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Uses of the fruit of Breadfruit tree (*Artocarpus altilis*) in the Republic of Benin: Bibliographic Synthesis

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Abstract

Artocarpus altilis is a species whose fruit possesses important nutritional characteristics; this fruit has a major advantage in the agri-food sector and can provide a varied range of food products. The objective of the study is to provide information on the physicochemical, technological, physiological and genetic characteristics of the breadfruit by means of a bibliographic synthesis in order to obtain an overview of possible uses of this species in Benin. The study made it possible to note the existence of several varieties of the species of which the two morphotypes currently registered in Benin are locally referred to as "Azintin" and "Bèléfututin" in Wémènou; The denomination of the species by local populations varies from one region to another. The breadfruit usually grows on deep, fertile, well-drained soils. The fruit contains carbohydrates, proteins, lipids, celluloses, minerals, vitamins C, A, B1 and B2. It thus constitutes a solution in the fight against malnutrition and a great asset for the assurance of food safety and security. The food use of the tree in Benin is the preparation of the fruit in the baked, fried or associated form with banana plantain to obtain the fufu, a product similar to crushed yam.

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Introduction

The breadfruit tree (*Artocarpus altilis*) provides a varied range of staple foods and has a high economic value (Soetjipto and Lubis, 1981). The fruit can be cooked and eaten at all stages of maturity. The food use of the tree in Benin is the preparation of the fruit in the baked, fried or associated form with banana plantain to obtain the fufu, a product similar to crushed yam (Azokpota, 2012). The denomination of the breadfruit certainly stems from the fact that its transformation could give bread products. The fruit would then have the ability to be used for bread making. Thus, attempts to exploit breadfruit through cake-type cakes have been reported (Akouêhou, 2012; Azokpota, 2012), as have many studies on the development of composite flours in which a portion of wheat flour is replaced by other starchy sources (Defloor, 1995). It is therefore possible to obtain formulations from flour of breadfruit from flours composed of cereals and/or roots and tubers with a low proportion of wheat flour for the manufacture of by-products such as cakes, and English or French cakes to some extent (Chargelegue *et al.*, 1994).

In Benin, *Artocarpus altilis* is one of the ten woody food species on which sustained attention and priority actions must be carried out on the basis of their socio-economic importance (Eyog Matig *et al.*, 2002). Akouêhou *et al.* (2014) found two forms of the species in southern Benin (Bèlèfututin and Azintin en Wémènou) with distinct characteristics. They have also shown that six uses are made: food, wood fire, construction, fodder, artisanal, and medicinal.

According to Abimbola *et al.* (2010), breadfruit could also be used to replace maize in animal feed, up to 22.2% in feeding rabbits without changes in digestion or feed quality of meat. Bokossa *et al.* (2016) showed that bread flour added to that of sorghum and soya is an important staple in the fight against child malnutrition. *Artocarpus altilis* is an "under-used" and "neglected" plant, as Ragone pointed out in 1997. Similarly, Agudo (2014) stated that it found a low in Western scientific literature between the mid-1990s and 2005 reflecting a lack of interest on the part of the scientific community of the "developed countries" for this plant.

In Benin, the various uses of the species indicate an endogenous knowledge of the species which is an essential component for the conservation of local biodiversity (Pilgrim *et al.*, 2007). However, few scientific studies have addressed these different aspects of the species in Benin. Preliminary surveys carried out in the commune of Abomey-Calavi and the diagnostic survey carried out on the species recently in Ouémé and Plateau revealed a post-harvest loss of almost 50% (Akouêhou, 2012, Azokpota, 2012). In spite of the great socio-economic, nutritional and technological advantages of food processing presented by the breadfruit, its valorization on the territory of Benin remains very limited to the present day. A thorough knowledge of the endogenous technologies of agro-food processing and their variability can contribute to the optimization of the valorization of this fruit. The present article proposes to list, through a bibliographic synthesis, the technological, nutritional, physiological and genetic information of breadfruit, as well as the structural, behavioral characteristics of the species in general and Beninese territory in particular, in the aim is to provide a basic document for researchers who will be involved in research on breadfruit.

History

The term "*Artocarpus*" is derived from the Greek artos (bread) and karpos (fruit), breadfruit, pan arbol, Fruta-pao, Fouyapen in Caribbean Creole etc. This name comes from the smell of bread fresh from the oven that releases when leavened when cooked.

The breadfruit tree is native to Oceania and has been domesticated and grown in agroforestry systems by the populations of the South Pacific islands over 3000 years ago and is a basic component of their diet; *Artocarpus altilis* originates more precisely from the island of New Guinea (Lebot, 2002) and is found only in the wild on this island. According to the NTBG (National Tropical Botanical Garden) of Hawaii, the wild ancestor of *Artocarpus altilis* is *Artocarpus camansi* (Breadnut) which is found in the wild in New Guinea, Indonesia and the Philippines. *Artocarpus camansi* is a fertile species cultivated for its seeds.

According to the genetic studies of *Zeregra et al.* (2005), the closest relatives of *Artocarpus altilis* are *Artocarpus camansi* and *Artocarpus mariannensis* as well as hybrids derived from a derivative of *Artocarpus camansi* X *Artocarpus mariannensis*. *Artocarpus mariannensis* is endemic to Micronesia and is hybridized with the derivatives of *Artocarpus camansi* reported by Men when they arrived on these islands (NTBG, 2009).

There are about 100 cultivars (or varieties) of the species *A. altilis*, some are fertile diploids (2n = 56) and others are sterile triploids (or asperms) (3n = 84); they are propagated by vegetative propagation (Zeregra *et al.,* 2004). Sterile triploids seem to originate rather from Polynesia (Lebot, 2002).

The species was reported to have been propagated during the migrations between the islands by the local populations, from Indonesia to Hawaii, and by European settlers from the beginning of the 17th century (Ragone, 1997). Initially, a first vegetative selection was made to select the plants with the seeds most appreciated from a taste point of view.

The seed being fragile, vegetative propagation has been favored for long-distance transport and also for the conservation of the desired traits because there is a great phenotypic diversity in *Artocarpus altilis*. Domestication continued and the spread of "seedless" varieties resulted in a change in the use of the plant from a seed crop to a starch crop (Ragone, 1997).

The worldwide spread of breadfruit began with the first explorers of this region in the 1600s. Conquered by the abundance and nutritional quality of the fruit, they brought breadfruit plants with them wherever they founded new colonies. In 1775, the botanist John Ellis proposed his introduction in the "West Indies" to feed the slaves (Ragone, 1997).

The story of the spread of the breadfruit is also associated with the famous mutiny of the HMS Bounty. Indeed, when the ship set sail in 1787 for Tahiti, it was with the aim of bringing breadfruit plants back to the West Indies. It was obviously a failure.

The mission was accomplished in 1792 by another ship which brought 600 plants back to Jamaica (Robineau, Universalis). The French also transported the breadfruit to their colonies as early as 1772, first to Mauritius, then to Guyana, Guadeloupe, and so on. From there, the species was distributed throughout the tropical zone of the American continent. It was suggested that the Spaniards would have brought the breadfruit back to Mexico long before it arrived in the West Indies (Morton, 1987).

For the African continent, it would seem that there was only one introduction via the west coast and Madagascar around 1901 (Ragone, 1997). The Breadnut (*Artocarpus camansi*) will follow almost the same paths as the breadfruit tree, it is now found throughout the tropical zone of the globe (NTBG, 2009). Most of these introductions have been made from the population of *Artocarpus altilis* from one or a few islands in Oceania by vegetative propagation.

Genetic diversity is therefore still much higher in the Pacific Islands. According to FAO (1999), the breadfruit tree was introduced into Benin from the West Indies since the slave trade.

Botanical description

The bread tree has the scientific name: *Artocarpus altilis* (Parkinson) Fosberg and comes from the family of Moracea. The non-preferred scientific names are: *Artocarpus camansi, Artocarpus mariannensis, Artocarpus communis, Artocarpus Incisa*.

Local names (Benin)

Artocarpus altilis is a well-known species of local populations that have several knowledge about its uses. For this purpose, the denomination of the species by local populations varies from one socio-cultural group to another (Table 1).

Table 1. The denomination of the species by the local populations.

Names of *Artocarpus altilis* by the different socio-cultural groups		
Socio-cultural groups	Languages	Local Names
Wémènou	Wémè	Tévitin, Belefututin
Fon	Fongbé	AkutakpanWun
Holli	Holli	Berefutu

Source: Akouêhou *et al.* (2014).

Other regions

Árbol has pan (Spanish), the shaft to bread (French), rimas (Philippines), sukun (Indonesia), Breadfruit (English).

Shaft size

Trees can reach a height of 21m or more at maturity, more commonly around 12-15m. The trunk may be as large as 2m (6.6 ft.) in diameter, occasionally increasing to a height of 4 m or more before forking. A milky white latex is present in all parts of the tree (Ragone, 1997).

Flowers

Artocarpus altilis is monoecious with male and female flowers on the same tree and the male inflorescence appearing first. The male flowers are club-shaped, up to 5cm in diameter and 45cm long. Thousands of small flowers with two anthers are attached with a central spongy nucleus. Female inflorescences consist of 1500-2000 reduced flowers attached to a spongy nucleus. The flowers fuse and develop in the fleshy edible portion of the fruit. It is cross-pollinated, but pollination is not necessary for fruit development (Ragone, 1997).

Sheets

The leaves are alternate, obovate to broadly oval, much more complete, with only a slight deeply pennatilobed lobe, with sinus up to two-thirds or more of the margin distance, with up to six pairs of lobes and a large Apical tip. The blade is usually smooth, shiny, dark green with green or yellow-green veins, and many reddish white or white hairs on the central vein and veins. Leaves on new shoots and suckers are usually larger and hairy than leaves on mature branches. The size varies depending on the variety, ranging from 15-60 cm (6-24 in.) in length (Fig. 1) (Ragone, 2006).

Photos: D. Ragone (2006)

Fig. 1. Different types of leaves of *Artocarpus altilis* (Ragone, 2006).

Fruits

The fruits are of varying shape, size and texture of the surface. They are generally round, oval or oblong ranging from 9 to 20cm in width and over 30cm in length, Weighing 0.25-6kg. The hard skin is composed of five to seven face discs, each surface with a flower individual.

Two shaped bracelets, curved stigmas protrude from the center of the disc and often leave a small distinctive scar when they blacken and fade. The texture of the skin is slightly bumpy or spiny. The color is light green, yellowish-green, or yellow when ripe. The skin is usually colored with dried latex exudates at maturity.

The flesh is creamy white or pale yellow and contains no or many seeds, depending on the variety. The fruits are usually mature and ready to be harvested and to be eaten as a staple food of starchy food in 15-19 weeks. Ripe fruits have yellow or brownish-yellow skin, creamy flesh and can be eaten raw (Fig. 2) (Ragone, 2006).

Photos: D. Ragone (2006)

Fig. 2. Different types of breadfruit (Ragone, 2006).

Seeds

The breadfruit has a great morphological variability, ranging from real seedless varieties to those with several small aborted seeds, or one to a few seeds, to varieties with many viable seeds. The seeds are thin-walled, subglobular or obovoid, irregularly compressed, 1-2cm thick, and embedded in the paste. The outer tegument is usually dark brown shiny with a slight layer of brown inner seed. Seeds have little or no albumen and no dormancy; they germinate immediately and are unable to withstand desiccation. The seeds are distributed by the bats, where they occur. Seeds are rarely used for propagation (Ragone, 2006).

Photos: Jones *et al* (2006).

Fig. 3. Morphological variability of leaves and fruits of *Artocarpus altilis* (Jones *et al.,* 2012).

Distinction of similar species

Artocarpus camansi (Breadnut, camansi) is oblong, with very spiny fruits with little pulp and many large light brown seeds and large leaves, superficially dissected with 4-6 pairs of lobes.

Artocarpus mariannensis (dugdug, chebiei) is small, cylindrical or kidney-shaped, with dark green fleshy fruits and small dark brown seeds, with superficially 1-3-lobed leaves (Fig. 4).

Variability of the species

The breadfruit tree is *genetically diverse, particularly the seeded forms in the western Pacific and the hybrids (Artocarpus mariannensis*) in Micronesia. Many triploid Polynesian varieties are genetically identical, but morphologically distinct. These Polynesian triploids tend not to develop under difficult climatic conditions, while the two seeded and seeded hybrid varieties are better adapted to these conditions (Ragone, 2006).

Photos: D. Ragone (2006).

Fig. 4. *Artocarpus camansi* (left) and *Artocarpus mariannensis* (right) (Ragone 2006).

In Benin there are a variety of the species called Azintin locally. This variety is distinguished from *A. altilis* by the leaves and fruit. (Akouêhou *et al.,* 2014).

Photos: Akouêhou *et al* (2014).

Fig. 5. Leaves of Azintin (left) and Blèfututin (right)/ Fruits of Azintin (left) and Blèfututin (right).

Preferences and environmental tolerances

Climate

The breadfruit tree has a wide range of adaptability to ecological requirements (Ragone, 2006). It grows best in the equatorial plains below:

600-650m, but is at altitudes up to 1550m. The latitudinal limits are about 17°N and S; but marine climates extend this range to the tropics of Cancer and Capricorn. Rainfall: 1500-3000mm

Duration of dry season (consecutive months with <40 mm precipitation): 0-3 months average annual temperature: 15-40°C (59-104°F)

Average maximum temperature of the hottest month: 32-38°C (90-100°F)

Minimum coldest month of the month: 16-18°C (61-64°F)

Minimum temperature tolerated: 5-10°C (41-50°F)

Floors

The tree prefers deep, fertile, well-drained soils, although some varieties adapt to shallow sandy soils (Ragone, 1997).

Soil texture: medium light soils (sand, silt sand, marls and sandy clay loam).

Soil acidity: Neutral for alkaline soils (pH 7.4 to 6.1)

Tolerances of special soils: saline soils, as well as coral *Soils*. Tolerances drought: resists drought for a few months, but will prematurely give up its fruit.

Shade: Young trees prefer 20-50% shade when they are young, but can be grown under full sunlight.

Fire: It can grow back from the roots after a small fire, but the Trunk and branches are not tolerant to fire.

Gel: It is damaged by frost, which causes it to lose all fruits and leaves, and a die-back branch can occur.

Engorgement: It can tolerate water-soaked soils for only very brief periods.

Salt fog: It can tolerate a certain salt spray for brief periods, but the leaves turn yellow and fall.

Wind: Branches break and lose in strong winds, because suitable for heavy fruit load, but new shoots and branches regenerate quickly.

Growth and Development

Rate of growth

The breadfruit tree is growing rapidly under favorable conditions, growing 0.5-1.5m (01.07 to 04.08 feet) per year and reaching a diameter of nearly 1m (3.3 ft) within 10-12 years. Small branches often die back at the tip after fruiting, but new shoots and branches continue to develop throughout the life of the tree (Ragone, 1997).

Flowering and fruiting

The breadfruit tree seasonally bears its fruit with most varieties, producing one or two crops per year. The main crop begins during the warm and rainy months followed by a small crop 3-4 months later.

Trees grown from seeds begin blooming and produce fruit in 6-10 years, or earlier. Vegetatively propagated trees begin fruiting in 3-6 years (Ragone, 1997).

Yields

Yields vary widely, ranging from less than 100 to more than 700 fruits per tree, depending on the variety, age and condition of the tree. Average yields are 150-200 fruits per tree (Ragone, 1997).

Rooting

The roots spread and develop on or slightly below the surface of the soil. Some varieties, particularly *A. altilis* × *A. mariannensis* hybrids, develop large buttress roots (Ragone, 1997).

Pests and Diseases

It is relatively free of diseases and parasites, although the 'mealy bugs' can be a problem at the local level. *Phellinusnoxius*, a root rot, fruit and rots caused by *Phytophthora, Colletotrichum* (Anthracnose), and *Rhizopus* can be a problem. The fruit flies infest the ripe fruit on the shaft and the ground (Orwa *et al.,* 2009).

Spread

The breadfruit tree spreads easily from root shoots or root cuttings, aerial layering branches, or from seeds. It can also be grafted by various techniques. Cuttings are not used. Seeds are rarely grown because they do not grow according to the type of tree. Vegetative propagation is an asset for seedless varieties, and root or root cuttings are the preferred methods for both seedless and seedless varieties (Ragone, 2006).

In Benin, in the departments of Ouémé and Plateau (massive production areas), *A. altilis* is planted in field gardens, fields, and near houses to serve as shade, hedges and Decorative plants. Also, the species is dominated in lowland and marshy areas. This is explained by the preference of the species for hydromorphic soils. But in the Ouémé and Plateau departments, the species is found on the plateaus but the productivity is lower compared to the individuals present in the lowlands.

Access to the species is also monitored. The notion of ownership is very important and much respected. Thus each individual exploits only the feet of trees that belong to him to avoid any conflict. There is a variant of the species that is differentiated by fruits, and leaves.

This variation could be explained by the expression of the genotype, since the two forms are found together in the same media (Akouêhou, 2012).

Physicochemical composition and nutritional value of the breadfruit tree

Breadfruit is a high-energy, nutritious food with a moderate glycemic index, rich in fiber and a good source of vitamins B1, B2 and C, potassium, magnesium and calcium, with a non-negligible thiamine content, Riboflavin, niacin and iron.

The fruit can be cooked and consumed at all stages of maturity. The fruit also contains artocarpine and papayotine. Stilbenes, arylbenzofuran, flavanone, three flavones, two triterpenes and sterols were also identified in the fruit as well as hydrocyanic acid (Azokpota, 2012). The leaves contain geranyldihydrochalcones, quercetin and camphorol with hypotensive properties. The bark of the root is rich in prenylflavonoid flavonoids, cyclomulberrin and pyranoflavonoids). Fresh fruit contains on average 70% water; 5% carbohydrates; 1.5% protein; 0.5% lipids; 1.5% cellulose; Mineral materials; Little vitamin C and A but vitamins B1 and B2 (Azokpota, 2012).

Breadfruit is an energy food. Starch and sugar make it a high-calorie food that the body needs for its energy expenditure. It is also a good source of vitamin C which strengthens the tissues of the body, helps it to assimilate iron and promotes metabolism. In addition, the breadfruit is rich in fiber necessary for good intestinal transit. People who eat high fiber foods are less exposed to obesity, which can be a cause of diabetes and heart disease (FAO, 1983). Breadfruit seeds are a good source of protein that the body needs for its growth and good health. Vitamin B 1 (thiamine), whose seeds are stuffed, helps the body convert carbohydrates into energy and heat. The breadfruit leaves are a good source of vitamin C, iron and calcium. Iron is good for blood and calcium helps to have strong bones and teeth (FAO, 1983).

Uses and products

Food uses

The breadfruit produces abundant and nutritious fruits that are generally consumed as a staple food and starchy when they are firm and mature. The fruits are rich in carbohydrates and are a good source of vitamins and minerals.

The seeds are high in protein and low in fat and a good source of vitamins and minerals. They are cooked in isolation and eaten (Orwa *et al.,* 2009). Leaves and flowers are eaten only when they are very young. In Benin, the fruit of the breadfruit tree is a starchy rich of uses: gratin, puree, donut, croquette, fried, soup, migan, babe, etc. The basis is to boil it with salt to accompany the meat or vegetables. In pastry, its flesh is used for the preparation of cakes and flour (Azokpota, 2012) the production of the flour is carried out from the unit operations mentioned in the technological diagram of Fig.6 below:

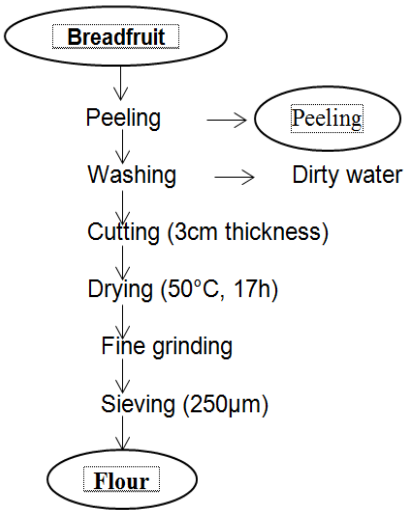

Fig. 6. Diagram of breadfruit breadmaking flour production (Azokpota, 2011).

The breadfruit is called "breadfruit" because the Beninese assimilates it to the bread of bakery. Today, traditional cooking methods can always be applied, but the fruit can also be roasted in the oven, baked in an oven or fried. In the first two cases, the skin of the fruit is pricked with a fork before cooking so that it does not burst. It is then baked (180°C) for about an hour and a half, until the fruit is tender.

In some recipes, wheat flour can be replaced with grated bread. The fruit can be used in baked or gratin, mashed or fried form (Azokpota, 2012).

It is also possible to obtain from the breadfruit fermented flour according to the diagram of Bokossa *et al.* (2016) (Fig. 7).

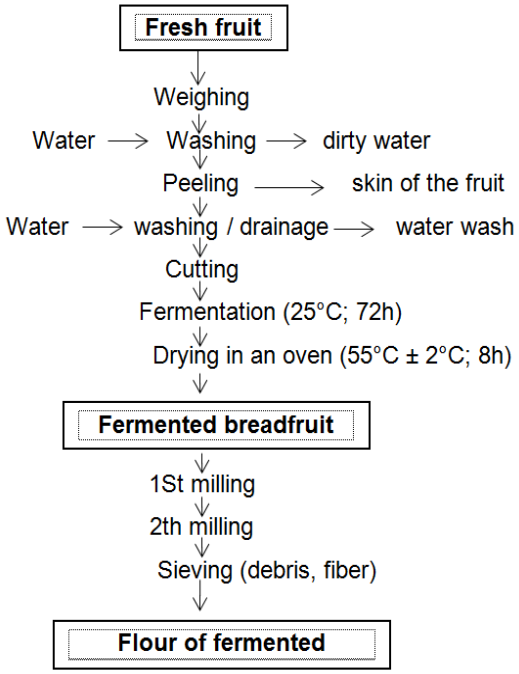

Fig. 7. Technological diagram of fermented breadfruit flour production (Bokossa *et al.,* 2016*)*.

Non- food uses

Medicine: All parts of the plant are used in medicine in the Pacific and the Caribbean, especially latex, leaf tips and inner bark. Latex is massaged into the skin to treat bone and broken sprains and is bandaged on the spine to relieve the sciatic nerve. It is commonly used to treat skin ailments and fungal diseases such as "thrush", which is also treated with crushed leaves. Diluted latex is taken internally to treat diarrhea, stomach pain, and dysentery.

The sap coming from the pound of leaf stalks is used to treat infections of the ear or the eyes. The root is astringent and used as a purgative; When macerated, it is used as a poultice for skin affections. Bark is also used to treat headaches in several islands. In the West Indies yellow (yellowing) leaves are crushed as tea and taken to reduce high blood pressure and relieve asthma. Tea is also taken to control diabetes (Ragone, 2006). In Benin, roots are used to treat pimples on the body and sex of children (Azokpota, 2012).

In southern Benin, six (06) types of uses were identified indicating the importance of the species for local populations.

Table 2. Summary of the uses of the organs of the breadfruit tree in the South of Benin.

Organes	Catégories	Utilisation (s)	Frequency (%, n = 100)
Leaves	Feed	Direct consumption by small ruminants	25
Fruits	Food	Cooking, Frying	100
Trunk	Combustible	Firewood	86
	Construction	Manufacture of canoes	49
	Craft	Sculpture, Tam Tam	37
Latex	Sociocultural	Glue (For catching birds)	22
Roots		Treatment of pimples on the body and sex of children	9

Source: Azokpota (2012).

Other uses

The wood is light weight, flexible, and can withstand termites. It is used in the construction of houses, in crafts, and as firewood. The light weight of the wood is used in the land to make small canoes for one or two people. The inner bark is used to make the bark tissue (tapa), but this custom, once widespread, is now practiced in the Marquesas and other regions. The inner wool has traditionally been used to make strong cords used for fishing in Samoa, Cronesia and the Philippines.

Large soft sheets are used in the Pacific to wrap food for cooking in earthen ovens. The sticky white latex is used as a chewing gum and as an adhesive. It has been widely used to caulk canoes as a bird trap. Dried male flowers can be burned to repel mosquitoes and other flying insects (Ragone, 2006).

Table 3. Medicinal uses and traditional *Artocarpus altilis* (Parkinson) Fosberg.

Place	Part of the plant	Preparation	Use	Reference
Vanuatu	Latex	Mix the same amount of latex of *Ficus adenosperma* and *Artocarpus altilis* and drink.	Treatment of the menorrhagia	Bourdy & Walter, 1992
Vanuatu (Mota lava)	Latex	Not documented.	Diarrhea	Navarro *et al.*, 2007
Pacific Island	Latex	Rub on the water p	Treatment of fractures and nerves.	Ragone, 1997
Pacific Island	Latex	Dilute and drink	Diarrhea, dysentery and stomach aches.	Ragone, 1997
Pacific Island	Latex and /or crushed leaves	Rub on the water p	Food allergies and infections Fungal infections	Ragone, 1997
Pacific Island	Latex and /or crushed leaves	The latex or the juice from the leaves crushed.	Infections of the Ears	Ragone, 1997
Pacific West	Bud and latex	Chew and swallow a to five buds of fresh leaves and then drink a small glass of fresh latex. Repeat one to three times a day, until the recovery.	Intoxication to the cigarette	Bourdy *et al.*, 1992
Pacific West	The Buds	Mix the buds of fresh leaves with the coconut oil	Intoxication to the cigarette	Lobel, 1979
Trinidad And Tobago	Sheets	Not documented.	High blood pressure	Lans, 2006
Suriname	Sheets	Not documented.	Fever	Bipat *et al.*, 2008
Rotuma	Sheets	Not documented.	Pain and oral inflammation	McClatchey 1993
Taiwan	Sheets	Not documented.	Fever and diseases of the liver	Ragone, 1997
West Indies	Sheets	Tea made from the yellowed sheets	High pressure of blood and diabetes	Ragone, 1997
Vanuatu (Mota lava)	Young leaves	Not documented.	Headache	Navarro *et al.*, 2007
Vanuatu (Aneithyum)	Young leaves	Not documented.	Urinary Tract Infections	Navarro *et al.*, 2007
Vanuatu (Mota lava)	Male inflorescence	Burned	To hunt mosquitoes	Navarro *et al.*, 2007
Not documented.	Male inflorescence	Roast, put in powder and rubbed against the gums	Relief of Pain hearing.	Ragone, 1997
Not documented.	Root	Not documented.	Serves as a purgative	Ragone, 1997
Not documented.	Root	Macerated and use as poultice	Food allergies	Ragone, 1997
Pacific West	Shoots	The fluid obtained from the shoots	Intoxication to the cigarette	Weiner, 1984
Samoa	Sheets	The juice of the petiole chewed or crushed and Miss drop by drop in the affected eye.	Treatment of the eyes.	Whistler 2001
Samoa	Bark/root	An infusion of the bark or roots beating is sometimes regarded as a potion	Urinary problems	Whistler, 2001
Samoa	Small branches	The smoke of the small branches blown in the anal region of a child for the treatment of a disease called Ali.	Ali	Whistler, 2001
Vanuatu (Mota lava)	Unknown	Not documented.	Black magic to stop the rain	Navarro *et al.*, 2007

Source: Jones *et al.* (2011).

Procedures for preserving breadfruit

According to the study by Worrell *et al.* (1998), breadfruit can be harvested between the 15th and 19th week to be consumed. However it deteriorates rapidly in 2 to 3 days at room temperature (≈ 26°C). Prolonged storage of 7 to 9 days is possible in polyethylene bags at a temperature of 12 to 13°C. In order to avoid cold damage, chilling injury should not be stored at temperatures below 12°C (Thompson *et al.,* 1974, Marriot *et al.,* 1979, Morton, 1987; Maharaj and Sankat, 1993, Worrell *et al.,* 2002).

Drying is done in the sun or in a very soft furnace (50°C). Wash the ripe fruit and cut into pieces. Peel and remove the heart. Cut into very thin slices, arrange the latter on racks and put to dry in the sun. Once the slices are dry, pack them in plastic bags or leaves to protect them from moisture. Dried bread is an excellent vegetable to be added to soups and stews (FAO, 1983). Another method of drying is to first cook the fruit and then crush it to give it a pasty consistency. Dry the paste in the sun and store in watertight containers (FAO, 1983).

Jacob John and Narasimham (1998) also studied another drying method. They observed the effects of 4 types of drying: vacuum drying, cross-flow drying, low temperature controlled vacuum drying and lyophilization. They concluded that the best drying method was the low temperature controlled vacuum because the breadfruit pieces had a low water content at the end of drying (1.97%) and had very good rehydration (77.29% in 1h).

In 1998, the same authors conducted a study on modified atmosphere conservation. They added carbon dioxide and gaseous potassium metabisulfite (0.5 g.kg-1 material) in polypropylene bags. They have previously immersed the breadfruit pieces in potassium metabisulphite (1000-2500ppm and 5000ppm SO2). They concluded that the small fried pieces processed at 1000ppm SO2 and then stored at room temperature are correct for 30 days, but those at 0°C are 120 days. They also noted that increasing the SO2 concentration did not extend the shelf life to 0°C.

Traditional conservation methods exist in parts of the Pacific where bread is buryed to preserve it. After peeling and removing the heart, cut into small pieces. A hole is then drilled in the ground and packed with banana leaves or breadfruit, after which the fruit pieces are poured into it. The whole is covered with leaves, old sacks, earth and a layer of stones. After two months, the fruit is fermented and ready to be eaten, but it can be kept buried for a year. When it is removed from its hole, it is placed in linen bags and rinsed with water until the fluid is completely evacuated to the foul odor. The mixture is then mixed with coconut milk and baked. Crushed bananas can also be added to the mixture before cooking (FAO, 1983).

Another traditional method in the Pacific islands is to immerse the fruits in water, resulting in a fractionation of the epicarp and softening of the fruit. However, the inner parts of the fruit remain acceptable (Thompson *et al.,* 1974). This method of storage allows storage for one week. Older processes, still in the Pacific, for longer conservation use lactic fermentation, immersing fruits or pieces of pulp in sea water, in holes dug on the shore (Coenen and Barrau,1961, Goodman, 1972, Cox, 1980). The products are a rather acidic and stable paste reminiscent of some cheeses. In another method, the fruit is selected in the mature (green-ripe) stage where the skin is removed and the edible portion is cut into 10 mm slices and then artificially dried at 49°C for 4 days, reducing moisture Of 8 to 10%. The pieces remain in good condition for 2 to 3 years if stored in an airtight container (Barrau, 1957).

Freezing also offers a way to keep the bread fruit after it has been boiled or roasted. Cut the fruit into thin slices, wrap in parchment paper and then pack in plastic bags. It will be easier to use if you freeze small quantities. Before using the frozen product (in stews or soups), reheat with steam. Once thawed, it can be fried (FAO, 1983).

Conclusion

In Benin, the field of valorization and literary review on *Artocarpus altilis* is still very limited. The information gathered through this bibliographic synthesis on the species has opened up new branches of study, notably that of the genetic characterization of the species in Benin and its ability to bread-making.

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