for timber around the world.

Lecythidaceae, a tropical plant family, is indigenous to South America and Madagascar. It has about 20 genera and 250–300 species of woody plants. Neotropical Lecythidaceae comprises ecologically dominant species in the Amazonian forests and are spectacular plants with showy flowers and large woody fruits. They include the edible and economically important Brazil nut (*Bertholletia excelsa*), and the edible, lesser-known paradise nut or monkey nut (*Lecythis* spp.). Other edible but lesser-known species are the *Barringtoni*a species which are eaten in southeast Asian and the Pacific Island countries. The genus *Barringtonia* is also placed in the family, Barringtoniaceae.

Magnoliaceae comprises about 225 species in 7 genera. Magnoliaceae is better known for its ornamental species and timber species. The bark and flowers from several species are believed to possess medicinal qualities. In this family the edible fruit species that is treated in this volume is *Michelia mediocris*, a highly valued and productive indigenous Vietnamese timber species. The fruit and seeds of this species have good potential as a spice.

Malpighiaceae comprises approximately 75 genera and 1,300 species, all of which are native to the tropics and subtropics. About 80% of the genera and 90% of the species occur in the New World (the Caribbean and the southernmost United States to Argentina) and the rest in the Old World (Africa, Madagascar, and Indomalaysia to New Caledonia and the Philippines). The Malpighiaceae are shrubs, small trees, or woody lianas. Of the two edible genera *Malpighi*a and *Bunchosi*a, the former also has species with pharmacological and medicinal attributes. Acerola (*Malpighia emarginata*) has been reported to have very high vitamin C content, much higher than other fruits like pineapple, araçá (*Eugenia stipitata*), cashew, guava, kiwi, orange, lemon, and strawberry. Acerola has also reported to have carotenoids and bioflavonoids which contribute to its high antioxidant capacity and provide important nutritive and pharmacological values.

The Marantaceae or arrowroot or prayer plant family, is a family of flowering, herbaceous plants under the order Zingiberales. Based on nucleotide sequence variation, 59 species (21 genera) formed the ingroup, and 12 species (12 genera) of other Zingiberales formed the outgroup (Andersson and Chase 2001). There is no support for the traditional subdivision of Marantaceae into a triovulate and a uniovulate tribe or the informal groups previously proposed (Andersson 1981). Based on phylogeny it is concluded that Africa where early diversification of the family took place, in spite of being much poorer in species, is the most likely ancestral area of Marantaceae. The family is found in the lowland tropics of Asia and Africa, mainly (80%) in American tropics, occasionally subtropics, southern United States to northern Argentina. The family is known for its large starchy rhizomes and house-hold ornamental plants. The most significant food plant is *Maranta arundinacea*, cultivated in tropical regions

worldwide for arrowroot starch. However, one species, *Thaumatococcus daniellii* produces fruit with edible aril which furnished a natural source of thuamatin, an intensely sweet protein which is about 100,000 times sweeter than sugar on a molar basis and 3,000 times on a weight basis. Thaumatin is used as a sweetener and flavour enhancer for food, desserts, confectionary and beverages.

Malvaceae has been circumscribed to embrace the non-monophyletic families, Bombacaceae, Tiliaceae, and Sterculiaceae, which have always been considered very close to the traditional Malvaceae *sensu stricto,* a very homogeneous and cladistically monophyletic group. Following this circumscription which is based on newer techniques, Malvaceae *sensu lato* now include all of these families so as to have a monophyletic group. The circumscription of the Malvaceae is still controversial. A close relationship between Bombacaceae and Malvaceae has long been recognized but until recently the families have been kept separate in most classification systems, and continue to be separated in many recent references, including the reference work in classification of flowering plants by Heywood et al. (2007) and Takhtajan (2009). However, the Angiosperm Phylogeny Group (2003, 2009) have lumped them together into a larger family Malvaceae *sensu lato*. Heywood et al. (2007) assert "although closely related to Malvaceae, molecular data supports their separation. Only pollen and habit seem to provide a morphological basis for the separation." Contrariwise they say: "One approach is to lump them (the families in the core Malvales, including Bombacaceae) all into a 'super' Malvaceae, recognizing them as subfamilies. The other, taken here, is to recognize each of these ten groups as families". Members of the Bombacaceae have been covered in volume 1. In this volume, members of Sterculiaceae (e.g. kola, cacao, cupuassu) are included together with species belonging to the traditional Malavaceae *sensu stricto* which comprises the mallows, abutilons, cotton, okra, hibiscuses and related plants. Species of Malvaceae *sensu lato* provide sources of fibre, food and beverages, medicines, timber, and in horticulture (ornamental). Also some members are deemed as weeds or invasive species. The species with edible fruits/seeds and medicinal properties covered in this volume include *Grewia asiatica, Abelmoschus esculentus, Scaphium macropodum, Sterculia foetida, Sterculia monosperma and Sterculia parviflora, Theobroma bicolour, T. cacao* and *T. grandiflorum.* Due to their high concentration of catechins and procyanidins, bioactive compounds with distinct properties, cocoa and chocolate products may have beneficial health effects against oxidative stress and chronic inflammation, risk factors for cancer and other chronic diseases (Maskarinec 2009).

The Meliaceae or mahogany family comprises about 50 genera and 550 species, with a pantropical distribution but a weak penetration into the temperate zone. One genus (*Toona*) extends north into temperate China and south into southeast Australia, and another (*Melia*) nearly as far north. The species are evergreen or deciduous trees or tree-lets and rarely shrubs; the bark sometimes with a milky latex. Meliaceae species are very common trees in the understory of lowland primary forest throughout Malesia. Various species are used for vegetable oil, soap-making, insecticides, and highly prized wood mahogany (*Swietenia* spp. and *Aglai*a spp.). Species that provide edible fruits are mainly tropical and include various *Aglaia* spp., the duku, langsat, lonkong (*Lansium domesticum*) and the santol (*Sandoricum koetjape*). The latter two species are popular and widely eaten fruits in southeast Asia and also have several pharmacological properties; various plant have been used in traditional folkloric medicine.

The Moraceae family comprises between 37 and 43 genera and 1,100–1,400 species, widespread in tropical and subtropical areas but less common in temperate areas. They comprise trees, shrubs, vines, frequently with milky or watery latex. Flowers occur usually in heads and are unisexual; ovule is anatropous or campylotropous and united into a more or less fleshy compound fruits. Economically, the most important species are those of *Morus* and *Maclura* associated with the production of silk. Some species in *Broussonetia*, *Maclura*, and *Morus* are important for paper making. Some *Artocarpus* and *Broussonetia* species are used for furniture or timber.

Some species in *Artocarpus*, *Ficus*, *Prainea*, *Treculia* and *Morus* have edible fruit. The common edible tropical *Artocarpus* species include the bread fruit *A. altilis*, the breadnut *A. camansi*, jackfruit *A. heterophyllus*, chempedak *A. integer* and the marang or terap *A. odratissimus*. Many of the edible *Artocapus s*pecies contain bioactive compounds such as the prenylated flavonoids or stilbenoids, and lectins which have significant pharmacological activities. The edible *Ficus* species include the common and popular fig *Ficus carica* and other lesser-known fig trees like the elephant ear fig tree, *F. auricalata*, cluster fig, *F. racemosa*, the creeping ivy fig, *F. pumila* and dinner plate fig tree *F. dammaropsis*. Many of the *Ficus* species have medicinal attributes. *Prainea limpato* is a rare species with unusual stellate, grosteques looking fruit which is edible. The edible *Morus* species include the red (*M. rubra*), white (*M. alba*) and black (*M. nigra*) mulberries, the plant parts of which have bioactive chemicals with pharmacological activities.

Moringaceae or horseradish tree family comprise only one genus with 12 species, found mainly in tropical and subtropical climates. The most widely known species is *Moringa oleifera*, a multi-purpose tree native to the foothills of the Himalayas in north-western India and cultivated pan-tropically. *M. stenopetala*, an African species, is also widely cultivated, but to a much lesser extent than *M. oleifera*. *Moringa oleifera* (horseradish or drumstick tree) has edible fruits and leaves. The seeds provide "ben oil" used in perfumery and light lubricants and the seeds are also used to purify water and removal of industrial pollutants and heavy metals. *Moringa oleifera* oil was found to have potential as acceptable feedstock for biodiesel. The leaves made highly nutritious cattle feed and the roots are also a source of edible condiment. The tree's bark, roots, fruit, flowers, leaves, seeds, and gum are also used medicinally.

Muntigiaceae is indigenous to the neotropics. The small family includes the monotypic genera, *Muntingi*a, *Dicraspidia* and *Neotessmania*. They were previously included in Elaeocarpaceae, Tiliaceae or Flacourtiaceae. Muntigiaceae is closely related to the rosid order Mavales (Sterculiaceae, Tiliaceae, Bombaceae and Malvaceae) and several other families but the relationships are still obscure and unresolved. *Muntingia calabura,* the type species, has edible fruits and contains phytochemicals with pharmacological properties.

The genus *Musa* in the family Musaceae is divided into four sections, including members of both seeded and non-seeded (parthenocarpic) types. Two of the sections contain species with a chromosome number of 2n = 20 (*Callimusa* and *Australimusa*) while the other two sections (*Eumusa* and *Rhodochlamys*) have species with a basic chromosome number of 11 (2n = 22). The majority of cultivated bananas arises from the *Eumusa* group of species. This section is the biggest in the genus and the most geographically widespread, with species being found from India, throughout South East Asia to the Pacific Islands.

Linnaeus first classified banana (*Musa*) into two species based on their culinary use, *Musa sapientum* for dessert bananas and *Musa paradisiaca* for plantains. This distinction is entirely semantic and artificial with no botanical basis and no consistent culinary basis. In 1948, Cheesman found that *Musa sapientum* and *Musa paradisiaca*, described by Linnaeus, were actually cultivars and intra and interspecific hybridizations of two wild and seedy species, *Musa acuminata* and *Musa balbisiana,* each contributing the A and B genomes respectively. The identification of *Musa* cultivars has traditionally been based upon various combinations of morphological, phenological and floral criteria. The preponderance of cultivars magnified the taxonomic problems of classifying *Musa* until Simmonds and Shepherd (1955) devised a scoring system based on 15 diagnostic morphological characters to differentiate *M. acuminata* cultivars from *M. balbisiana* cultivars and their hybrids into six genome groups. Generally, modern classifications of banana cultivars follow Simmonds' and Shepherd's system. The accepted names for bananas are *Musa acuminata*, *Musa balbisiana* or *Musa acuminata* × *balbisiana*, depending on their ancestral genome. Examples of the new classification scheme adopted include: *Musa acuminata* (AA group) 'Lakatan', *Musa acuminata* (AAA Group) 'Gros

Michel', *Musa acuminata x balbisiana* (AAB Group) 'Horn Plantain', *Musa acuminata x balbisiana* (AAB Group) 'Pisang Raja' *Musa acuminata x balbisiana* (ABB Group) 'Bluggoe'. Other edible Muss spp covered in this volume are *Musa troglodytarum* (Fei bananas), *Musa velutina* and *Musa zebrina*.

As described above, most banana cultivars are derived from two species, *Musa acuminata* (A genome) and *Musa balbisiana* (B genome). However, Shepherd and Ferreira (1982) found cultivars derived from hybridizations with *M. schizocarpa* (S genome), which was subsequently confirmed by Carreel et al. (1993). Several landraces containing the two genomes *acuminata* and species from the Australimusa section (T genome) and two landraces containing the three genomes, A, B and T have been found in Papua New Guinea and a Philippine clone (Butuhan) is considered to be the result of an ancient hybridization between *M. balbisiana* and *M. textilis* (T genome) (Carreel et al. 1993).

Myristicaceae, the nutmeg family comprises about 20 genera and approximately 500 species of evergreen trees and shrubs found in tropical Asia to the Pacific islands and also in Africa and tropical America. The most well known and widely cultivated species is the spice, *Myristica fragrans*, the nutmeg or mace. Nutmeg has culinary and medicinal uses. Two other edible species covered in this volume are *Myristica fatua Myrtaceae*, and *Horsfeldia australiana.*

Myrtaceae , the myrtle family, placed within the order Myrtales comprises at least 133 genera and 3,800 species of woody shrubs to tall trees. It has centers of diversity in Australia, southeast Asia, and tropical to southern temperate America, but has little representation in Africa. The family is distinguished by a combination of the following features: entire aromatic leaves containing oil glands, flower parts in multiples of four or five, ovary half inferior to inferior, numerous brightly coloured and conspicuous stamens, internal phloem, and vestured pits on the xylem vessels. Until relatively recently, the family has been considered to be naturally divisible into two subfamilies, the fleshy-fruited Myrtoideae and the capsular-fruited Leptospermoideae. This was seriously challenged by Johnson and Briggs (1984) who concluded, from a cladistic analysis based on morphological and anatomical characters, that these subfamilies must be abandoned. Species of the myrtle family provide many valuable products, including timber (e.g. *Eucalyptus*), essential oils and spices (e.g. allspice, cloves), and horticultural plants (e.g. ornamentals such as *Verticordia*, *Callistemon, Leptospermum*) and edible fruits such as the common guava, strawberry guava, other *Psidium* spp., Feijoa, myrtle, rose myrtle, jaboticaba*, Eugenia* spp*. Myrciaria* spp. *and Syzygium* spp. Many of these myrtaceous plants also have medicinal properties.

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