

REFERENCES

BAOBAB
MONKEY'S BREAD
MBUYU (Swahili)

Adansonia digitata or Sito, Baobab

1. Trees, shrubs and climbers of the Bijilo Forest Park.

Very large swollen looking tree with gnarled branches and smooth grey bark. The leaves are palmately lobed with 5-9 smooth leaflets on long leaf stalks. Flowers are large, fleshy and white with a projecting fringed staminal tube and bloom from August to October. Fruits are also large, hard, boat shaped structures covered with green, felty, irritating hairs. The dry, white fibrous fruit pulp can be cooked into a juice for drinking, while the bark is stripped for fibre.

2. In a conversation with Dr. Malcom Stuart. He remarked that the outer seed case contains very high levels of tartaric acid. This is stripped off in order to get to the pod which contains the seed oil.

3. In a data sheet from A&E Connock. we read of *Adansonia digitata* (Bombacaceae). It is known as Baobab, Monkey's Bread and Mbuyu (Swahili).

This is a deciduous tree that occurs throughout Africa, especially in East Africa. It is reputed to have the thickest trunk and to be the longest-lived of any tree in the world and is known to achieve ages of over 2,000 years or up to 3,000 years.

The fruit is seasonal and usually appears in June or July.

Botany

This massive tree grows to a height of about 16 m and has a disproportionately large, fibrous trunk with a smooth grey surface and stout, twisting branches. Because of its scattered distribution and the fact that the branches look much like roots gave rise to the Taita legend that it was uprooted by a furious deity and planted upside-down.

The fruit is contained in a greenish, hard, oval pod about 25cm long. When cracked open the pod reveals a number of bean-sized seeds embedded in fibre and a dry cream coloured powder known as "cream of tartar".

Traditional uses

There are a number of myths and beliefs amongst the people who live in baobab-country and the tree is considered sacred by many. The people of Tharaka and Meru (Kenya) never cut down young plants and the old trees are never debarked for fear of failure of the rains. The Giriama people regard the trees as sacred and peaceful and believe that misfortune awaits anyone who cuts or slashes its trunk. The valley tribes of Zimbabwe believe that the spirits live in the white flowers and that anyone who picks one will be eaten by lions within the year.

Another common belief is that the old trees are consumed by fire and there have, indeed, been reports of spontaneous combustion. However, the most common cause of the death of the Baobab is eventual collapse due to elephant damage or a virus.

The bushmen of Southern Africa say that Gawe, the Great Spirit, gave all the animals a particular species of tree except the hyaena. He told the hyaena that he would not be given one unless he behaved properly and stopped stealing. The hyaena was angry and resolved not to change his ways. The Great Spirit finally gave him his last, tiny Baobab plant. The hyaena was not impressed and became angry and, in a fit of temper, planted the seedling upside down.

Another Southern African myth is as follows:

"The soul walks like a shadow behind its caretaker, who must attend to its every whim. When the caretaker dies he passes both his own soul and the attendant spirit on to the next-in-line. A man may thus acquire a collection of souls.

To ensure that this train does not become too long and unwieldy, long-dead ancestors are dropped out of the shadow after a few generations and take up residence in the Baobab tree. The tree often forms an integral part of village life where tribesmen look forward to joining their ancestors among the boughs of the tree. So the dead and the living mingle happily together with the Baobab forming the centre of their world."

In the 17th century a Va-Mbara chieftan, called Chief Chidzere migrated with his people, for the second time, from Zambia to the south bank of the Zambezi. He came into conflict with Chief Dandawa who had himself moved up from the central plateau. They came into conflict and at the ensuing battle Chief Chedzere was killed and Zimbabwean folklore has it that he turned into a Baobab tree.

[Excerpts from "The Zambezi, River of the Gods"]

The pulp or powder of the fruit is dissolved in water, the seeds are sieved off and the remaining "mboga" sometimes mixed with coconut juice or milk or added to a porridge.

The powder is also mixed with fig latex and used as a birdlime.

The tuber-like root tips are cooked and eaten in times of famine and the young leaves cooked as a vegetable, mixed with other vegetables.

The seeds are roasted like groundnuts or, when still pulp coated, are coloured and sold as sweets in coastal towns. In times of famine the Wagogo of Tanzania pound the seeds as a food source and, in happier times, extract the oil from the seeds (see below).

Pod shells are used for fuel wood, containiers and for making a variety of items including rat-traps. Burnt, they give off a dense, acrid smoke used to passify bees when honey is taken from a hive.

When softened, the fibre from the trunk is used as string and woven into mats and baskets,. The bark is used as a roofing material and as walls in temporary shelters.

The traditional method of oil extraction is by pounding the seeds. The oil thus produced is used as a rub to relieve aches, pains and rheumatism, but more especially, to treat skin complaints such as eczema and psoriasis.

4. In the Air Malawi Reflections magazine (Summer 1993). We read that the Baobab, *Adansonia digitata*, grows mainly in hot low-lying areas with little rainfall such as the littorals of Lake Malawi, Lake Malombe and the Shire Valley. It is also found around Lakes Chirwa and Chiuta. The fruits appear from April to September.

The fruit and seeds used as a dysentery remedy (Central Africa). Leaves are used as prophylactic against malaria in Sierra Leone.

The pulp is edible and makes a refreshing and cooling drink with water. A fluid obtained by kneading the pulp in water is used for dilution of milk among the Fulani. The young shoots are edible. The trees grow in extremely dry surroundings and stores much water. The fruit is an important source of ascorbic acid (vitamin C) offering 2.73mg/100g fresh fruit.

5. Bep Oliver: Medicinal Plants in Nigeria - being a course of four lectures delivered in April 1959 in the Pharmacy Department of the Nigerian College of Arts, Science and Technology, Ibadan. Published as a private edition 1960 by the Nigerian College of Arts, Science and Technology.

Adansonia digitata is Baobab or Monkey Bread.

A characteristic tree of the North with enormous trunk and a small crown of digitate leaves.

The bark of this tree provides a bast fibre, the fruits and seeds a food or beverage and the leaves a soup vegetable and horse food. In local medicine the bark is used as a diaphoretic and febrifuge, and the pulp and seeds in the same way and as an anti-dysenteric. A decoction of the fibres lining the fruitshell is given for amenorrhoea (Sebire; Dalziel). The leaves find use as a diaphoretic and in the treatment of excessive perspiration (S. Leone), in kidney and bladder diseases and for asthma; their analysis reveals tannins, potassium tartrate, catechins and a flavonic pigment: adansonia flavonoside. Their mucilage contains galacturonic acid and rhamnose. Paris and Moyse Mignon; *Ann. Pharm. Franc.*, 1951,**9**,472.

The leaves have hypotensive and antihistaminic properties and the leaf-powder has been suggested as an anti-asthmatic (D. Vincent, P. Brygoo, I. Sero, *Presse Med.*, 1946,**54**,630)), but this use could not be confirmed (Caiment Leblond).

6. 2. Leyel (B10) says that the order contains the largest tree known, the Baobab tree, *Adansonia digitata*. The plants in this family are chiefly shrubs which produce gums valued for their medicinal properties and economic use. the woolly cooton in which the seeds of these plants are enveloped is so soft that it makes excellent stuffing for cushions and mattresses, and it has the merit of remaining smooth and not forming into lumps.

The leaves when dried are made by the natives into a preparation called lalo, which reduces perspiration.

7. Anti-infectious phytotherapies of the tree-savanna, Senegal (West Africa) III: a summary of the phytochemical substances and the antimicrobial activity of 43 species. Alternative title: Les phytotherapies anti-infectieuses de la foret-savane, Senegal (Afrique occidentale) III: un resume des substances phytochimiques et l'activite antimicrobienne de 43 especes. Journal-of-Ethnopharmacology. 1989, 25: 3, 315-338; 143 ref.

Author: Grand,-A-le; Le-Grand,-A. Address: Centre of Biopharmaceutical Sciences, Department of Pharmacognosy, University of Leiden, Leiden, Netherlands.

LA: French. LS: English

Abstract

The results of a literature survey of the ethnobotanical and pharmacological data concerning 43 species used by the Diola against fungal and bacterial infections are presented. The plants, their medicinal uses, known constituents and antimicrobial activities are listed. The traditional uses of 10 species (*Adansonia digitata*, *Azadirachta indica*, *Carica papaya*, *Cassia tora*, *Fagara* [*Zanthoxylum*] *leprieurii*, *Guiera senegalensis*, *Khaya senegalensis*, *Mangifera indica*, *Psidium guajava* and *Voacanga africana*) were clearly associated with the presence of pharmacologically-active substances.

8. Medicinal plants of the tree-savanna. Part 3. Evaluation of the use and therapeutic value of some fifty medicinal plants. Alternative title: Les plantes medicinales de la foret-savane. Partie 3. Une evaluation de l'emploi et la valeur therapeutique reelle d'une cinquantaine de plantes medicinales.

Author: Grand,-A-le. SO: 1985, 68pp.; 17 pp. of ref. Amsterdam, Netherlands; Amsterdam University. 1985. Language: French

Abstract

Plants which could provide substitutes for imported western drugs were sought. Information from the literature (on medical activity, chemical composition, anti-microbial properties and possible medical uses) is compared with actual use by the Diola. Plants considered include *Ipomoea batatas*, *Erythrina senegalensis*, *Elaeis guineensis*, *Adansonia digitata*, *Azadirachta indica* and *Carica papaya*. Vernacular names are given.

9. H.M. Burkill: The useful plants of West Tropical Africa. Edition 2. Vol. I. Families A-D. Royal Botanic Gardens Kew. 1985. ISBN No. 0-947643-01-X. Burkill refers to *Adansonia digitata* Linn. as baobab, monkey-bread tree, sour gourd; cream of tartar tree.

A tree to about 15m high, with an enormous squat trunk to 20 m girth or more. The name baobab arises from the Arabic *bu hibab*, meaning fruit with many seeds. Its first mention in European literature is in Alpino (Venice, 1592): *de Plantis aegypti liber*, as ba hobab, referring to the fruits commonly sold in Egypt for their edible pulp. From this it must appear to have entered western European languages as baobab, though to Adanson (1727-1806), whose name the genus bears, it

was known as *arbre aux calabasses* (Calabash tree).

The wood is light and spongy. It is not durable and easily attacked by fungi with the result that local uses are rare. Furthermore, the shape of the tree does not make felling easy: an axe is more likely to bounce off the wood than to cut into it. A Hausa epithet for the wood, *fanko*, means good for nothing! The wood makes poor firewood unless thoroughly dried out. It is not even very good for paper making, and makes only a poor charcoal. It can be burnt for its vegetable salt. A good tree may hold a 1000 gallons of water, and girth may vary according to weather conditions.

The odd appearance of the tree has resulted in magical and superstitious uses. In Upper Volta it is left standing as a fetish tree. Primitive tribes of N. Nigeria reverence it by cutting symbols in the bark. The hollowed out trunk has been used as a tomb, and a place where a body is suspended between earth and sky for mummification.. In places it is worshipped as a fertility symbol. Rock-art in the Limpopo Valley depicts women's breasts as baobab pods. In Upper Volta children of the *Ela* born under the sign of this tree (*kukulu*, Lyela) are given the patronymic *kukulu*, boys, or *ekulu*, girls.

The bark contains a quantity of edible, insoluble, acidic tragacanth-like gum. This is used for cleaning sores. The bark has medicinal properties as a febrifuge in West Africa and in other parts of the world. It has been used as a quinine substitute. It has been imported to Europe as *cortex cael cedra*. It is diaphoretic and anti-periodic. Its benefit as a febrifuge has not been detected in experimental malaria. It has a bitter taste. An unnamed alkaloid is recorded as present, and also the presence of the alkaloid, adansonin, but examination of Nigerian material gave inconclusive results on the presence of alkaloids. Adansonin has a strophanthin-like action, yet in E. Africa the bark is said to be antidotal to *Strophanthus* arrow-poison. In some countries the bark is used for tanning. In Congo the bark decoction is used to bathe rickety children, and in Tanganyika as a mouthwash for toothache. A soap lye can be made from the bark ash, and the ash of all parts has a value as a fertiliser.

The leaves, and especially the young leaves, are a popular item of diet as a spinach or to make soups and sauces. In some parts the trees are pollarded so as to produce an abundance of young leaves.

The most common use of the leaves is to dry and powder them in to an article known throughout much of West Africa as lalo. the leaves are rich in mucilage containing uronic acids, rhamnose and other sugars. Tannins, potassium tartrate, catechins and a flavonic pigment, Adansonia flavonoside, are also present.

On alkaline soils at least, if not on others, the leaves contain high calcium content. It is said that the Dakaraise consume 35-49g of lalo daily providing an adequate calcium intake. The fresh leaf is rich in vitamin C, but this is lost on drying in producing lalo. Lalo is a term applied to other similar ingredients used as food, condiment and seasoning. It is also used to denote medical preparations based on the dried leaf. The leaves have hypotensive and antihistaminic properties. They are diaphoretic and promote sweating, but are recorded also to treat excessive perspiration.

General applications of the leaf are for kidney and bladder diseases, asthma, general fatigue, tonic,

blood cleanser, prophylactic and febrifuge, diarrhoea, inflammations, insect bites, expulsion of guinea worm, internal pains and other affections. Dysentery is treated by mouth or in hip-baths, and asthma, sedation, colic, fevers, inflammations, diseases of the urinary tract, ear troubles, backache, ophthalmia, wounds and tumours, respiratory difficulty, etc., are treated by lalo by mouth or in liquid preparations.

The leaves are browsed by stock, and are fed to horses. In Nigeria the leaves are the most usual ingredient of a horse food, which is given in large quantities is said to keep a horse in good condition on a journey. Given in smaller amounts it is tonic, blood-making, and good for subcutaneous swellings caused by insect-bites.

The roots may be cooked and eaten as food. The dried powdered root is prepared as a mash which is taken for malaria, perhaps as a tonic. The roots are used in E. Africa to yield red dye.

The pods, or more correctly the mealy fruit pulp within them, are the Monkey Bread. They are of various shape, subspherical to ovoid, 15 to 35 cm long by 7-15 cm in diameter. The husks are good for burning and a potash-rich vegetable salt may be obtained from the ash which is usable for making soap. The powdered husk or the powdered peduncle may be smoked like tobacco. The whole husk can be used as a dipper or to hold liquids and is sometimes fashioned as a snuff box. Fibres lining the inner surface of the husk are given in decoction to treat amenorrhoea.

The seeds are embedded in the dry acidulous mealy pulp which is rich in mucilage, pectins, tartrates and free tartaric acid. The presence of tartrates gives rise to the name "Cream of Tartar tree". Calcium and, when eaten raw, vitamins B and C are abundant. It is important in diet as a seasoning and appetiser, and in time of dearth is eaten as a foodstuff.

It has medicinal uses as a febrifuge and antidiysenteric. It appears in small-pox and measles treatment as an eye-distillation.

The pulp burns with a smoke which can be used for preserving and drying fish. Its acrid smell is also useful to drive away stinging insects troublesome to stock.

The seed-pods are burnt as a fuel in N. Nigeria and the ash used to make soap. The white mealy substance surrounding the seeds when soaked in water produces a milky solution which is taken as a milk substitute.

The kernel is rich in protein and thiamine, 100 g daily is an adequate human adult requirement. Oil content by ether extraction is recorded as 68% of the kernel. The oil is non-drying and consists of stearic, palmitic and oleic acids. The kernel is free of starch, alkaloid and cyanogenetic glycosides. The oil can be obtained by boiling it off and this has uses for gala occasions in Senegal. Roasted seeds are crushed to a paste which is applied to diseased teeth and gums. When burnt, a potash-rich salt can be got from the ash suitable for soap making.

The white shoot of the germinating seed and the roots of very young seedlings are edible.

10. G.Wood and F.Bache. The Dispensatory of the United States of America. 15th edition. 1883.

J.B.Lippincott & Co. The U.S. Dispensatory 1883 refers to *Adansinia digitata* as Baobab. The leaves and bark of the tree abound in mucilage, and have little smell or taste. By the Africans, the leaves are used as a diaphoretic, and the subacid pulp of the fruit in dysentery. The bark is highly commended by some as an anti-periodic.

11. D.M.A. Jayaweera: Medicinal Plants used in Ceylon Part 1. National Science Council of Sri Lanka. Colombo 1981

Adansonia digitata Linn. or Baobab tree, African Calabash, Monkey Bread, Cream of tartar Tree. Grows in the dry, arid regions of Northern and Southern Rhodesia, Nyasaland and cultivated in various parts of India and Ceylon. In Ceylon, it has been planted in Mannar, Batticaloa and Peradeniya.

Composition: The bark contains a crystalline bitter principle, adansonin, which has a strophanthus-like action and the fruit, free tartaric acid, potassium bitartrate, pectic substances, proteins, sugars, citric acid and a bitter principle. The fruit pulp has a high ascorbic acid content. The leaf abounds in mucilage and contains sodium chloride, potassium acid tartrate and tannin. The soft, oily kernel of the seed contains a fixed oil.

Uses: The leaves are considered an emollient, diuretic and febrifuge. In Ghana, the bark is used as substitute as quinine in cases of fever. The pulp of the fruit is given for pestilent fevers and as an astringent in diarrhoea and dysentery. In Southern Rhodesia, the leaf is eaten as a vegetable, while in Central Africa it is used as a diaphoretic against fevers. The seed is a remedy for dysentery. In Messina, the powdered seed is given for hiccough in children.

12. Abbiw, D.K.: Useful plants of Ghana - West African use of wild and cultivated plants. Intermediate Technology Publications and the Royal Botanic Gardens Kew. 1990. ISBN No. 1-85339-043-7 or 1-85339-080-1 (Hardback). Abbiw says that it is a bast fibre plant, a wild edible fruit, a source of drinking water from the stem, as well as a coagulant for rubber. It is also considered a wild vegetable, like spinach, as well as a sweet beverage, a fodder plant for horses, an oil crop plant, for basket making. A decoction of the roasted seeds is used for diarrhoea and dysentery. The leaf decoction is used for earache and otitis (inflammation). The leaf or bark infusion is used as a febrifuge, and for swellings. The powdered or mashed leaves for guinea worm sores. The decoction of the fruit fibres for menstrual problems. A thick emulsion of the fruit pulp for smallpox, put on the patient's eye several times a day. The roasted pulverised seed and latex for toothache. The bark is used as an antidote to arrow poison.

The leaves yield tannin. The seed, shell, and bark ashes yields source of potash for soap making.

13. Hepper, F.N.: The West African Herbaria of Isert and Thonning. Royal Botanic Gardens Kew. 1976. No ISBN number. Hepper says that the inhabitants in Ashanti, Akim, Aquapim always bury their principal dead secretly and often in this tree especially in times of war, when they fear that the enemy will discover the body and keep the bones on his drums as a sign of victory and of his enemies' disgrace. The inhabitants declare that the body is dried without putrefaction in this tree; at old age the trunk is hollowed out and the body lowered into it. The wood is loose and useless even for burning. The mealy acid substance which surrounds the seed is eaten by the

natives. The whole fruit is burnt to an ash and used with boiled palm oil for soap making.

14. Margaret Roberts: Indigenous Healing Plants. Southern Book Publishers. 1990. ISBN No. 1-86812-317-0. Roberts refers to *Adansonia digitata* as Crewam of tartar tree, lemonade tree, Monkey Bread Tree. In Afrikaans as Broodboom, kremetartboom, bobbejaanbroodboom. In Zulu as Isimuhu, umshimulu.

The baobab grows in frost-free, tropical zones; the northern and eastern areas of the transvaal and up through Botswana, Zimbabwe, Namibia and Zambia. It flourishes in hot dry areas and is a remarkable source of water in desert regions. A tree can hold 1000 gallons of water.

The bark on the great bole is pinkish grey and smooth and contains a tragacanth-like gum, and is thick with mucilage. Although bitter in taste it is nevertheless used as a food by the indigenous people. It has been used commercially as a medicine - it is excellent for bringing down fevers, and some tribes believe it to be a cure for malaria. It can be made into rope and cloth mats, baskets and sacking.

The long pink ribbons from the inner bark yield a pulp which can be used for paper making.

The wood is salty when burnt to an ash and is thus valuable to tribes who have little contact with civilisation and thus no access to salt. It is also nourishing when mixed with food.

The leaf is edible, and is a valuable medicine. It can be eaten fresh or made into a spinach, the latter being most common. The water in which it is boiled is taken a little at a time to bring down a fever, and for chest ailments, coughs and asthma. The leaf contains tannin, mucilage, sodium chloride and potassium acid, and is therefore valuable for treating fevers and to check copious perspiration. It is also used by some tribes as a poultice around the chest and on sores and scratches.

Exquisite large white flowers are produced in the summer. They have a strong unpleasant scent.

The large, hard-shelled fruit follow the flowers, and is about 12 cm long, ovoid and covered in yellowy-grey fine hairs. The seeds are embedded in a white, powdery pulp, which contains tartaric acid (hence the name of Cream of Tartar tree). They are refreshing to suck, and when boiled or soaked in water make a pleasant lemony flavoured drink that is taken to bring down fevers and relieve colds.

15.

MEMORANDUM

To: The Department of Women's Arrairs, The Office of the President
From: Cyril Lombard & Mara Amats

Marketing Indigenous Wild Plants of Namibia

BAOBAB (*Adansonia digitata*)

This giant "up-side-down" tree needs little or no introduction. In Africa it occurs from Ethiopia in the north to northern Transvaal in the south. This is another excellent multi-purpose tree that should be fully utilised. The pulp of its bulbous fruit has one of the vegetable kingdom's highest vitamin C content, in excess of 10 times per 100g compared to oranges. It also contains enough pectin to set jam and to curdle milk. The baobab probably has more traditional uses than any other tree in the world. The fruit pulp, seeds, leaves, flowers and young shoots are all edible. The oil from the seed is good for cooking and for cosmetic uses. The roots yield a red dye. The bark, leaves and roots have dozens of medicinal uses. The seeds are high roasted and used as a coffee substitute. The bark fibres are used for cordage, mats, weaving, clothing and have even been used to make bank notes. The wood is light and spongy and used for canoes and household products. The hollowed trunks have been used to store up to 9000 litres of water, used as dwellings, tombs and even bars.

Scientific research has established that baobab fruit pulp is rich in carbohydrates, energy, calcium, thiamin, nicotinic acid and extremely rich in potassium and vitamin C. We are therefore going to market the dried "cream of tartar" as a nutritional supplement. The pulp is also packed with pectin and we are investigating the possibilities of developing gelling agents from it. Research also suggests that baobab fruit pulp could be used to manufacture a very pleasant and nutritious soft drink. We are eager to pursue this novel marketing possibility. We are also interested in the seed (nuts) from baobab. They have an excellent nutritional profile, make good eating and the oil expressed from them is clear and high in oleic and linoleic acids. Because of this tree's fame and legend we feel that the nutritional supplement, cosmetic and massage lotion options would be the most suitable avenue for this oil. The possibilities of producing fine quality speciality papers from the bark will be investigated. We will keep abreast with research into the medicinal properties of the baobab so that should a demand be created for it we would be in a position to supply the market. The feasibility of air freighting fresh young leaves to Europe as an exotic salad vegetable will be followed up.

In Namibia baobab occurs in much of Ovamboland. Its distribution partly coincides with that of marula but is also found further north. Communally based groups in Ondangwa, Oshakati, Okahao and further north in Ruacana and surrounding areas will be involved with the harvesting and supply of baobab products.

16. G.E. Wickens: The Baobab- Africa's upside-down tree. Reprint from Kew Bulletin Vol.37. No.2 (1982). Wickens refers to *Adansonia digitata*.

Baobab fruits were apparently known to the ancient Egyptians, although the tree is not native in Egypt. The fruits have been reported from their tombs, but unfortunately no-one recorded in which the fruit were found, and the museums of Paris and Turin, said to have been the depositories for this material, cannot confirm that the fruits still exist. Such fruits must have been rare; there is no mention of the baoba in any of the more recent works on plants in ancient Egypt.

The baobab (fruit?) referred to in inscriptions near Aswan of a caravan-leader named Harkhuf (ca 2500BC), although present day translations make no mention of it.

In 1592, the Venetian herbalist and physician Prospero Alpino wrote that the fruit was known in those markets under the name *bu hobab*, which gave rise to the common European name baobab. One Cairo botanist, the late Mohammed Drar, suggested a derivation of *baobab* from the Arabic *lobab* or *lobb* referring to the fruit pulp, once used in medicine. However, the Arabs do not now call the tree by this name, and it is more likely *bu hibab* - 'the fruit with many seeds'. Trees cultivated in Egypt are known as *habhab*. In the Sudan the common Arabic vernacular name is *tebeldi*, more rarely *homeira* or *humr* on account of the reddish tinge to the bark; the fruit is known as *gongoleis*.

15th century Portuguese travellers to West Africa knew the fruit as *cabacevre*, and the 17th century French as *calebassier*; it was the French botanist Michel Adanson who reapplied Alpino's name of *baobab* to the fruit and later to the genus itself.

The text continues with some more history.

Uses of the tree

Roots

In West Africa the roots are reputed to be cooked and eaten, presumably in times of famine. The Temne of Sierra Leone believe that a root-decoction taken with food causes stoutness. The dried powdered root prepared as a mash may be taken by malaria patients perhaps as a tonic.

In East Africa a soluble red dye is obtained from the roots.

In Zambia an infusion of the roots is used to bath babies in order to promote a smooth skin. The root bark is used as string or rope for making fishing nets, socks, mats, etc.

Hollow trunks

The hollow trunks can hold 400-2000 gallons of water. In the Sudan they place twigs of *Boscia senegalensis* or *Maerua crassifolia* (both of the Caper family, *Capparidaceae*) in the water. In the same place the trees are regarded as personal property, which may be inherited or sold, and the ownership of the various trees is kept in local government registers.

In West Africa the hollow trunks may be used as tombs. The reference continues with the use of the tree interior as a flush toilet, loom, prison, etc.

Bark

The bark fibres are commonly stripped from the lower trunk. Despite this injury, baobabs survive and regenerate new bark. Fibres used for rope, cordage, weaving, baskets nets etc.

The dried bark was once exported to Europe for the manufacture of packing paper, and since 1848 it has also been imported into Europe under the name *cortex cael cedra* and has been used in fevers and as a substitute for cinchona bark. Its benefit as a febrifuge, however, has not been detected in experimental malaria treatments, although it is both diaphoretic and antiperiodic. The bark is

certainly used for the treatment of fever in Nigeria.

The bark contains a white semi-fluid gum which oozes from wounds. The gum is odourless, tasteless, acidic and insoluble and is used for cleaning sores.

The bark tastes bitter; there are uncorroborated accounts of it being eaten in Senegal. As for whether the bark contains alkaloids there are conflicting accounts. One states that it contains the alkaloid *adansonin* which has strophanthus-like action - yet in East Africa the bark is used as an antidote to strophanthus poisoning! In Malawi the flesh of an animal killed by a poisoned arrow has the juice of the baobab bark poured into the arrow wound in order to neutralise the poison before the meat is eaten.

In some countries the bark is used for tanning. In Congo-Brazzaville a bark decoction is used to bathe children with rickets, and in Tanzania as a mouthwash for toothache. The ash from the bark and fruit boiled in oil is used as a soap.

Wood

The wood is sponge-like, making cutting difficult, it is not very useful.

Leaves

The young leaves are popular as a spinach; sometimes they are dried and powdered and made into soups and sauces. The trees may be pollarded in order to encourage an abundance of young leaves. They are also a fodder plant for stock, especially horses.

The fresh leaves are rich in vitamin C as well as containing uronic acids, rhamnose, and other sugars, tannins, potassium tartrate, catechins, etc.

The leaves are used medicinally as a diaphoretic, an expectorant, and as a prophylactic against fever, to check excessive perspiration, and as an astringent. The leaves also have hyposensitive and antihistamine properties, being used to treat kidney and bladder diseases, asthma, general fatigue, diarrhoea, inflammations, insect bites, guinea worm, etc. David Livingstone treated indolent sores with poultices of powdered baobab leaf; the success of the treatment may have been because the ulcers were of dietetic origin.

Flowers

The only recorded economic use of the flower is the mixing of the pollen with water to make glue.

Fruit

Why the fruit was brought to the ancient Cairo markets is not certain. In the late 16th century, the pith was regarded as a substitute for *terra lemnia*, an astringent medicinal earth from the Isle of Lemnos in the Aegean, and as such imported into Europe.

The husks of the fruit may be used as dishes or fashioned into vessels or snuff boxes; they are even used as fishing floats. They can be used as a fuel and provide (like the bark) a potash-rich ash suitable for soap making. The powdered husk or peduncle may be smoked as a substitute for tobacco, while the fibres lining the husk are used as a decoction to treat amenorrhoea.

The acid pith, which is rich in ascorbic acid is used as a substitute for cream of tartar in baking. It may also be ground and made into a gruel or prepared as a refreshing drink. The pith, though dry at first, has a pleasant wine-gum flavour once moistened in the mouth - this is much appreciated by the children. The pectin content of the fruit is low and of poorer quality than commercial pectin. Medicinally the pith may be used as a febrifuge and as an anti-dysenteric, and in the treatment of smallpox and measles as an eye instillation. The pulp is also used to curdle milk, and a decoction used to coagulate the latex of *Landolphia heudelotti*. The pulp is also used for smoking fish; the smoke's acrid smell also drives away insects troublesome to stock.

Both the pith and the seeds, like the bark, seem to contain an antidote to strophanthus poisoning and are carried by a special member of the Shangaan hunting party.

An emulsion of the pith is used by the Fulani herdsmen to adulterate milk, a popular drink with the Kaura farmers whom the Fulani supply.

The seeds have a relatively thick shell, which is not readily separated from the edible kernel; this limits their usefulness. The seeds may be eaten fresh or dry, either sucked, ground and used to flavour soups, or roasted to provide a substitute for coffee. The shoots and roots of germinating seeds and seedlings are also eaten.

An oil may be obtained by distillation of the seeds, which is used in Senegal on gala occasions. The crushed roasted seeds are applied as a paste to diseased teeth and gums. When burnt the seeds, like the junks, provide a potash-rich salt used in soap making.

The text goes on to describe the cultural importance.

17. Adesanya S A, Idowu T B and Elujoba A A (1988) Antisickling activity of *Adansonia digitata*. *Planta Medica*, 54(4): 374

The drinking of an aqueous extract of the bark of *A. digitata* is used in Nigerian traditional medicine as a treatment for sickle cell anaemia. The aqueous and methanolic extracts of the bark, as well as their ether fractions, were incubated with 2% sodium metabisulphite sickled washed HbSS blood samples. The results showed that the extracts possess reversal antisickling properties. However, no inhibitory antisickling activity was observed for any of the extracts when they were incubated with the HbSS blood samples for 6 h prior to deoxygenation by sodium metabisulphite. It is concluded that the low level of reversal activity compared to p-hydroxybenzoic acid and the absence of inhibitory activity *in vitro* do not justify the use of *A. digitata* for the prevention of sickling crises. Plant extracts from *Zanthoxylum xanthoxyloides* [*Z. zanthoxyloides*] and *Cajanus cajan*, which are not used by traditional medical practitioners, have been reported to possess both activities *in vitro*.

18. Andrianaivo-Rafehivola A A, Siess M H and Gaydou E M (1995) Modifications of hepatic drug metabolizing enzyme activities in rats fed baobab seed oil containing cyclopropenoid fatty acids. *Food and Chemical Toxicology*, 33(5): 377-382

The effects on drug metabolizing enzymes of cyclopropenoid fatty acids present in baobab seed oil were evaluated in rats fed either a diet with baobab seed oil (1.27% cyclopropenoid fatty acids in the diet) or a diet with heated baobab seed oil (0.046% cyclopropenoid fatty acids in the diet). Comparison was made with rats fed a mixture of oils that contained no cyclopropenoid fatty acid. Rats fed baobab oil showed retarded growth. In comparison with the other groups, the relative liver weights were markedly increased whereas cytochrome P-450 content and NADPH cytochrome c reductase and NADH cytochrome c reductase activities were decreased. In rats fed the heated baobab oil the relative liver weight was decreased and the cytochrome P-450 level and reductase activities were increased relative to levels in rats fed the unheated oil. Ethoxycoumarin deethylase, ethoxyresorufin deethylase and pentoxyresorufin deethylase activities, expressed on the basis of cytochrome P-450, were greater in the group fed unheated baobab seed oil. Cytosolic glutathione transferase activity was markedly decreased in rats fed fresh baobab seed oil and heating the oil, which reduced the content of cyclopropenoid fatty acids, led to a considerable increase of this activity. UDP-glucuronyl transferase activities were not modified by the type of oil included in the diet. It is possible that the mechanisms of action of cyclopropenoid fatty acids are related to alterations of membrane lipid composition or microsomal proteins.

19. Grand A le and Wondergem P (1985) Medicinal plants of the tree-savanna. Part 1. An inventory of phytotherapy among the Diola in southern Senegal. 50pp. Amsterdam University; Amsterdam; Netherlands

An inventory was made of 50 medicinal plants, each with a description and notes on local uses and preparation. The efficacy of about 30 species against microbial infection was confirmed in the laboratory; these species included *Adansonia digitata*, *Ceiba pentandra*, mango, oil palm, pawpaw, sweet potato [*Ipomoea batatas*] and guava.

20. Grand A le (1985) Medicinal plants of the tree-savanna. Part 3. Evaluation of the use and therapeutic value of some fifty medicinal plants. 68pp, 17 pp. Amsterdam University; Amsterdam; Netherlands

Plants which could provide substitutes for imported western drugs were sought. Information from the literature (on medical activity, chemical composition, anti-microbial properties and possible medical uses) is compared with actual use by the Diola. Plants considered include *Ipomoea batatas*, *Erythrina senegalensis*, *Elaeis guineensis*, *Adansonia digitata*, *Azadirachta indica* and *Carica papaya*. Vernacular names are given.

21. Locher C P, Burch M T, Mower H F, Berestecky J, Davis H, VanPoel B, Lasure A, VandenBerghe D A and Vlietinck A J (1995) Anti-microbial activity and anti-complement activity of extracts obtained from selected Hawaiian medicinal plants. *Journal of Ethnopharmacology*, 49(1): 23-32

Selected plants having a history of use in Polynesian traditional medicine for the treatment of infectious disease were investigated for anti-viral, anti-fungal and anti-bacterial activity in vitro. Extracts from *Scaevola sericea*, *Psychotria hawaiiensis*, *Pipturus albidus* and *Eugenia*

malaccensis showed selective anti-viral activity against Herpes Simplex Virus-1 and 2 and Vesicular Stomatitis Virus, *Aleurites moluccana* extracts showed anti-bacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa*, while *Pipturus albidus* and *Eugenia malaccensis* extracts showed growth inhibition of *Staphylococcus aureus* and *Streptococcus pyogenes*. *Psychotria hawaiiensis* and *Solanum niger* inhibited growth of the fungi *Microsporum canis*, *Trichophyton rubrum* and *Epidermophyton floccosum*, while *Ipomoea* sp., *Pipturus albidus*, *Scaevola sericea*, *Eugenia malaccensis*, *Piper melhysticum*, *Barringtonia asiatica* and *Adansonia digitata* extracts showed anti-fungal activity to a lesser extent. *Eugenia malaccensis* was also found to inhibit the classical pathway of complement suggesting that an immunological basis for its in vivo activity was identified. This study has confirmed some of the ethnobotanical reports of Hawaiian medicinal plants having curative properties against infections using biological assays *in vitro*.

22. Yazzie D, Vanderjagt D J, Pastuszyn A, Okolo A and Glew R H (1994) The Amino Acid and Mineral Content of Baobab (*Adansonia digitata* L.) Leaves. Journal of Food Composition and Analysis, 7(3): 189-193

The leaves of the baobab tree (*Adansonia digitata* L.) are a staple of populations in many parts of Africa, especially the central region of the continent. Among the people who comprise the Hausa ethnic group in particular, it serves as the main ingredient of a soup called "miyar kuka." However, the literature contains few studies of the nutritional quality of baobab leaf. In the present report, we show that baobab leaf contains 10.6% (dry weight) protein and an amino acid composition which compares favorably to that of an "ideal" protein: valine (5.9%), phenylalanine + tyrosine (9.6%), isoleucine (6.3%), lysine (5.7%), arginine (8.5%), threonine (3.9%), cysteine + methionine (4.8%), tryptophan (1.5%). In terms of mineral content, baobab leaf is an excellent source of calcium, iron, potassium, magnesium, manganese, molybdenum, phosphorus, and zinc. These data indicate that in terms of both quality and quantity, baobab leaf can serve as a significant protein and mineral source for those populations for whom it is a staple food.

23. Bhat RB (1995) Leaf Architecture and its Dynamics in the Bombacaceae. Beitrage zur Biologie der Pflanzen, 68(2): 169-179

The architecture of the leaf (leaflets) has been investigated in 3 genera and 3 species of the family Bombacaceae. The mature leaflets from both fresh and herbarium materials were cleared using the customary methods, and terminologies of Hickey (1973) are used to determine the characters of leaf architecture. The whole lamina of the leaflet is more or less symmetrical in all the species studied. The major venation pattern conforms to the camptodromous mixed with festooned brochidodromous and the festooned brochidodromous types. In all the members of the family studied, the primary and secondary veins are ornamented with parenchymatous bundle sheaths. Imperfectly developed areoles are predominant over the developed ones. The size and the shape of the areole is variable. The vein endings may be simple, once or sometimes twice dichotomously branched. The highest venation order of the family is 6 degree. Marginal ultimate venation is looped. Tracheids are either uni-, bi-, tri-, or multi-seriate and vary in shape, size and are commonly found at the free vein endings. Extension cells and isolated tracheids are not common. These characters are of great taxonomic importance.

24. Bianchini J P, Ralaimanarivo A, Gaydou E M and Waegell B (1982) Hydrocarbons, sterols and tocopherols in the seeds of six *Adansonia* species. *Phytochemistry*, 21(8): 1981-1987

Analyses are presented of the total seed oil content and the unsaponifiable components of seed lipids of *Adansonia grandidieri*, *A. za*, *A. fony*, *A. madagascariensis*, *A. digitata* and *A. suarezensis*. Oil contents were highest for *A. suarezensis* (46.2%) and *A. grandidieri* (38.7 and 36.4% in 2 samples). Cholesterol was present in low concentrations in all spp., 24-ethylcholesterol being the main sterol. The tocopherol composition differed considerably between spp., but γ -tocopherol predominated. Each sp. showed a characteristic gas liquid chromatography pattern for the hydrocarbon fraction, squalene being the major component for 5 spp.

25. Bianchini J P, Ralaimanarivo A and Gaydon E M (1982) Reversed-phase high-performance liquid chromatography of fatty acid methyl esters with particular reference to cyclopropenoic and cyclopropanoic acids. *Journal of High Resolution Chromatography & Chromatography Communications*, 5(4): 199-204.

HPLC of saturated, monounsaturated, diunsaturated, triunsaturated, cyclopropenoic (malvalic and sterculic) and cyclopropanoic (cis-8,9-methylenehexadecanoic and dihydrosterculic) fatty acids obtained from litchi seed oil was performed with their methyl esters. All separations were carried out with 2 types of reversed phase columns, the eluent consisting of acetonitrile/water mixture. The effect of water was studied in the range 0-15%. The best separation was obtained with acetonitrile/water (85:15 v/v). Quantitative results indicated that the detection limits depended on UV wavelength and in the present study were 4 ng of methyl sterculate and 125 ng of methyl dihydrosterculate at 195 nm. The detn. of response factors using a UV detector at 195 nm permits a quantitative study of potentially carcinogenic cyclopropenoid fatty acids (CPEFA). Results suggest that reverse HPLC would be a convenient method for assay of CPEFA in edible oils (cottonseed, kapok and baobab oils).

26. Chauhan J S, Kumar S and Chaturvedi R (1984) A new flavanonol glycoside from *Adansonia digitata* roots. *Planta Medica*, 50(1): 113

It was isolated and identified as 3,7-dihydroxy flavan-4-one-5-O- β -D-galactopyranosyl (1 right arrow 4)- β -D-glucopyranoside.

27. Eromosele I C, Eromosele C O and Kuzhkuzha D M (1991) Evaluation of Mineral Elements and Ascorbic-acid Content in Fruits of some Wild Plants. *Plant Foods for Human Nutrition*, 41(2): 151-154

The fruits of some wild plants were examined for their contents of mineral elements and ascorbic acid. High levels of ascorbic acid were found in fruits *Sclerocarya birrea* (403.3 mg/100 g) and *Adansonia digitata* (337 mg/100 g). In nine of the fruits examined, the mineral contents (Ca, P) were comparable with average values found in common fruits. The iron contents were however 2-5 times higher than the values for common fruits.

28. Essien A I and Fetuga B L (1989) β "-Carotene content and some characteristics of under-exploited seed oils of forest trees in Nigeria. *Food Chemistry*, 32(2): 109-116

In oils from 21 species, " β "-carotene content varied from 11.97 micro g/100 g oil (*Berlinia auriculata*) to 684 micro g/100 g oil (*Lonchocarpus caprium*). Six oils were useful sources of vitamin A (*Bauhinia monandra*, *Tetrapleura tetraptera*, *Pterocarpus osun*, *L. caprium*, *Triplochiton scleroxylon* and *Voacanga africana*).

29. Gaiwe R, Nkulinkiyi Nfura T, Bassene E, Olschwang D, Ba D and Pousset J L (1989) Calcium and mucilage in the leaves of *Adansonia digitata* (baobab). Original Title: Calcium et mucilage dans les feuilles de *Adansonia digitata* (baobab). International Journal of Crude Drug Research, 27(2): 101-104

The leaves, which are a known source of Ca, are eaten as a laxative condiment by certain west African populations, especially those whose diet is based on millet. Analyses of leaves collected in May at Dakar showed a mucilage content of 12% (DW) as well as 2.01% Ca. Tests elsewhere on rats have shown that the mucilage is rapidly excreted together with much of the Ca and other beneficial constituents. A food preparation method is described for extracting all the mucilage but retaining 23% of the total Ca in the fraction.

30. Glew R H, VanderJagt D J, Lockett C, Grivetti L E, Smith G C, Pastuszyn A and Millson M (1997) Amino acid, fatty acid, and mineral composition of 24 indigenous plants of Burkina Faso. Journal of Food Composition and Analysis, 10(3): 205-217

The leaves, seeds, flowers, and fruit of many indigenous plants are staples of populations who inhabit the Sahel region of Africa. They serve to supplement the nutrients provided by cereals such as millet and sorghum. However, there is a lack of comprehensive compositional data regarding the nutrient content of these indigenous plants. In this report, we present nutritional data for 24 plant materials collected in Burkina Faso, including their content of amino acids, fatty acids, and minerals. Three plants contained 20 to 37% protein (on a dry weight basis): *Vigna* sp., *Hibiscus esculentus*, and *Parkia biglobosa*. Relative to a WHO protein standard, three plants scored relatively high: *Voadzeia subterranea*, *Pennisetum americanum*, and *Bixa orellana*. Plants which contained large amounts of the essential fatty acids linoleic or alpha-linolenic acid were *Vigna* sp., *Hibiscus esculentus* seeds, *Parkia biglobosa* seeds, and *Vitex doniana* fruit. Three plants were rich in iron: *Adansonia digitata*, *Bixa orellana*, and *Xylopia* sp. The fruit and seeds of *Hibiscus esculentus* were an excellent source of zinc. The plant foods with the highest calcium content were *Adansonia digitata* leaves, *Hibiscus* sp., and *Bombax costatum*. These data show that in terms of both quality and quantity there are numerous spontaneous desert plants that can serve as significant sources of essential amino acids, essential fatty acids and trace minerals for populations living in the western Sahel.

31. Nour A A, Magboul B I and Kheiri N H (1980) Chemical composition of baobab fruit (*Adansonia digitata* L.). Tropical Science, 22(4): 383-388.

Baobab fruit pulp contained moisture 6.7% and, on a dry basis, protein 2.6, fat 0.2, fibre 5.7, ash 5.3, total soluble solids 79.3, alcohol-insoluble solids 57.3, total sugars 23.2, reducing sugars 18.9, pectin, as galacturonic acid, 56.2% and, in mg/100 g, ascorbic acid 300, calcium 655, phosphorus 51 and iron 9. The pectin was mainly water-soluble and of poorer quality than commercial pectin.

32. Okoh P N (1984) An assessment of the protein, mineral and vitamin losses in sun-dried Nigerian vegetables. *Nutrition Reports International*, 29(2):359-364

Edible parts of *Adansonia digitata*, *Capsicum annum*, *C. frutescens*, *Zingiber officinale* and *Hibiscus esculentus* were dried in the sun for 7 to 10 days to about 5% moisture. There was no difference in fat, protein, carbohydrate and mineral contents between fresh and dried samples but dried samples showed considerable loss of vitamins, particularly of vitamin C from between 252 and 980 mg/100 to between trace and 27 mg/100 g. Greatest loss of riboflavin was 19% in fruit of *H. esculentus*. Loss of thiamin varied from 18% in fruit of *A. digitata* to 83% in root of *Z. officinale*.

33. Ramadan A, Harraz F M and El Mougy S A (1994) Anti-inflammatory, analgesic and antipyretic effects of the fruit pulp of *Adansonia digitata*. *Fitoterapia*, 65(5): 418-422

The aqueous extract of *A. digitata* fruit pulp showed a LD-50 in mice by i.p. route of 8000 mg/kg and induced a marked and long lasting anti-inflammatory and antipyretic effects at 400 and 800 mg/kg per os in rats. The extract showed also a marked analgesic activity in mice at 2 h after administration. Phytochemical screening of the fruit pulp of the plant indicated the presence of sterols and/or triterpenes, saponins, tannins, carbohydrates and glycosides.

34. Sipra Dan and Dan S S (1986) Phytochemical study of *Adansonia digitata*, *Coccoloba excoriata*, *Psychotria adenophylla* and *Schleichera oleosa*. *Fitoterapia*, 57(6): 445-446

Friedelin, lupeol, bauerenol, β -sitosterol and scopoletin were identified in the leaf and bark of *A. digitata*. The bark also yielded betulinic acid and the leaf taraxerone and the acetates of bauerenol and lupeol. Leaf and bark of *C. excoriata* yielded taraxerone, lupeol, betulinic acid, ursolic acid and β -sitosterol. The leaf yielded friedelin and the bark lupeol acetate. *P. adenophylla* leaf yielded bauerenol acetate, bauerenol, friedelin, betulin and ursolic acid, and traces of α -amyrin, betulinic acid and β -sitosterol. The bark of *S. oleosa* contained lupeol, lupeol acetate, betulin, betulinic acid, β -sitosterol and scopoletin.

35. Woolfe M L, Chaplin M F and Otchere G (1977) Studies on the mucilages extracted from okra fruits (*Hibiscus esculentus* L.) and baobab leaves (*Adansonia digitata* L.). *Journal of the Science of Food & Agriculture*, 28(6): 519-529.

The mucilages from both species were acidic polysaccharides with associated protein and minerals. The polysaccharide from okra was composed of galacturonic acid, galactose, rhamnose and glucose. Both mucilages formed viscous solutions at low concentrations (5-10 g/l) and attained maximum viscosity at neutral pH, but neither was heat stable.

36. Arnal-Peyrot F and Adrian J (1974) [Effect of gums and mucilages on digestibility. Baobab \(*Adansonia digitata*\) leaf](#). *Annales de la Nutrition et de L'Alimentation*, 28(6): 505-521.

A study with rats.

37. Barminas J T, Carles M and Emmanuel D (1998) Mineral composition of non-conventional leafy vegetables. *Plant Foods for Human Nutrition*, 53(1): 29-36.

Six non-conventional leafy vegetables consumed largely by the rural populace of Nigeria were analyzed for mineral composition. Mineral contents appeared to be dependent on the type of vegetables. *Amaranthus spinosus* and *Adansonia digitata* leaves contained the highest level of iron (38.4 mg/100 g and 30.6 mg/100 g dw, respectively). These values are low compared to those for common Nigerian vegetables but higher than those for other food sources. All the vegetables contained high levels of calcium compared to common vegetables, thus they could be a rich source of this mineral. Microelement content of the leaves varied appreciably. Zinc content was highest in *Moringa oleifera*, *Adansonia digitata* and *Cassia tora* leaves (25.5 mg/100 g, 22.4 mg/100 g and 20.9 mg/100 g dw, respectively) while the manganese content was comparatively higher in *Colocasia esculenta*. The concentrations of the mineral elements in the vegetables per serving portion are presented and these values indicate that the local vegetables could be valuable and important contributors in the diets of the rural and urban people of Nigeria. The mean daily intake of P, Mg, Ca, Fe, Cu and Zn were lower than their recommended dietary allowances (RDAs). However, the manganese daily intake was found not to differ significantly ($p = 0.05$) from the RDA value.

38. Becker B (1984) Wild plants in the nutrition of the population of arid regions in Africa: 3 case studies from Kenya and Senegal. *Gottinger Beitrage zur Land- und Forstwirtschaft in den Tropen und Subtropen*, 6: 343.

Diet in the Turkana and Sambura districts of northern Kenya and in Ferlo, northern Senegal, inhabited mainly by nomadic or seminomadic pastoral peoples, but with crops grown in some parts, was investigated and traditional use of wild plant species, in diet or as medicine, and mode of preparation, if any, were ascertained largely by questions addressed mainly to the women. The most important food plants, providing fruits, berries, nuts, seeds or leaves, were in Turkana. *Hyphaene ventricosa*, *Cordia sinensis*, *Salvadora persica*, *Boscia coriacea* and *Dobera glabra*; in Samburu *Grewia tenax*, *G. villosa*, *Cyphostemma maranguensis*, *Cordia sinensis* and *Hyphaene coriacea*; in Ferlo *Adansonia digitata*, *Balanites aegyptiaca* and *Ziziphus mauritiana* and among the Peulh ethnic group also *Boscia senegalensis* and *Cassia obtusifolia*. In the 3 districts about 80, 170 and 20 indigenous species were consumed, contributing theoretically about 10% of dietary energy and considerable amounts of minerals and vitamins, especially A and C and riboflavin, leaves of *C. obtusifolia* and *C. maranguensis* being particularly valuable. Plant foods were useful at the start of the rainy season, when staple items were scarce, but the potential supply of edible species, totalling nearly 800 for the whole Sahel area, remained largely unexploited.

39. Becker B (1983) The contribution of wild plants to human nutrition in the Ferlo (Northern Senegal). *Agroforestry Systems*, 1(3): 257-267

In this arid part of Senegal (covered by open woodland) the most important food plants are *Adansonia digitata*, *Balanites aegyptiaca*, *Ziziphus mauritiana*, *Boscia senegalensis* and *Cassia obtusifolia*. A further 20 species are used to a smaller extent. Their main value is in supplying vitamins A, B and C.

40. Bille J C and Houerou H N le (1980) Measuring the primary palatable production of browse plants. *Browse in Africa*, 185-195, International Livestock Centre for Africa; Addis Ababa; Ethiopia.

Results, mostly from the International Biological Programme, on DM production of *Acacia spp.*, *Adansonia digitata*, *Balanites aegyptiaca*, *Commiphora africana*, *Guiera senegalensis* and *Pterocarpus lucens*, presented as a function of trunk diam., are reviewed. Productivity variation and the effect of climate are discussed.

41. Cook J A, VanderJagt D J, Dasgupta A, Mounkaila G, Glew R S, Blackwell W and Glew R H (1998) Use of the Trolox assay to estimate the antioxidant content of seventeen edible wild plants of Niger. *Life Sciences*, 63(2): 106-110

Although wild edible plants of the western Sahel and other parts of sub-Saharan Africa are consumed to some extent at all times of the year, greater amounts are consumed when cereal harvests are insufficient to support the populations living in these areas. The purpose of this study was to use a recently reported Trolox-based assay to measure the total antioxidant capacity of aqueous extracts of 17 plants that we gathered from southern Niger. The antioxidant contents of the aqueous extracts were compared to those of spinach and potato. Of the 17 plants, 11 had a greater antioxidant content than spinach and 14 had a greater antioxidant content than potato. The leaves of *Tapinanthus globiferus* had the greatest antioxidant content, and the fruit of *Parinari macrophylla* had the lowest. In general, leaves contained more antioxidants than either fruits or seeds. The total antioxidant capacity of the aqueous was relatively high, indicating that the wild plants of the western Sahel may contain substantial amounts of water-soluble flavonoid glycosides, which are potent antioxidants and have been shown to have anticancer properties.

42. Dako D Y (1981) Potential of dehydrated leaves and cocoyam leaf protein in the Ghanaian diet. *Nutrition Reports International*, 23(1): 181-187.

Dark green leafy vegetables, *Hibiscus sabdariffa*, baobab (*Adansonia digitata*), *Amaranthus hybridus* and cocoyam (*Colocasia esculenta*), commonly consumed in Ghana and protein extract from cocoyam leaves were examined. Dried leaves were fairly rich in protein, 13 to 25%, and leaf protein extract had 45% protein. Dried leaves were also rich in fibre and minerals. The essential amino acid compositions of the dried leaves and cocoyam leaf protein were similar, apart from total sulphur amino acids 1.6 and 2.4%, respectively, of protein. Protein values obtained with rats from dried cocoyam leaves and cocoyam leaf protein were similar, except for protein efficiency ratio, 0.89 and 1.37, compared with casein 3.58; true digestibilities were 87.9, 89.3 and 96.2%, respectively. The probable use of cocoyam protein is discussed.

43. Diagayete M (1981) Tannin contents of African pasture plants and their effects on analytical results and *in vitro* digestibility. *Landwirtschaftliche Forschung. Sonderheft* 37, 416-426.

Tannin contents of 42 samples of West African forage plants (2 grasses, 2 herbaceous legumes, 4 legume pods and 34 samples of tree and shrub leaves) were determined photometrically, and were >5% of DM in 11 samples and >20% in 4. There were significant correlations between the contents of crude fat and total phenolic compounds, and between CP in the acid detergent fibre and tannin content. There was a highly significant logarithmic relationship between *in vitro* protein digestibility and tannin content. This was thought to explain the very low digestibility of CP of *Acacia albida* and *Adansonia digitata* in trials with wethers.

44. Dicko Toure M S and Houerou HN le (1980) The contribution of browse to cattle fodder in

the sedentary system of the Office du Niger. Browse in Africa, 313-319, International Livestock Centre for Africa; Addis Ababa; Ethiopia

Characteristics and relative abundance data were presented for 3 *Acacia* spp., *Adansonia digitata*, *Balanites aegyptiaca*, *Bauhinia rufescens*, *Boscia senegalensis*, *Cadaba farinosa*, *Combretum* spp., *Commiphora africana*, *Feretia apodanthera*, *Guiera senegalensis*, *Grewia bicolor*, *Pterocarpus lucens* and *Ziziphus mauritiana*. The grass cover was dominated by *Schoenefeldia gracilis*, *Loudetia togoensis*, *Diheteropogon hagerupii*, *Brachiaria antholata*, *Pennisetum pedicellatum*, *Cenchrus biflorus*, *Elionurus elegans*, *Zornia glochidiata* and *Borreria* spp. Seasonal variations in grazing behaviour clearly demonstrated interactions with forage availability and herd management. Grazing time was in inverse ratio to fodder availability and palatability.

45. Ezeagu I E, Petzke K J, Lange E and Metges C C (1998) Fat content and fatty acid composition of oils extracted from selected wild-gathered tropical plant seeds from Nigeria. *Journal of the American Oil Chemists Society*, 75(8): 1031-1035

As the search for alternative sources of food to alleviate hunger continues, this study was undertaken to determine the fat content and the fatty acid composition of 15 lesser-known wild tropical seeds gathered in Nigeria. Results were contrasted with five tropical soybean varieties (*Glycine max*). The fat content varies from less than 1% (*Pterocarpus santalinoides*, *Daniellia ogea*) to 59% (*Entandrophragma angolense*). The fatty acid composition of most of the wild and mostly leguminous seeds differed considerably, compared to the composition of tropical soybeans. The oil of *Adansonia digitata*, *Prosopis africana*, *Azizia lebeck*, *Enterolobium cyclocarpium*, and *Sesbania pachycarpa* contained high proportions of linoleic and oleic acid as well as palmitic and linolenic acid. Seeds of *Milletia thonningii*, *Lonchocarpus sericeus*, and *S. pachycarpa* were much higher in linolenic acid and relatively poor in linoleic acid, compared to soybeans. The content of saturated fatty acids was higher than that of soybeans, resulting in lower polyunsaturated/saturated (P/S) ratios (0.83-2.12) than observed in soybeans (P/S = 3.4), with the exception of the composition of *S. pachycarpa* (P/S = 3.15). Some of these less familiar wild seeds could be used as sources for industrial or edible oils, provided that possible toxic constituents could be removed.

46. Huq R S, Abalaka J A and Stafford W L (1983) Folate content of various Nigerian foods. *Journal of the Science of Food & Agriculture*, 34(4): 404-406.

Data on folate levels in food from three localities and at different times of year are tabulated. The foods analysed included red peppers, okras, African spinach [*Amaranthus* sp.] baobab leaf [*Adansonia digitata*], egusi [*Cucumeropsis* sp.] seeds, carrots, tomatoes, mangoes, oranges, cowpeas, maize, rice, millet, sorghum, sweet potatoes and cocoyams. Levels of folate were generally low, sweet potatoes, with 1.93-1.96 μ g/g dry weight, being the richest source.

47. Okafor J C (1980) Trees for food and fodder in the savanna areas of Nigeria. *International Tree Crops Journal*, 1(2-3): 131-141

Fifty-one species of edible-product trees in 46 genera of 27 families have been identified during field surveys of the savanna region, which occupies 86.4% of Nigeria's land area. This paper outlines the results of studies on their taxonomic variation, nutritional importance, uses in

livestock feed and the suitability of various propagation techniques. The species discussed include *Adansonia digitata*, *Annona senegalensis*, *Ficus*, spp., *Tamarindus indica* and *Ziziphus* spp. (for fruits), *Butyrospermum paradoxum* [parkii] and *Borassus aethiopicum* (for oils) and many sources of vegetables, condiments and beverages.

48. Prem Nath and Denton L (1980) Leafy vegetables in Nigeria. Plant Genetic Resources Newsletter, 42: 14-17.

The results of an expedition to collect and identify leafy vegetables, in cultivated form, as volunteer plants or in the wild, are tabulated and areas of availability are shown on a map. Details are given of material of several species of *Amaranthus*, two of *Telfairia*, two of *Basella*, two of *Gnetum* as well as of *Corchorus olitorius*, *Hibiscus sabdariffa*, *Lactuca sativa*, *Nasturtium officinalis*, *Adansonia digitata*, *Talinum triangulare* and *Celosia argentea*.

49. Prentice A, Laskey M A, Shaw J, Hudson G J, Day K C and Jarjou L M A (1993) The calcium and phosphorous intakes of rural Gambian women during pregnancy and lactation. British Journal of Nutrition, 69(3): 885-896

The Ca and P intakes of 148 pregnant and lactating women in a rural village in The Gambia, West Africa, have been estimated by direct weighing of food on a total of 4188 d. The Ca and P contents of local foods were determined by analysis of raw ingredients, snack foods and prepared dishes. Information about the contribution of mineral-rich seasonings was obtained. Efforts were made to discover unusual sources of Ca that might not be perceived as food by subject or observer. The main contributors to daily Ca intake were shown to be leaves, fish, cereals, groundnuts and local salt. Cow's milk accounted for only 5 % of Ca intake. Unusual sources of Ca were discovered, namely baobab (*Adansonia digitata*) fruit and selected earths, but these were consumed infrequently and their contributions to Ca intakes were small. Cereals and groundnuts were the main sources of P. Ca and P intakes (mg/d) were shown to average 404 (SD 110) and 887 (SD 219) respectively. Seasonal changes in the availability of leaves, cereals and groundnuts resulted in variations in Ca and P intakes. The rainy season was associated with increased Ca intakes (by 16 %) but decreased P consumption (by 15 %). No difference was observed in Ca intake between pregnant and lactating women but P intake in lactation was 11 % higher than that in pregnancy during the post-harvest season. The implications of these low Ca intakes require investigation.

50. Saka J D K and Msonthi J D (1994) Nutritional value of indigenous wild trees in Malawi. Forest Ecology Management, 64(2-3): 245-248

The edible portions of 16 edible wild fruits were analysed for moisture, protein, fat, crude fibre, ash and minerals (Ca, Mg, Fe, P, K, and Na). The total carbohydrate and energy contents were calculated. *Trichilia emetica*, *Strychnos spinosa*, *Azanza garckeana*, *Ximenia caffra* and *Parinari curatellifolia* gave the highest levels of protein (17.0%), fat (31.2%), fibre (45.3%), ash (11.2%) and carbohydrate (88.2%), respectively. The highest and lowest energy values were found for *Strychnos spinosa* (1923 kJ 100 g⁻¹) and *Azanza garckeana* (810 kJ 100 g⁻¹), respectively. *Bauhinia thonningii* afforded the highest dry matter content (91.6%). The highest contents of Ca, Mg, Fe, P, K and Na were found for *Adansonia digitata* (1156 mg g⁻¹), *Syzigium guineense*

(2247 mug g⁻¹), *Syzigium guineense* (758 mug g⁻¹), *Trichilia emetica* (3164 mug g⁻¹), *Ximenia caffra* (41 79 1 mug g⁻¹) and *Flacourtia indica* (589 mug g⁻¹), respectively.

51. Salami L I and Okezie U N (1994) The nutritional composition and storage stability of millet (*Pennisetum americanum*) supplemented with varying levels of baobab (*Adansonia digitata*) flours. Ecology of Food and Nutrition, 31(3-4): 211-218

This study was undertaken to evaluate the effects of treatment (storage) on the nutritional value of "Bulum mardam" based on millet and baobab seed flours (BSF). "Bulum mardam" a traditional gruel based on 100% millet flour served as the control in this study. Other gruels contained varying levels of BSF. Standard assay methods were adopted to analyze the parameters selected for use. These mixtures were analyzed for various nutritional attributes. The nutrients increased with increase in the percentage of BSF in the blends. Sensory evaluation showed that the blends were significantly different ($P < 0.05$) from the control. The 85 : 15 blend (millet : BSF) was preferred by the taste panelists. The pH of these blends decreased with storage. However, the titratable acidity TA increased with storage for all blends.

52. Smith G C, Dueker S R, Clifford A J and Grivetti L E (1996) Carotenoid values of selected plant foods common to southern Burkina Faso, West Africa. Ecology of Food and Nutrition, 35(1): 43-58

Six edible plants common to West African diet were analyzed for vitamin-A precursors α -carotene, β -carotene, β -cryptoxanthin, and cis-isomers of β -carotene. They were fresh leaves of *Adansonia digitata*, *Ceiba pentandra*, *Hibiscus sabdarifa*, and *Vigna sp.*, dry leaves of *Adansonia digitata*, and flower and seed pulp of *Adansonia digitata*, *Biwa orellano*, *Hibiscus sabdarifa*, and *Parkia biglobosa*. Plants were chosen because they were important to diet and were colored, with dark green, pink, orange, and yellow preferred. Color was assumed to reflect carotenoid concentrations. Four of the six were wild edible species, two were cultivated. Both fresh and dry samples were analyzed. On a weight basis, fresh samples contained twice the carotenoid content as dry samples. Colors did not reflect carotene content for the analyzed carotenoids. Fresh kapok leaves (*Ceiba pentandra*) contained twice the beta-carotene content of the reference food fresh spinach (*Spinacea oleracea*).

53. Toure S F, Michalet Doreau B, Traore E, Friot D and Richard D (1998) Occurrence of digestive interactions in tree forage-based diets for sheep. Animal Feed Science and Technology, 74(1): 63-78

The effect of browse level in the diet on the *in vivo* dry matter digestibility (DMD) in sheep and the DM degradation of peanut hay in the rumen of cattle-fed tree forage-based diets were investigated in order to detect the occurrence of digestive interactions between diet components. Selected browse species *Acacia albida* pods, *Pithecellobium dulce*, *Adansonia digitata* and *Calotropis procera* leaf samples were collected in the central regions of Senegal, sundried and stored in LNERV animal barns for *in vivo* trials. Classical *in vivo* balance trials were performed for each tree forage sample. The proportion of browse in the applied diet varied between 0 and 75% of DM. Regression and difference procedures were both tested to estimate the DMD of the browse component of the diet. DMD capacity in the rumen of three young Gobra bulls fed the browse-based diets was estimated by measurement of the *in sacco* dry matter degradation profile of a standard sample, peanut hay. For each sample, large variations were observed when the

browse DMD was calculated by difference. Both total ration DMD and rumen DM degradation capacity were significantly ($p < 0.001$) influenced by browse level in the diet. However, non-linear response of total diet DMD to increasing levels of browse was observed only in *A. digitata* and *P. dulce* indicating occurrence of digestive interactions in those species. Rumen DM degradation capacity varied according to plant species which played a major role in the observed digestion profile. Results suggest that the digestion of tree forages-based diets may be influenced by digestive interactions but the large variations observed in plant species show their importance. Optimal DM degradation occurred at 15-30% of browse level in the diet for both *A. albida* and *A. digitata* while for *P. dulce* it was at 50%. Corresponding browse digestibility was of 50%, 47.1%, 51.3% and 60.7% DM for *A. albida*, *A. digitata*, *P. dulce* and *C. proceras* respectively. Further work using the regression method in a wider range of browse species could help confirm between-species variations.

54. Addy E O and Eteshola E (1984) Nutritive value of a mixture of tigernut tubers (*Cyperus esculentus* L.) and baobab seeds (*Adansonia digitata* L.). Journal of the Science of Food and Agriculture, 35(4): 437-440

The seeds of baobab (*Adansonia digitata* L.) and the tubers of tigernut (*Cyperus esculentus* L.) were analysed chemically for their proximate composition and amino acids. The tubers contained 47.9% digestible carbohydrates, 32.8% oil and 3.8% crude protein. The baobab seeds contained 24.1% digestible carbohydrate, 29.7% oil and 28.4% crude protein. A mixture of the vegetables was prepared from three parts of the tigernuts and one part of baobab seeds, by weight, such that a 10% crude protein meal was obtained. The chemical score of the mixed vegetable was 51%, based on limiting amino acids, i.e. those which contain sulphur. The level of antinutritive substances, such as tannin and tryptic inhibitors, in the raw vegetable were reduced by soaking or boiling.

55. Delisle H, Bakari S, Gevry G, Picard C and Ferland G (1997) Provitamin A content of traditional green leaves from Niger. Original Title: Teneur en provitamine A de feuilles vertes traditionnelles du Niger. Cahiers Agricultures, 6(8): 553-560

As part of a study on vitamin A intake of preschool children in Niger, traditional green leaves as locally processed were sampled for provitamin A determination, using HPLC (high performance liquid chromatography). A total of 168 samples from 15 plant species were collected from three different villages in western Niger, two in Bouza district and one in Ouallam district. The main species available and consumed throughout the year, supply sources, and processing methods, were identified in a preliminary study. In both districts, most women are involved in drying leaves. Dried greens are used year-round, mostly in soups served with the staple dish of millet, while fresh leaves are mainly prepared during the rainy season, either boiled or steamed with millet flour. Plant species found in both areas are usually processed similarly, but not all species were found in a given site. Samples of processed leaves were collected during the rainy season. In a given village, three different women provided a sample of every leaf species available for every processing method used. Weighed specimens of dried or fresh cooked leaves were wrapped in opaque plastic bags, quickly frozen, and shipped to Montreal on dry ice for analysis. Provitamin A carotenoid determinations were done in duplicate with the results expressed as total provitamin A carotenoid (μg of retinol equivalents RE) per 100 g. Moisture content was also determined for all samples after drying in a conventional oven for 48 to 72 h. The average

provitamin A level for the 57 samples of dried leaves was 2,273 $\pm$ 1,152 RE/100 g, ranging from a low of 861 in *Adansonia digitata* to a high of 3,681 in *Ceratotea sesamoides* (Table 1). The variance was very high and significant differences were observed among plant species and collection sites. Residual moisture did not vary according to species and site, and therefore could not explain the observed differences. Fresh boiled leaves had on average 1,333 $\pm$ 596 RE/100 g fresh weight, and steamed leaves 928 $\pm$ 526 RE (Table 2). For fresh leaves, in addition to species and site, the cooking method was significantly associated with the provitamin A level. For the four species cooked either way (Figure 1), boiled leaves had a higher provitamin A content than steamed leaves, both on a fresh and dry weight basis, this difference could not be ascribed to cooking time. Per dry weight unit (Table 3), leaves collected in the dried state had roughly half the provitamin A content of samples cooked fresh, and steamed leaves had half as much provitamin A as boiled samples of the same species. After adjustment for the processing method, species with the highest level of provitamin A, on a dry weight basis, were *Allium cepa* (onion greens), *C. sesamoides* (false benniseed) and *Hibiscus sabdarifa* (red sorrel). Despite wide variations in the provitamin A content of green leaves, these food items can be major contributors of vitamin A for children in the study areas. Depending on the species and type of dish, a small portion could provide from 11% to 104% of the safe vitamin A intake level for young children (Table 4). The study suggests that in rapid dietary assessments, fresh boiled greens should be distinguished from other green leaf dishes, in view of their provitamin A content. Based on children's food intake data, the estimated contribution of green leaves was on average two-thirds of the safe vitamin A intake level, but with a wide range. The real contribution of green leaves to vitamin A requirements may however be much lower, as the bioavailability of green leaf carotenoids is likely much lower than was assumed until recently, and as requirements may be increased in these children as a result of high exposure to infection. Elucidation of the above issues is needed for relevant food-based strategies to be advocated for the prevention of vitamin A deficiency in tropical Africa.

56. Glew R H, VanderJagt D J, Lockett C, Grivetti L E, Smith G C, Pastuszyn A and Millson M (1997) Amino acid, fatty acid, and mineral composition of 24 indigenous plants of Burkina Faso. *Journal of Food Composition and Analysis*, 10(3): 205-217

The leaves, seeds, flowers, and fruit of many indigenous plants are staples of populations who inhabit the Sahel region of Africa. They serve to supplement the nutrients provided by cereals such as millet and sorghum. However, there is a lack of comprehensive compositional data regarding the nutrient content of these indigenous plants. In this report, we present nutritional data for 24 plant materials collected in Burkina Faso, including their content of amino acids, fatty acids, and minerals. Three plants contained 20 to 37% protein (on a dry weight basis): *Vigna* sp., *Hibiscus esculentus*, and *Parkia biglobosa*. Relative to a WHO protein standard, three plants scored relatively high: *Voadzeia subterranea*, *Pennisetum americanum*, and *Bixa orellana*. Plants which contained large amounts of the essential fatty acids linoleic or alpha-linolenic acid were *Vigna* sp., *Hibiscus esculentus* seeds, *Parkia biglobosa* seeds, and *Vitex doniana* fruit. Three plants were rich in iron: *Adansonia digitata*, *Bixa orellana*, and *Xylopia* sp. The fruit and seeds of *Hibiscus esculentus* were an excellent source of zinc. The plant foods with the highest calcium content were *Adansonia digitata* leaves, *Hibiscus* sp., and *Bombax costatum*. These data show that in terms of both quality and quantity there are numerous spontaneous desert plants that

can serve as significant sources of essential amino acids, essential fatty acids and trace minerals for populations living in the western Sahel.

57. Nordeide M B, Hatloy A, Folling M, Lied E and Oshaug A (1996) Nutrient composition and nutritional importance of green leaves and wild food resources in an agricultural district, Koutiala, in Southern Mali. *International Journal of Food Sciences and Nutrition*, 47(6): 455-468

This paper discusses the nutrient composition and the nutritional importance of green leaves and wild gathered foods in an area with surplus food production in Mali. In this West African country, there is little information about the nutrient composition and the nutritional quality of foods in general, and of wild gathered foods in particular. Food frequency was collected in two cross-sectional surveys. Focus group discussions with women in the area were used to collect information about seasonality, availability and preparation of various foods. Selected food samples were collected for chemical analysis of nutrient composition. The food samples of green leaves (*Adansonia digitata*, *Amaranthus viridis*, *Tamarindus indica*, *Allium cepa*), seeds and flour (*Parkia biglobosa*) and fruits (*Tamarindus indica*) were analysed for water, energy, fat, protein, minerals, amino acids and carotenoids. Availability and use of the foods varied with seasons. In the rainy season, wild gathered foods (e.g. *A. digitata*) were used as much as fresh cultivated foods (e.g. *A. viridis* and *A. cepa*). The wild food resources were more frequently used in rural than in urban areas, with *A. digitata* as the dominating green leaves. Green leaves were rich in energy, protein and minerals (calcium, iron). Leaves of *A. viridis* were, in particular, rich in beta-carotene (3290 µg/100g). Chemical score in dried green leaves varied from 47 (*A. cepa*) to 81 (*A. digitata*), with lysine as the first limiting amino acid. *P. biglobosa* fermented seeds, with 35% fat and 37% protein were a complementary source of lysine in the diet. Based on the seasonality, the frequency of use and the nutrient contents of selected green leaves and wild gathered foods in Koutiala district, it is concluded that these traditional and locally produced foods are valuable and important nutrient contributors in the diet both in rural and urban areas, but most important in rural areas.

58. Obizoba I C and Anyika J U (1994) Nutritive value of baobab milk (gubdi) and mixtures of baobab (*Adansonia digitata* L.) and hungry rice, acha (*Digitaria exilis*) flours. *Plant Foods for Human Nutrition*, 46(2): 157-165

The baobab milk and fermented baobab/acha flour mixtures were analyzed chemically for their proximate, ascorbate, mineral and antinutrient composition. The dry pulp scraped from baobab fruits was kneaded, made into solution, extracted through cheese-cloth and stored frozen until analyzed. The acha and baobab grains were cleaned, fermented for 24 to 120 hours, dried and hammermilled into fine flours. The unfermented flours served as controls. The standard assay methods of AOAC were selected for use for the analysis of the nutrients and the antinutrients. The mixtures were composed of 70% acha and 30% baobab flours (70:30 protein basis). The baobab milk contained more protein (1.5%) and minerals (Fe, 17.8 mg; Ca 134.2 mg) than those of human milk (protein, 1.3%, Fe, 0.2 mg, Ca 30 mg) and cow milk (Fe, 0.1 mg; Ca 1.20 mg) and most leading national commercial infant formulas e.g. cerelac (Fe, 10.0 mg). The composite flours contained more nutrients than the baobab or the acha flour alone. The BF96 had greater advantage over other BF flours as a supplement to acha. The mixtures are within the reach of lower income group and can be incorporated into their diets.

59. Oliviera J F S (1974) The nutritional value of some foods consumed on San Tome Island. Ecology of Food & Nutrition, 3(3): 237-242.

Plant foods were prepared for eating, cooked or raw, by the local methods of San Tome island. Tables give weight of raw and cooked foods or edible part and, for the foods as eaten, the proximate composition and content of 10 amino acids, 8 minerals, 3 vitamins and several indices of protein quality. Highest content of thiamin was in baobab (*Adansonia digitata*) seed, 190 µg/100 g, water 10%, and baobab pulp had 150 µg, water 9%, both are eaten raw. Highest riboflavin was in cassava flour, 237 µg/100 g, water 8.8%, probably from microorganisms during wet preparation of the flour. Highest niacin was in baobab pulp, 1.78 mg/100 g. Isaquente (*Treculia africana*) seed is boiled and eaten as dessert with sugar or butter, or cooked with rice or maize. It had, in 100 g cooked edible part, water 69, crude protein 4.6, fat 4.4, fibre 2.1, ash 0.97 g; energy 132 kcal (551 KJ); Ca 10, P 128, Fe 0.96 mg; thiamin 157, riboflavin 137 µg; niacin 0.28 mg and tryptophan 1.37 g/16 g N. It had the highest Kuhnau's index (Sheffner, NAR 38, 2137) of 89 [protein quality relative to human milk]; the other foods had 54 to 67. Only cassava and baobab would make useful contributions of those 3 vitamins. Isaquente had the greatest potential as source of protein and energy, and might be of use as supplement during weaning. The other foods were bananas of a starchy and a sweet variety, hog plum (*Spondias dulcis*), carambola (*Averrhoa carambola*), breadfruit (*Artocarpus communis*) and taro (*Colocasia esculenta*). Increased production of cereal and oil palm seemed more necessary than fish protein supplements to the diet of San Tome.

60. Proll J, Petzke K J, Ezeagu I E and Metges C C (1998) Low nutritional quality of unconventional tropical crop seeds in rats. Journal of Nutrition, 128(11): 2014-2022

As the search for alternative sources of food to alleviate hunger continues, this study was undertaken to determine the biological value in growing rats (BV) of proteins of some lesser known tropical seeds gathered in Nigeria. Antinutritional factors (trypsin inhibitors, phytic acid, oxalate, tannin, alkaloids) and amino acid compositions were also determined, and protein digestibility-corrected amino acid score (PDCAAS) was calculated using the amino acid requirement pattern of the preschool child and individual seed-specific correction factors for crude protein. A rat growth and balance study was conducted to determine digestibility, nitrogen-, and energy balance by feeding as the only unsupplemented protein source milled and heat-treated seeds of *Adansonia digitata* (Bombacaceae) and *Prosopis africana*, *Lonchocarpus sericeus*, *Enterolobium cyclocarpium*, *Sesbania pachycarpa* and *Pterocarpus osun* (Leguminosae) in comparison to casein fortified with methionine (control). Diets containing *P. africana* and *L. sericeus* seeds caused poor feed intake and weight loss in rats and were excluded from the nitrogen-balance test. Among the seed samples, *S. pachycarpa* followed by *A. digitata* showed the most advantageous nutritional quality [amino acid composition, digestibility, BV and net protein utilization (NPU)]. True digestibility was 82.9 and 74.5 vs. 98.5, BV was 64.6 and 70.0 vs. 90.4, and NPU was 53.5 and 52.1 vs. 89.0 for *S. pachycarpa* and *A. digitata* vs. casein (control), respectively. In terms of PDCAAS, lysine was the first limiting amino acid for *S. pachycarpa* (88%) and for *A. digitata* (58%). The PDCAAS of all essential amino acids was below 100% for *E. cyclocarpium* (e.g., cysteine + methionine: 37%) and for *P. africana* (e.g., threonine: 46%, except valine and a very high content of cycteine and methionine). In conclusion, all seeds tested in the rat balance trial were of inferior quality compared to casein.

Before these tropical seeds could be used as food components or feed supplements, safety studies and proper processing to remove antinutritional factors and possible toxic constituents were required.

61. Saka J D K, Msonthi J D and Maghembe J A (1994) Proceedings of a regional conference on agroforestry research in the African miombo ecozone held in Lilongwe, Malawi, 16-22 June 1991. *Forest Ecology and Management*, 64(2-3): 245-248

The edible portions of 16 edible wild fruits were analysed for moisture, protein, fat, crude fibre, ash and minerals (Ca, Mg, Fe, P, K, and Na). The total carbohydrate and energy contents were calculated. *Trichilia emetica*, *Strychnos spinosa*, *Azanza garckeana*, *Ximenia caffra* and *Parinari curatellifolia* gave the highest levels of protein (17.0%), fat (31.2%), fibre (45.3%), ash (11.2%) and carbohydrate (88.2%), respectively. The highest and lowest energy values were found for *Strychnos spinosa* (1923 kJ 100 g⁻¹) and *Azanza garckeana* (810 kJ 100 g⁻¹), respectively. *Bauhinia thonningii* afforded the highest dry matter content (91.6%). The highest contents of Ca, Mg, Fe, P, K and Na were found for *Adansonia digitata* (1156 mug g⁻¹), *Syzigium guineense* (2247 mug g⁻¹), *Syzigium guineense* (758 mug g⁻¹), *Trichilia emetica* (3164 mug g⁻¹), *Ximenia caffra* (41 79 1 mug g⁻¹) and *Flacourtia indica* (589 mug g⁻¹), respectively.

62. Sena L P, Vanderjagt D J, Rivera C, Tsin A T C, Muhamadu I, Mahamadou O, Millson M, Pastuszyn A and Glew R H (1998) Analysis of nutritional components of eight famine foods of the Republic of Niger. *Plant Foods for Human Nutrition*, 52(1): 17-30

In the western Sahel, indigenous plants become important staples when cereal harvests are inadequate to support populations inhabiting that region of Africa. The purpose of this study was to assess the nutrient content of several of these edible wild plants. The leaves of the following seven plant foods were analyzed: *Ziziphus mauritiana*, *Cerathotheca sesamoides*, *Moringa oleifera*, *Leptadenia hastata*, *Hibiscus sabdarifa*, *Amaranthus viridis*, and *Adansonia digitata*. The fatty acid, vitamin E, carotenoid, selected mineral and amino acid contents of these plant foods were determined. These same analyses were performed on the fruit of the *Adansonia digitata*. In quantitative and qualitative terms, *Amaranthus viridis* was found to be an excellent source of protein. Its amino acid composition compared favorably to that of a World Health Organization (WHO) protein standard. It also contained considerable amounts of the two fatty acids that are essential in humans (linoleic and α -linolenic) and a number of minerals including iron, magnesium, calcium and zinc. The leaves of *Hibiscus sabdarifa* contained an appreciable quantity of protein the composition of which was comparable to the WHO standard. The mineral content of the leaves of this plant was also exceptionally high; noteworthy was its high zinc content. *H. sabdarifa* also contained significant quantities of the two essential fatty acids. *Ziziphus mauritiana* was an excellent source of the essential fatty acid linoleic acid and several of the metals including iron, calcium, magnesium and zinc. Its content of other essential nutrients, however, was rather low. In general, *Adansonia digitata* leaves were nutritionally superior to the fruit of the tree; however, the fruit did contain useful quantities of potassium, phosphorus, zinc and α -linolenic acid. The *Leptadenia hastata* leaves were an especially good source of lutein and beta-carotene. These data should be useful to the people who inhabit the western Sahel in helping them devise healthy diets during times when cereal staples are in short supply.

63. Sidibe M, Scheuring J F, Tembely D, Sidibe M M, Hofman P and Frigg M (1996) Baobab - homegrown vitamin C for Africa. *Agroforestry Today*, 8(2): 13-15

Baobab (*Adansonia digitata*) fruits were collected from 2-3 trees sampled in 3-5 villages in each of 3 regions in Mali, the pulp scraped out and separated from the seeds and fibres, and analysed for vitamin C [ascorbic acid]. There was a 3-fold variation in vitamin C content - indicating significant potential for selecting trees and clones with a high vitamin C content. The traditional grouping of baobab trees by bark colour was not useful as a means of selection, since high vitamin C contents were found in all 3 types (black, red and grey barked). The possibility of producing high vitamin C trees of baobab by grafting is discussed, and the potential importance of the tree fruit in raising nutritional standards in the region emphasized.

64. Smith G C, Clegg M S, Keen C L nad Grivetti L E (1996) Mineral values of selected plant foods common to southern Burkina Faso and to Niamey, Niger, West Africa. *International Journal of Food Sciences and Nutrition*, 47(1): 41-53.

Wild and cultivated fruits, leaves, nuts, seeds, spices and vegetables from southern Burkina Faso and Niamey, Niger, were analysed for their copper, iron, magnesium, manganese and zinc concentrations and compared to imported, exotic reference foods found within the study area. The species analysed covered a broad spectrum of local diet; 33 were wild and 16 were cultivated. The edible wild plants were often the highest in mineral concentrations. Five species analysed, exhibited consistently high mineral values, specifically, *Adansonia digitata*, *Boerhavia diffusa*, *Cerathoteca sesamoides*, *Sclerocarya birrea* and *Xylopi* sp. The latter was particularly high in zinc, an observation which suggests that there may be a solid rationale for local traditions which recommended its consumption during pregnancy and lactation. Respondents indicated that during times of drought, wild plants were not consumed in the volume they once were, due to changes of infrastructure and in famine relief programmes.

65. Szolnoki T W (1985) Food and fruit trees of The Gambia. 132pp. Published in conjunction with the Bundesforschungsanstalt fur Forst und Holzwirtschaft, Stiftung Walderhaltung in Afrika; Hamburg; German Federal Republic

After introductory sections on the utilization of food and fruit trees, detailed treatments are given for 40 species, with information on: scientific and common names; characteristics of trees and parts used; cultivation and propagation; food uses, with details on processing and cooking methods given for some species; other uses (including of timber etc.); and overall evaluation. The more intensively utilized species include: *Adansonia digitata*; *Balanites aegyptiaca*; *Borassus aethiopum*; *Citrus spp.*; *Elaeis guineensis*; *Ficus gnaphalocarpa* [*F. sycomorus*]; and *Parkia biglobosa*. A general discussion is presented on developing well-known and underutilized trees and shrubs for food use. Lists are included of common names (with botanical equivalents) in English, French, Fula, Jola, Mandinka, and Wolof; the lists of tribal names include some species not treated in the text.