



Dacryodes edulis

Bush butter tree



© A. AWONGO

Retailers selling bush butter tree fruits in a market (Cameroon)

Common name

Bush butter tree, African plum
(English)
Safou (French)

Scientific name

Dacryodes edulis
(G. Don) H. J. Lam.

Synonyms

Canarium edule Hook.,
Canarium mansfeldianum Engl.,
Canarium mubafo Fichalo,
Canarium saphu Engl.,
Pachylobus edulis G. Don.,
Pachylobus saphu Engl.,
Sorideia deliciosa A. Chev. Ex.
Hutch. & Dalz.

Family

Burseraceae

Joseph KENGUE

IRAD, P.O. Box. 02067 Yaoundé, Cameroon

Edouard KENGI

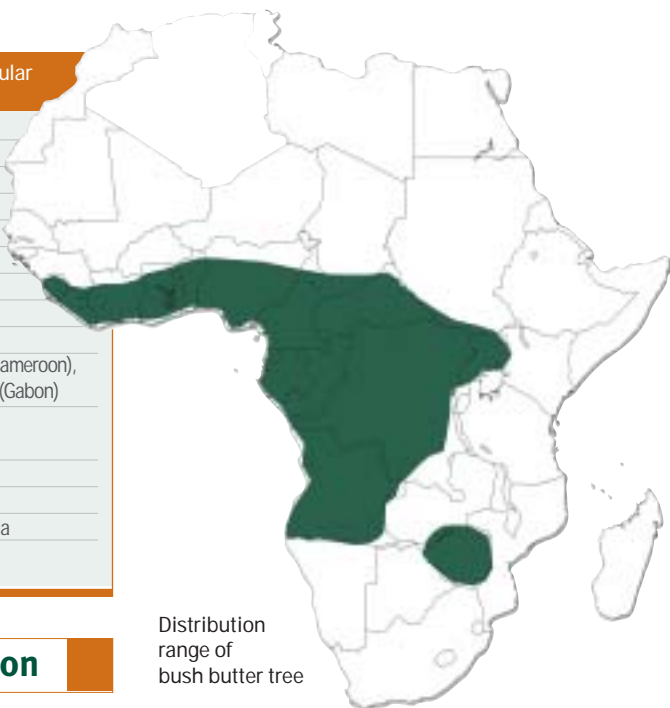
Department of Health Sciences, Sargent College,
Boston University, 667 Commonwealth Avenue,
Boston, MA 02115, USA

Honoré TABUNA

Expert Valorisation de la biodiversité, CEEAC, BP
21 12, Libreville, Gabon

This leaflet highlights the nutritional and socio-economic potential of bush butter tree and provides information to assist those working with the species. The focus is on conserving genetic diversity and promoting sustainable use of bush butter tree. The leaflet presents a synthesis of current knowledge about the species. The recommendations provided should be regarded as a starting point, to be further developed according to local or regional conditions. These guidelines will be updated as new information becomes available.

Socio-cultural group	Country	Vernacular name
Bakoko	Cameroon	Sas
Bakweri	Cameroon	Sao
Bamoun	Cameroon	Wom
Bassa	Cameroon	Sa
Bibaya Pygmies	Cameroon	Sené
Bulu	Cameroon	Assa
Douala	Cameroon	Sao
Dschang	Cameroon	Ekiép
Ewondo	Cameroon	Assa
Fang	Cameroon, Gabon, Congo,	Edou (Cameroon), atanga (Gabon)
Lingala	Democratic Republic of the Congo	Nsafou
Abe	Cote d'Ivoire	Vy
Akye	Cote d'Ivoire	Tsai
Anyi	Cote d'Ivoire	Kerendja
Ibo	Nigeria	Oube



Distribution range of bush butter tree

Geographical distribution

The natural range of bush butter tree is known to include at least south-eastern Nigeria and south-western Cameroon, but it is found growing wild throughout the humid tropics of central Africa, in Gabon, the Congo and the Democratic Republic of the Congo. It is grown in farmers' fields from Sierra Leone south to Angola and east to Uganda. The original distribution is difficult to determine because it has been planted and naturalized for many generations.

Importance and use

The cooking methods for bush butter tree fruit are simple. It is usually cooked in hot water, hot ash

or roasted. After cooking, the edible pulp is eaten with local staple foods such as cassava, cocoyam, maize, potatoes and plantains. In big hotels the fruit could be served stuffed with minced meat. It is a nutritious food for all ages. Recent investigations have shown that the pulp can be used to improve the nutritive value of biscuits.

Oil from the fruit or seed is suitable for use in cosmetics as well as in the food industry, but it has not been commercialized and extraction techniques are still experimental. Leaves, resin and bark are used medicinally for a variety of ailments and the leaves are also used to produce a dye. The wood is valued for carving and is used for construction and fuel. The tree is useful for shade in coffee and cocoa plantations.

Uses	Part of plant
Food	Fruits
Fodder	Leaves
Construction, carving material, fuel	Trunk
Medicine	Leaves, resin and bark
Tourism and soil protection	Whole trees in marginal land

Socio-economic value

Bush butter trees are found on many farms in south-eastern Nigeria and the humid lowlands of Cameroon. In spite of its short shelf life, the fruit is very common in local markets and is traded across Cameroon's borders into the Congo, Gabon and Equatorial Guinea. In 1999, fruit exports from Central Africa and Nigeria to Belgium, France and UK generated income estimated at US\$2 million. The exports are distributed through ethnic channels.

New derived products such as oil, dried fruits, paste and essence oil are now entering the marketplace. Produced principally in Cameroon, these new products are now commercialized through niche channels in Yaoundé and can be



Grilled fruits for consumption

occasionally found in supermarkets. The fruit is consumed there as a snack but the potential for such use has not been developed in rural areas. The promotion necessary to encourage use of dried fruit and vegetables as snacks is lacking.

Ecology and biology

Bush butter tree grows in humid forest, including rain forest and gallery forest, and on swampy land. It is shade-tolerant but also grows well in full sun and on a variety of soils. It is found at



Tree grown from seedling, with immature fruits

elevations ranging from sea level to 1000 m. Although it grows best with high humidity, it can withstand a four-month dry period with very low rainfall. In natural forest, bush butter tree is associated with other native tree crop species such as African palm oil (*Elaeis guineensis*), cola nut (*Cola* spp.), wild coffee (*Coffea* spp.) and timber-producing species such as African pearwood (*Baillonella toxisperma*), and ayous (*Triplochiton scleroxylon*). In agricultural production systems bush butter tree is often associated in the upper strata with other fruit trees such as mango (*Mangifera indica*), bush mango (*Irvingia gabonensis*), bitter kola (*Garcinia cola*), and cola nut, in the lower strata with cocoyam (*Xanthosoma sagittifolium*) and taro (*Colocassia esculenta*) and in the middle strata with coffee and cocoa.

Reproductive biology

The species is generally dioecious, i.e. separate male and female flowers on different trees. Female and male trees may sometimes have flowers that are both male and female. Each tree produces flowers for about one month but individual trees begin flowering at different times so within a population, flowering occurs over a three-month period. Pollen from an individual flower has a short viable period. It is usually released for about two hours in the morning and insects, including bees, are active pollinators during that period and for about two hours following the pollen release.

© J. KENGUE

© J. KENGUE

Isolated flowers that are both male and female have been observed to bear fruits that mature normally. Seeds from such fruits germinate satisfactorily and result in vigorous seedlings, indicating that the species may tolerate self-pollination. Cross-pollination between trees is essential for trees that have only female flowers.

Humans are likely the main seed disseminators. Birds such as toucans and parrots disseminate seed in the wild.

Phenology

Trees grown from seed flower after 3-6 years depending on the local conditions of climate and soil, farming systems and management practices. Trees propagated vegetatively, by air-layering (marcotting), may flower as soon as two years after planting.

In mature trees, flowering occurs after two months of water stress. The timing differs on each side of the equator. In Cameroon, flowering occurs in December, January or February at the peak of dry season periods in bush butter tree cultivation areas. Flowering is early in the coastal area and late in Western Highlands. Fruit ripens from June to November north of the equator and from December to April south of it.

Fruits mature 3-4 months after flowering. In Cameroon, fruits are available from May to October with a production peak from late July to early August. In adult trees, a year of high fruit production is followed by a year in which fruiting is poor; fruit production may be low for two or more years, depending on tree vigour.

Related species

The genus *Dacryodes* has been subdivided into 3 sections and 34 species. The three sections are:

- Section *Pachylobus* in tropical Africa, with 19 species.
- Section *Archidacryodes* in the Americas with two species in the Antilles and Peru.

- Section *Curtisina* in Indo-Malaysia with 13 species.

Among the 19 species of genus *Dacryodes* currently identified in Africa, 11 are found in Gabon. Gabon thus seems to be the centre of diversity of *Dacryodes* spp.

Nine other *Dacryodes* species other than bush butter tree are found in Cameroon, of which seven are common: *Dacryodes macrophylla*, *Dacryodes buettneri*, *Dacryodes camerunensis*, *Dacryodes ledermanii*, *Dacryodes klaineana* and *Dacryodes villiersiana*.

Morphological traits and their variation

The bush butter tree is an evergreen that can reach a height of 25–40 m in natural forest. It has a tall, dense crown and compound leaves with 5–8 pairs of leaflets.



Morphological variation in fruit size, shape and colour

© J. KENGUE

Fruit characteristics vary but fruits are usually ellipsoidal, approximately 5–6 cm in length and dark purple when ripe. Fruit weight, shape and skin colour differ greatly among provenances.

Crown shape ranges from conical to rounded. This is largely determined by the angle between trunk and branches. The leaf surface texture and colour varies among individuals from glossy to matt and from light green to dark green.

Genetic knowledge

Phenotypic variation of fruit traits has been well studied in bush butter tree but there are no published accounts of analyses based on common garden studies, where genetic effects can be separated from environmental effects using statistical methods. There are also no published studies of the tree's molecular genetics. Field trials are now underway in several countries and should provide valuable information on genetic variation in the future.

High levels of phenotypic variation in traits expected to be influenced more by genes than environment— such as early fruiting, fruit taste and size— are observed between different populations and it is clear that farmers have been selecting trees on the basis of such traits for generations.

Local practices

The bush butter tree has been valued by rural people for centuries leading to an extensive body of knowledge as well as various myths.

Women and men have traditionally had different roles in using and managing the species. For example, a study in Cameroon found that women are mostly involved in retail selling, while men deal mainly with wholesale business.

The degree of variation in traits among populations of planted trees associated with villages indicates that these populations could be considered to be a collection of cultivars resulting

from selections made by farmers over many generations in particular ethnological contexts (local uses, tastes and local production systems). The current populations are relevant to local population preferences and adapted to local agronomic requirements.

In general, at the local population level, the most important selection criterion is fruit flavour. Trees bearing small fruits with good flavour are preferred to those bearing large but less tasty fruits. Fruit size, skin colour and pulp thickness are important selection criteria for market purposes.

Examples of local beliefs and myths regarding bush butter tree include those of the Bamileke ethnic group in Cameroon. The Bamileke believe that if women climb on the trees when harvesting fruit, the next year's production will be very poor quality. Therefore only men are allowed to climb the trees. They also believe that when a person plants a seed they should sit on the soil so the future tree will branch very early and produce abundantly.

A belief that could hamper domestication efforts is that planting a whole fruit without removing the pulp will ensure that the resultant tree will have the characteristics of the mother tree. However, safou seeds must be planted with the root pole pointing downwards to facilitate germination. Seeds planted 'upside down' may not germinate or give rise to deformed seedlings. Since it is difficult to determine the correct orientation of the seed with the pulp still on, sowing seeds with the pulp can result in a lower germination rate.

Threats

The bush butter tree does not appear to be seriously threatened as a species, but wild populations are declining in many areas due to deforestation and forest degradation. Traditional agricultural practices that have contributed to safeguarding the genetic diversity of bush butter tree include the maintaining or introducing useful food trees in crop plantations and the use of such trees for shade in cocoa and coffee

plantations. However, these practices are giving way to intensified agriculture because of demographic pressure and international influences.

Conservation status

The high local demand for fruit and farmers' interest in domestication encourage conservation of bush butter tree genetic resources. Current selection and improvement programmes are small-scale and geographically dispersed, resulting in maintenance of much of the natural genetic variation.

The seed is recalcitrant so cannot be stored using conventional methods in a seed bank. However *ex situ* conservation plantations have been established in a number of locations. In Cameroon, field genebanks were established at Nkolbisson (humid forest with bimodal rainfall) and Barombi-Kang (humid forest with unimodal rainfall), with a total number of 132 accessions collected in Cameroon and few from the Brazzaville area of the Congo.

The number of wild populations that are adequately protected in reserves or parks is unknown.

Management and improvement

Usually, when the forest is cleared for agriculture, bush butter trees are saved and



Marcotting (air layering)



Young plant from marcotting (air layering) showing early branching

© J. KENGUE

protected for their edible fruits and for the shade they provide to crops. Trees are also commonly cultivated in association with coffee or cocoa. They are not systematically pruned but lower branches may be removed to reduce shade on associated crops species.

Selection and domestication

Farmers have selected trees for centuries, commonly removing trees with low yields or poor-quality fruits. Trees that have mostly or all male flowers are frequently eliminated, which results in reduced genetic diversity as subsequent generations of trees become more closely related because of the reduction in the number of male parents. Populations have become adapted to the local agronomic requirements and users' preferences.

More than 30 years ago, the Cameroon national agricultural research institute (IRAD) started a selection and tree improvement programme. Although the potential for improvement is recognized, the selected trees were not tested in genetic field experiments and seed orchards have not been established.

Propagation from seed

Planting seeds is by far the most common form of propagation. Fresh seeds have a germination rate of more than 95%, but this falls rapidly; when removed from the pulp and stored under ambient conditions, the germination rate



© J. KENGUE

Two year old plant from marcotting (air layering) with fruits

drops to 25% after seven days. By 14 days the seed completely loses viability. Thus it is essential to plant only fresh seed.

Vegetative propagation

The main advantage of vegetative propagation is to duplicate the genotype of a tree with superior traits. The most successful vegetative propagation method is air layering (or marcotting), which can be done in small community nurseries.



© J. KENGUE

Grafted plants

Propagation from cuttings gives good results with only juvenile material and thus has no advantages, given that juvenile material is genetically and morphologically an unknown quantity.

Guidelines for conservation and use

Circa situ conservation is the most promising approach to conserving bush butter tree genetic resources. Improvement programmes should be small, localized and influenced by local farmer preferences in order to maintain a broad genetic base. Farmers should be encouraged not to eliminate male trees in cultivated populations to maintain the genetic diversity. Care should be taken to avoid excessive use of vegetative propagation to multiply and establish only a few clones.

Ex situ conservation efforts should be expanded to collect and maintain genotypes that have superior fruit qualities and to sample trees growing in environmental extremes.

Research needs

- Determine the number of viable populations in protected natural areas such as national parks and forest reserves and determine the effectiveness of *in situ* conservation
- Develop protocols for *ex situ* storage (overcoming difficulty posed by recalcitrant seed)
- Determine genetic variation in drought tolerance and location of important sources of variation
- Determine genetic variation in tree growth and fruit production
- Determine effective population sizes in semi-natural farmland populations and minimum viable populations for conservation and long-term sustainable use. ■



Dacryodes edulis Bush butter tree

Bibliography

This leaflet was produced by members of the SAFORGEN Food Tree Species Working Group. The objective of the working group is to encourage collaboration among experts and researchers in order to promote sustainable use and conservation of the valuable food tree species of sub-Saharan Africa.

Coordination committee:

Dolores Agúndez (INIA, Espagne)
Oscar Eyog-Matig (Bioversity International)
Niéyidouba Lamien (INERA, Burkina Faso)
Lolona Ramamonjisoa (SNGF, Madagascar)

Citation:

Kengue J, Kengni E and Tabuna H. 2011. *Dacryodes edulis*, bush butter tree. Conservation and Sustainable Use of Genetic Resources of Priority Food Tree Species in sub-Saharan Africa. Bioversity International (Rome, Italy).

- Awono A, Ndoye O, Schreckenber K, Tabuna H, Isseri F and Temple L. 2002. Production and marketing of safou (*Dacryodes edulis*) in Cameroon and internationally: Market development issues. *Forests, Trees and Livelihoods* 12:125–147.
- Degrande A. & Kengue J. 2003. African Plumb. *Dacryodes edulis*. Compilation of Technical Notes. R7187 Forestry Research Programme, Department for International Development, UK.
- Eyog Matig O, Ndoye O, Kengue J and Awono A, editors. 2006. Les fruitiers forestiers comestibles du Cameroun. International Plant Genetic Resources Institute, Rome, Italy. 204 pp.
- ICUC. 2001. Fruits for the future. Safou. Factsheet 3. International Centre for Underutilized Crops, University of Southampton, UK. Available at: <http://www.icuciwmi.org/files/News/Resources/Factsheets/dacryodes.pdf>. Accessed 17 February 2010.
- Kengue J. 2001. Guide de la culture du safoutier. Editions CLÉ, Yaoundé, Cameroun. 55 pp.
- Kengue J. 2002. Safou (*Dacryodes edulis* G.Don.). Fruits for the Future 3. International Centre for Underutilized Crops, University of Southampton, UK. 147pp. Available at: http://www.icuc-iwmi.org/files/Publications/Safou_Monograph.pdf. Accessed 17 February 2010.
- Kengue J and Nya Ngatchou J. 1990. Problème de conservation du pouvoir germinatif chez les graines de safoutier. *Fruits* 45(4):409–412
- Kengue J, Tchuenguem FN and Adewusi HG. 2002. Towards the improvement of safou (*Dacryodes edulis*): population variation and reproduction biology. *Forests, Trees and Livelihoods* 12:73–84.
- Mbofung CMF, Silou T and Mouaragadja I. 2002. Chemical characterisation of safou (*Dacryodes edulis*) and evaluation of its potential as an ingredient in nutritious biscuits. *Forests, Trees and Livelihoods* 12:105–117.
- Verheij EWM. 2002. *Dacryodes edulis* (G.Don.) H.J.Lam. [online]. Record from Protabase. Oyen LPA and Lemmens RHMJ, editors. PROTA (Plant Resources of Tropical Africa/Ressources végétales de l'Afrique tropicale), Wageningen, The Netherlands. Available at: <http://database.prota.org/search.htm>. Accessed 17 February 2010.

ISBN: 978-84-694-3166-5

