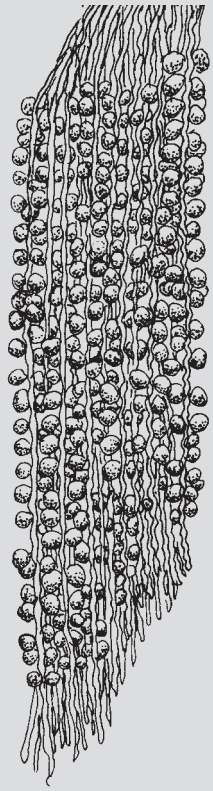
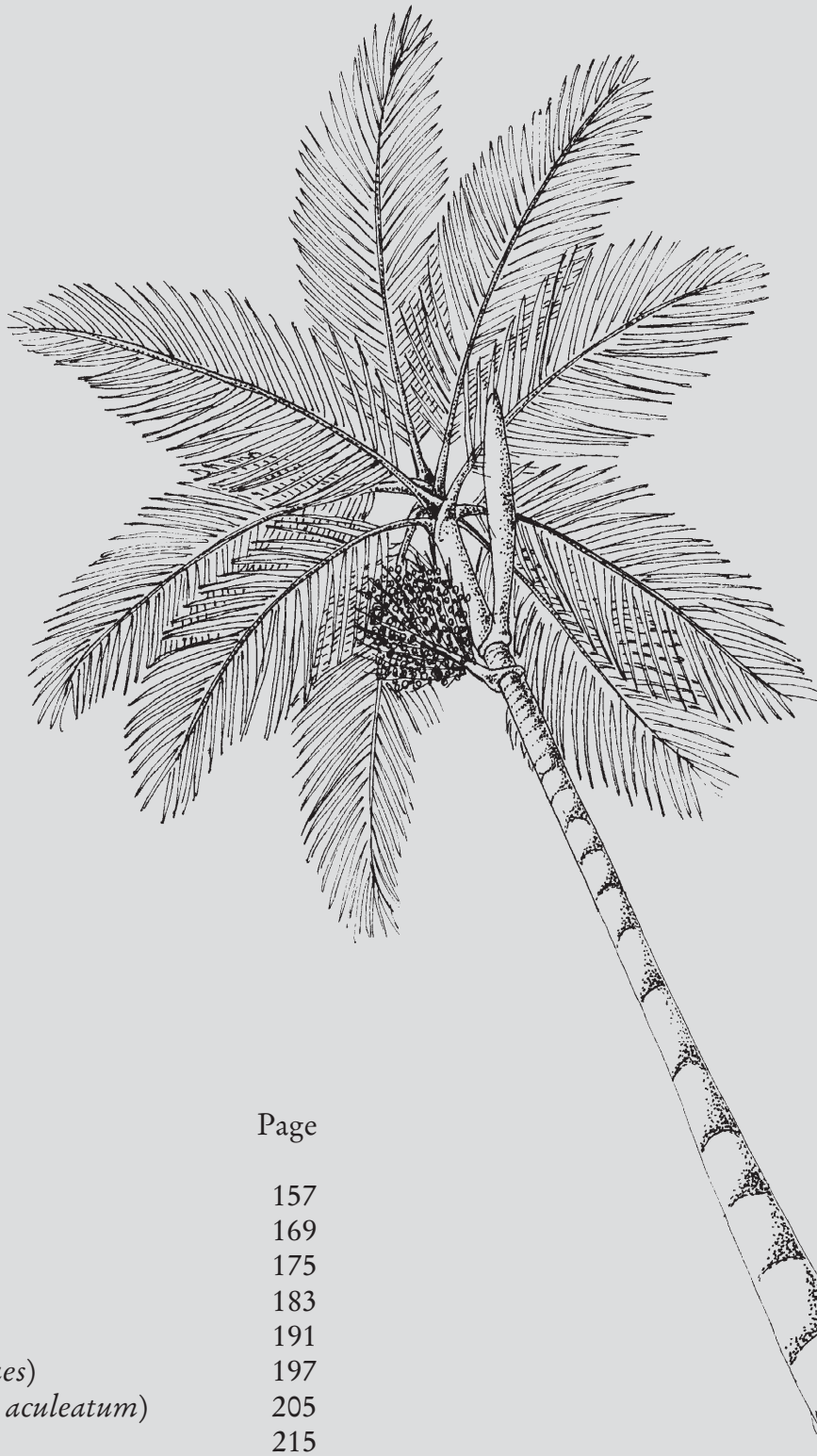
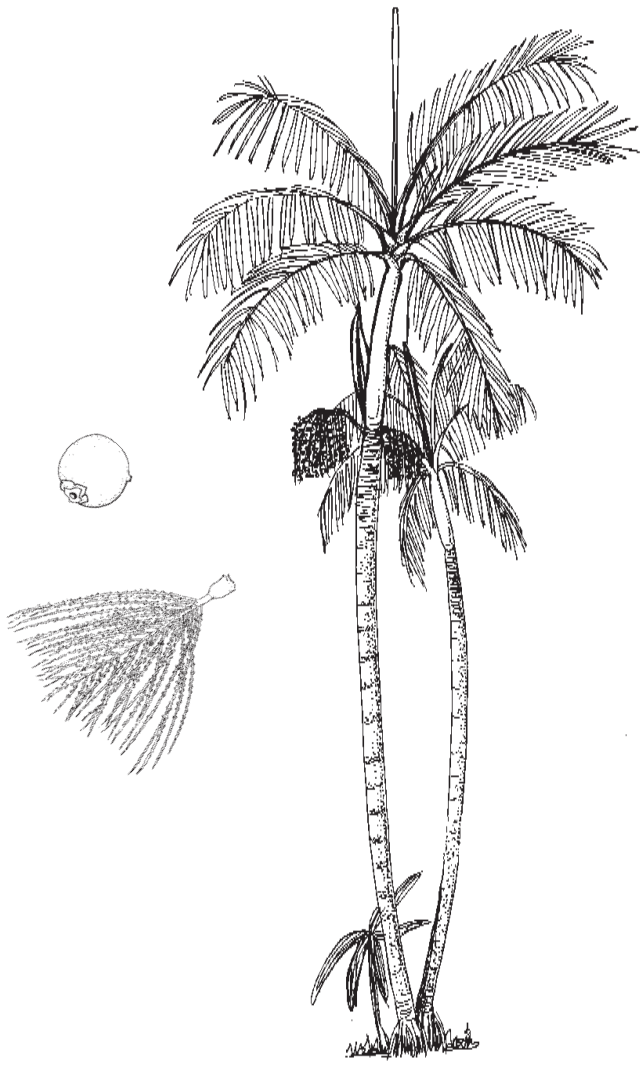
Palm trees
and diverse other species





Açaí

Euterpe oleracea Mart.



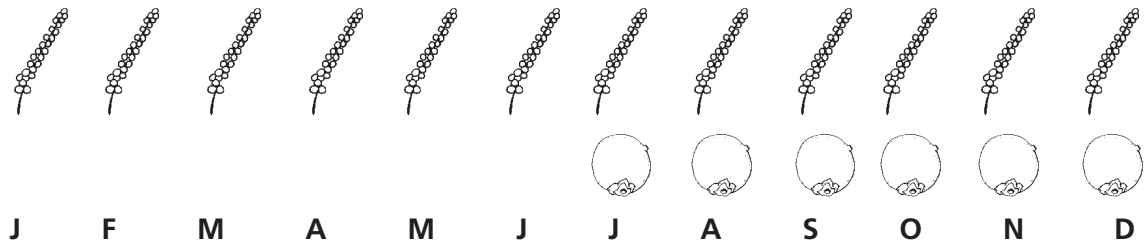
Margaret Cymerys
Nathan Vogt
Eduardo Brondizio

In the darkness before dawn, thousands of Amazonian river dwellers fill their large woven baskets with purple, pebble-sized açaí fruit and make the trip in small canoes or large boats to the scattered outdoor markets of the city of Belém. As the boats near Ver-o-Peso, the largest market at the mouth of the Amazon River, a seller shouts, "blood of the cow!" Buyers run to the boat, pressing their nails into the fruits to see if they are of good quality. "Blood of the cow" is a local reference for the meaty açaí fruit with wine-coloured pulp. From an age of six months, children of eastern Amazonia drink açaí juice. As one fairgoer says, "At a young age, the intestines of the Paráense natives are already accustomed to açaí." And with great benefits – açaí is being touted as a "super fruit" for its anti-inflammatory, antioxidant and anti-cancer effects. Because of its growing reputation, demand for açaí is expanding around the world.

Açaí is a multi-stemmed palm native to eastern Amazonia, with the greatest occurrence in the estuary of the Amazon River, where it occupies most of the floodplain forest of the region. The palm is also found in the Brazilian states of Amapá, Amazonas and Maranhão, as well as in Guyana, French Guiana and Venezuela. Açaí palms grow at various densities in both seasonally flooded forests and permanently flooded forests. Birds, monkeys, people and water are responsible for the dispersal of the açaí seeds. The açaí fruit grows best in open areas with substantial sun, such as floodplain forests where canopy trees have been thinned. The palms can reach a height of over 25 m, with trunks between 9 cm and 16 cm in diameter. The palms generally grow with 4–9 stems per clump, but up to 25 stems is possible.

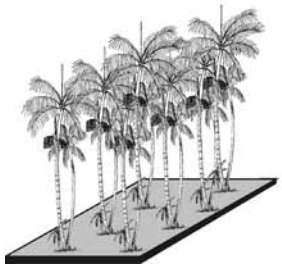
ECOLOGY

Flower and fruit seasons

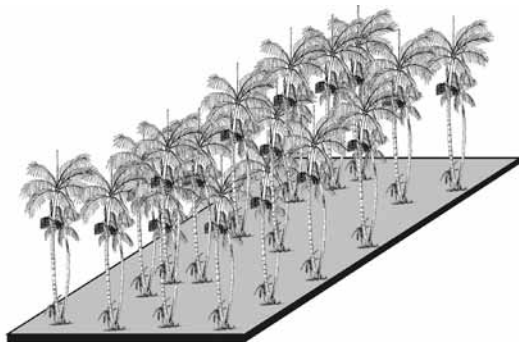


Flowers and fruit grow all year long, but there are periods when production peaks. These peaks vary across the açaí's region, thus lengthening the number of months the drink is available to supply enthusiastic consumers. In general, the period of the greatest fruit abundance occurs during the dry season, from July through December. When mature, the fruit becomes hard and blackish, like a pebble.

Density



170 clumps/ha in unmanaged forest

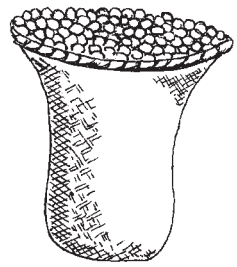


820 clumps/alqueire in unmanaged forest

In one Marajó municipality, clumps of açaí in unmanaged floodplain forest varied between 128 palms and 208 palms/ha.[1] In the flooded forests of the estuary of the Amazon River, there are between 300 and 400 adult açaí trees and an average of 800 juveniles/ha. Intensively managed forests can reach densities of 1 200 clumps/ha. In poorer soils, it is common to find densities of 100–200 clumps/ha.

Production

During the peak season, between 10 000 and 20 000 baskets of açaí fruit, weighing 14–15 kg each, arrive at the Açaí Fair each day.[2] Pará is the largest producer of açaí juice; in 1997 alone it produced more than 1 million litres.[3] Each adult açaí stem produces 4–8 fruit bunches/year. Each bunch contains 4 kg of fruit, giving a total of about 120 kg of fruit/açaí palm/year. On the island of Onças, where the river dwellers manage açaí for the markets of Belém, an average production of 1 160 kg/ha/year was produced on control plots. The palms, which are managed by pruning most of the young stems and thinning other plants that grow up around them, can produce 10 000 or 12 000 kg/ha/year in terra firme forest and up to 15 000 kg in flooded forest.[1]



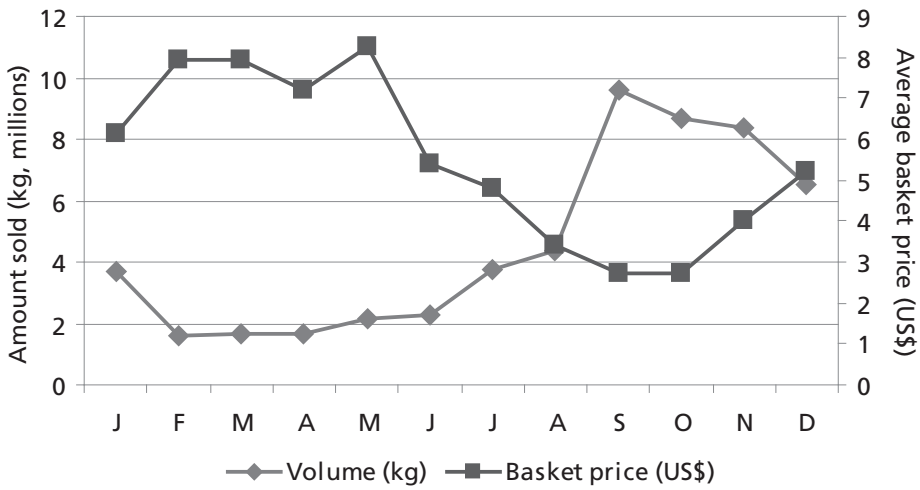
an average of 120 kg of fruit/palm/year

Economic value

In the early hours of the morning, 70–120 sellers arrive at the Açaí Fair in Belém; by 8 a.m., all the açaí has been sold – disappearing into the trucks, carts, and sacks of willing customers and large firms that fan out into the city. Guess how many açaí home shops and street vendors there were in Belém in 1995? More than 2 000! Imagine how many there are now. Most of the açaí consumed in Belém is produced on the neighbouring islands of Marajó, the island of Onças, and in the region of Acará. The majority of that production comes from *Euterpe oleracea*.

The amount of açaí sold at the ports of Belém varies throughout the year, with prices rising when the fruit is scarce and dropping during peak fruit production. During the 2007/2008 harvest in the municipality of Ponta de Pedras, two producers recorded the farm gate price of a basket to be US$3.50 at the beginning of the season (in August) and US$9 at the end of the season (in January). Not surprising, the price is slightly below that sold at the ports of Belém because the transporters take their share.

Açaí prices and the quantity of açaí consumed have both skyrocketed in recent years. In 1995, a 14-kg basket of açaí sold in Belém for between US$1 and US$5, a fraction of its current price. In April 2003, that basket of açaí sold for an average of US$4, and by April 2008, with growing international and national markets, one basket sold for more than US$30. However, this is not the reality for most producers around Belém where production rarely stretches through April. Only occasionally they strike it lucky with a small amount of off-season harvesting. Traders, on the other hand, usually bring açaí from distant regions to capture these opportunities. Producers from the state of Amapá who harvest açaí during Pará's off season are increasingly sending their product to Belém and surrounding regions.



Source: SECOM

Mean monthly price and volume of açai sold in ports of Belém 2004/05

In 2008, the price of one litre of açaí juice in Belém ranged from US$2 for thin juice and up to US$5 for very thick juice. Pressure from export markets has influenced the quality of açaí juice sold to those who consume açaí as a fresh staple food. When açaí fruit prices are high, processors who sell it fresh for daily consumption increase the amount of water and, in some cases, add thickening and colouring products. This way they can keep prices accessible to low income consumers, but at the expense of quality. While most Amazonians only consume it fresh, those who like smoothies and açaí desserts can ensure they have it out of season by purchasing frozen pulp for US$5/kg.

National and international consumption of açaí has grown dramatically in recent decades. In the Amazonian city of Macapá in 1998, people consumed between 27 000 and 34 000 litres a day, and the açaí industry earned more than US$15 million/year.[4] In Belém, consumption has risen from 90 000 litres/day in the late 1980s to an estimated 400 000 litres/day in the late 1990s.[5] In 2006, the Brazilian national statistics estimated that more than 101 000 tonnes of fruit were sold, for a value of US$47 million[6], but that misses much of the regional production vastly underestimating the actual trade.[1]

Açaí has become less important as a source of palm hearts as producers focus on supplying fruit to this growing market. Likewise, technological advances providing ice or refrigeration on cargo boats allow more remote producers to manage their açaí stands for the perishable fruit but palm hearts can be collected during stand thinning. Over 99% of the palm hearts harvested in the Amazon region come from açaí. In 1996, more than 86 000 tonnes of palm hearts were produced from açaí, at a value of more than US$13 million.[6] In 2006, palm heart production in the Brazilian Amazon had dropped to around 6 100 tonnes, still generating almost US$3.9 million[7] in supplemental income for riverine communities.

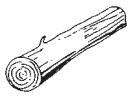
USES

Fruit: Açaí fruit is sold as frozen pulp, jam and juice. It is used to flavour ice cream and other frozen treats, cakes, porridges and bonbons. It is also sold as powder and pigments.

Palm hearts: The palm hearts are eaten fresh or canned.

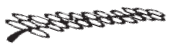
Leaves: The leaves are constructed into houses, baskets, carpets, fans and ropes for climbing trees. They also provide fertilizer and animal feed. The spathe that covers the fruit bunch can be taken by children to make toy boats or utilized by parents to make hammocks for babies.

Seed: The seeds make excellent fertilizer and, when dry, are crafted into jewellery.

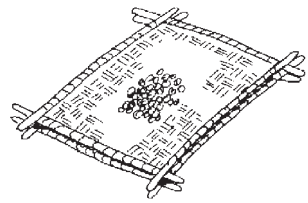


Trunk: The trunks are used for framing in the construction of rural houses and to make bridges across small streams.

Young roots: When made into a medicinal tea, the young roots help to get rid of worms.



Fruit stem: The stem remaining after the fruit are removed is used as a fertilizer or as a garden broom. When burned, the stem serves as an insect repellent.



Scientists learn from caboclos

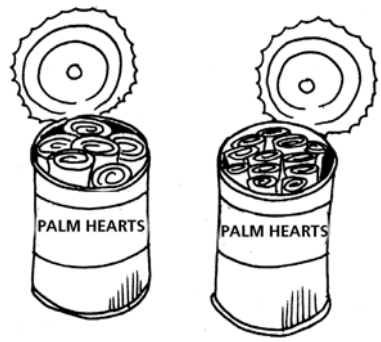
Mário Jardim

Black, purple, tinted, speckled and white – who can recognize so many types of açaí? Although scientists have only one name for açaí, people who live along the rivers identify distinct varieties. Black and purple açaí are considered the most common, while other varieties are distinguished by the characteristics of their fruit and palm. Some scientists are incorporating such local knowledge into their botanical identifications and are calling these differences "ethnovarieties".[7]

Palm heart extraction

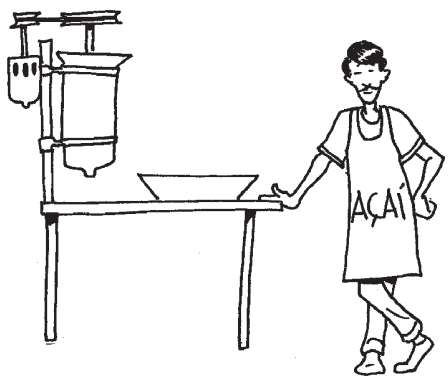
In the 1970s, when the palm heart industry began in Pará, extraction was intense, often destroying the açaí palms and leaving disgruntled people without açaí fruit juice. In the 1980s, the açaí stands started to show signs of unsustainable exploitation, and in 1989 IBAMA, the Brazilian federal environmental institute, created a law that only permitted the managed cutting of açaí palms. Today, the açaí merchants closer to the city can earn more through the sale of açaí fruit; and palm hearts are extracted from stands farther from metropolitan areas, but there are still cases of illegal açaí cutting.[9]

How many palm hearts per can?



In managed açaí palm groves, 700 large açaí palms grow on each hectare, translating to 190 kg/ha of palm hearts for each harvest. Palm hearts can be harvested repeatedly from the same plant, as the açaí forms shoots off numerous stems. This way, smaller stems can be left and a few larger stems removed without killing the tree. However, extracting a substantial number of palm heart stems from one tree can diminish the number of valuable fruits a palm is able to produce. Consumers can judge if the canned palm hearts in their house were harvested sustainably or not. A simple technique to monitor the pressure on açaí palms from the palm heart industry was developed by Harrison Pollak, Marli Mattos and Chris Uhl: count the number of palm hearts in the can. When there are more than 17 palm hearts in a can, you know this came from an area of overextraction as it indicates too many small stems are being harvested. A 1 kg can containing 17 palm hearts or less indicates a sustainable practice of harvesting larger stems and only a few smaller stems.[9]

Happy Açaí Sunday

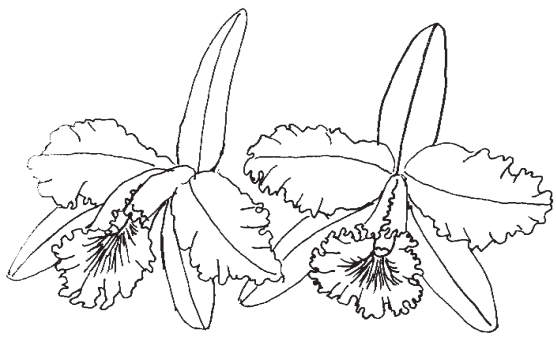


When the açaí harvest is at a peak, people in some cities in eastern Amazonia, like Abaetetuba, Cametá, Ponta de Pedras and Moções, have an Açaí Festival. Street competitions include: the largest variety of foods made from açaí; the largest or smallest bunch of fruit; the person who can drink the most juice; and folk dancing. Revellers in the streets stroll by with something in common, their lips stained purple by the fruit of açaí, singing an açaí-inspired song, "It's the plant that feeds the passion of our people…."

Treatment of cuts and worms

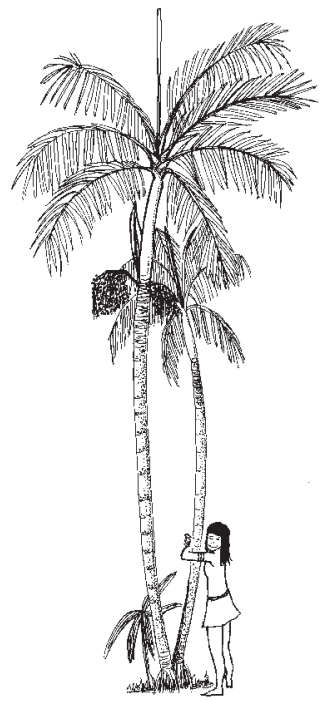
If someone has an accident in the woods, cut the top of an açaí palm heart and squeeze the juice over the wound. This should stem the bleeding. Also, in riverine areas an extract prepared from açaí roots as a tea or tonic is often used as an anthelmintic to expel parasitic worms from the body.

Attention orchidophiles!



João Batista da Silva, an orchidophile at the Goeldi Museum, in Belém, made a handy discovery regarding the cultivation of orchids and açaí seeds. After the pulp is removed from the seeds of açaí, the seeds are normally tossed aside as garbage. However, this garbage is a rich planting mix for orchids and ornamental plants. Açaí seeds can even serve as a substitute for expensive fertilizers found in the market. To make the fertilizer, gather together the açaí seeds, wash them and boil them to prevent germination. Let them dry before using them. Joao's discovery has become a widespread practice – seed sellers now sell açaí fertilizer door to door.

Legend of açaí



There are different legends associated with the açaí palm. A popular one goes as follows.

In ancient times, there was an indigenous tribe of Pará that passed through a long and difficult hunger season. To save some of his people, the chief felt that he had to order that all the children of the village be killed, including his own daughter Iaça. The daughter was heartbroken and set off for a walk through the woods. The chief went to look for Iaça and found her standing near a palm. The chief walked closer to his daughter and found her embracing a palm full of small black fruits. The chief prepared a drink from the fruit and brought it to his tribe to relieve their hunger. In homage to the palm tree that still feeds people today, the chief inverted her name and called the tree "açaí".

NUTRITION

People from Pará cannot live without açaí juice. The table can be laid with roast beef, salad, fish or barbeque, but without açaí, it just is not a meal. In some Amazonian caboclo communities, açaí was found to make up 42% of their daily intake by weight.[10] Some people in Belém drink up to 3 litres of açaí/day. In the 1990s, an average person from Belém consumed 60 litres of açaí/year.[5] An estimated 180 000 tonnes of açaí are consumed each year in the city.

It's good and good for you

Açaí tastes good and is also good for you. The pulp has a high number of calories, up to 247 calories/100 g. Açaí juice is rich in calcium, iron, phosphorous and vitamin B_1. It is also high in the beneficial fatty acids omega-6 and omega-9. The level of vitamin A is higher than many other tropical fruits. One hundred grams of açaí contains 2 g of protein, 12.2 g of lipids, 11.8 g of iron, 0.36 g of vitamin B_1 and 9 mg of vitamin C.[12] The level of protein in açaí is similar to milk. The palm heart of açaí has few calories, but is a good source of minerals, containing sodium, potassium, magnesium, iron, phosphorus, copper and silicon. Riverine caboclos indicate that it is not advisable to eat açaí with milk, alcohol or fruits such as cupuaçu, mango, cacao and watermelon. Scientists confirm that acidic fruits should not be eaten together with açaí, although this is a common practice outside the region where açaí consumption became popular in fruit smoothies.

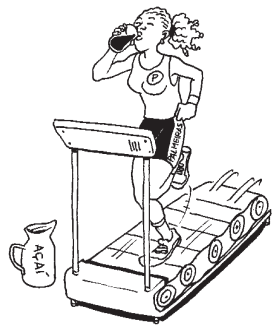
Nutrition facts

	Quantity/100 g	% of daily intake*
Calories	80	-
Total fat	6 g	9
Saturated fat	1.5 g	7
Omega 6	860 mg	-
Omega 9	3 360 mg	-
Cholesterol	0 mg	0
Sodium	10 mg	0
Total carbohydrate	7 g	2
Fibre	1 g	5
Sugars	0 g	-
Protein	2 g	-
Vitamin A 15%	**Calcium 4%**	
Vitamin C 8%	**Iron 6%**	

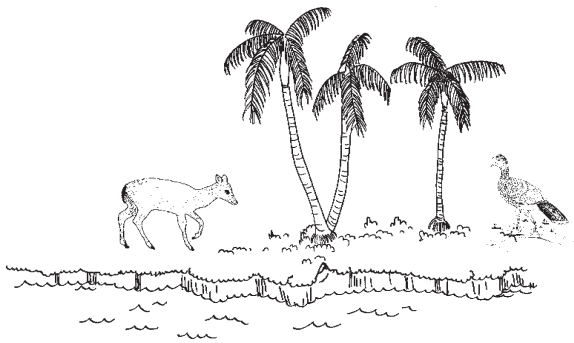
* Daily values are based on a 2 000 calorie diet. [11]

Açaí is being marketed in the United States of America and Europe as a "super food". In 2006, a study found that extracts from açaí berries initiated a self-destruct response in up to 86% of the leukaemia cancer cells tested in the lab.[13] These effects have not yet been demonstrated on cancer in humans. Açaí is rich in flavonoids, which give it its dark purple colour and provide a high dose of antioxidants.

Açaí pulp has become a fad in gyms in the south of Brazil. Athletes enjoy açaí mixed with guaraná and oats to give them a burst of energy. Dona Maria is one of the people in Belém who exports frozen pulp. She said she sent açaí to a snack shop in Rio de Janeiro for the first time in 1980. Twenty years later, she was sending up to 800 tonnes per year to different cities throughout Brazil.



WILDLIFE



Açaí is important in the diet of many mammals and birds, such as toucans, tinamous, chachalacas, spider monkeys, capuchin monkeys, deer, tapirs, peccaries and agouti. Fish and turtles also like açaí. Guans enjoy both the fruit and the leaves of the açaí tree. People from the Kayapó Indian group place açaí fruit on their fields to attract and feed wildlife.

MANAGEMENT

germination
30–40 days

growth
2 m/year

production
4–6 years

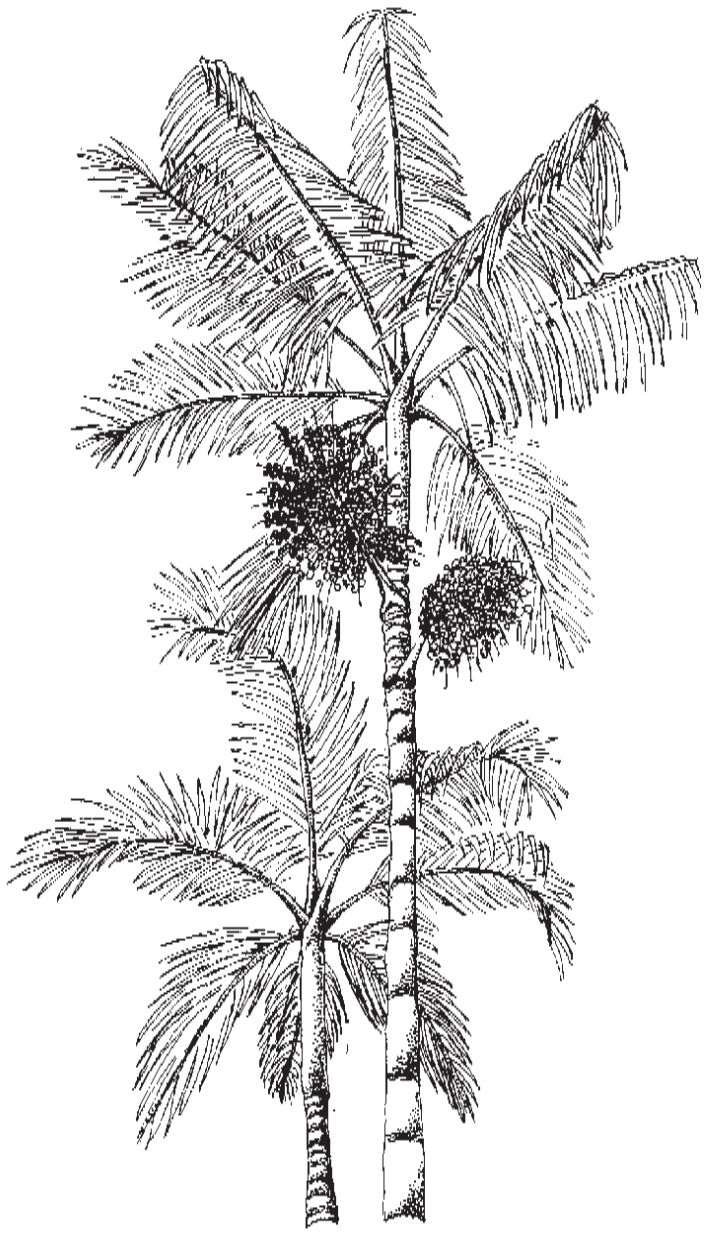
Açaí palms regenerate easily in the seasonally flooded forests of the estuary of the Amazon River, where the seeds are spread by people, animals and water. In the terra firme forests, the palm is cultivated by planting sprouts. The seeds germinate quickly (in 30–40 days in humid conditions) and in four or five months (at 30 cm in height) the sprouts are ready to be planted. In the natural environment, less that 50% of the seeds germinate. Light is the principal requirement for rapid growth. Açaí agroforestry systems in the estuary floodplains are developed primarily by the planting of açaí seedlings in swidden agriculture plots after planting of annual and biannual crops or by the management of native floodplain forests, or a combination of the two.[1]

Estuarine producers increase açaí productivity in floodplain forests by managing both the entire forest stand and the individual palm tree. To increase the productivity of the entire stand, it is necessary to thin the large canopy trees shading the açaí palms, but many producers keep the economically important species, such as andiroba, ucúuba and rubber trees. It is also wise to cut the vines and branches of neighbouring trees so they do not interfere with the crowns of adult açaí palms. But do not throw them away; they make good fertilizer.

For the individual palm, some families who manage açaí have discovered that removing some of the stems of the clump for palm heart extraction can also increase fruit production.[14] They remove the older stems that are too tall for fruit collection, as well as some of the smaller stems to take advantage of their inner, tender palm hearts. Experienced harvesters leave both the productive and nonproductive medium-sized stems. In one highly productive Marajó municipality, managed açaí groves contained an average 500 palms/ha, with some containing more than 870 palms/ha.[2]

Açaí fruits last between 36 and 48 hours without refrigeration. In areas where the fruits cannot be sold because of the long distances to markets, managing for palm hearts is an important alternative. To avoid harming the açaí palms, remove only three stems per cluster of the larger palms (those 10 cm or more dbh) every three or five years.

When your açaí fruit season is over, do not worry; açaí farmers have been experimenting with ways to extend the production season of açaí fruit. To encourage production out of season, they pick the flowers when they are still young as a way to alter the season when the tree gives fruit.



Small fruit makes a big splash

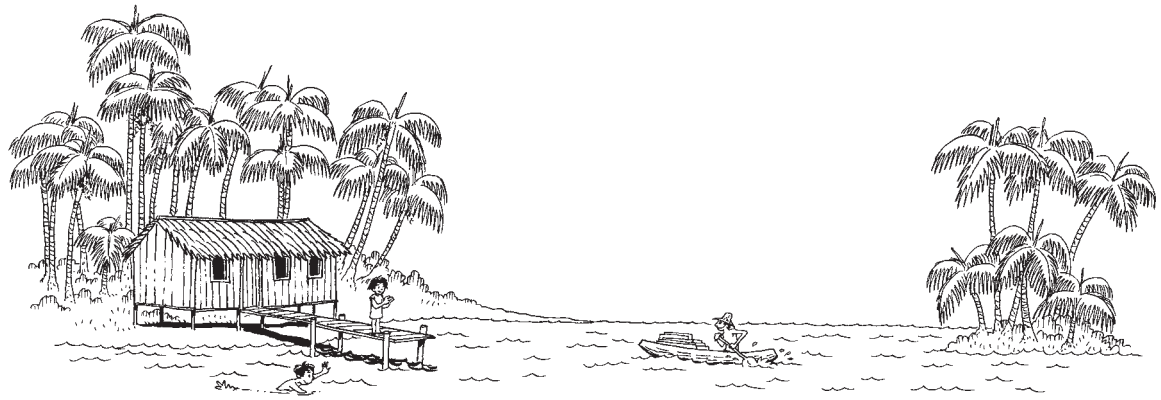
When rural families began establishing urban residences in large numbers in the 1960s, they brought their habits and their cultural preference for açaí fruit with them, creating a demand that has grown during the past 50 years.[15] In addition to contributing to cultural continuity regarding food preferences, açaí fruit has provided affordable nourishment and remains a caloric staple particularly important to low-income urban residents.[16] How did this regional demand, and later the national and international craving for açaí fruit, impact the estuary? Let's take a look.

From the air, the floodplains of the Amazon estuary appear as a continuous blanket of homogenous forests, sometimes misinterpreted as pristine. From the ground, forest landscapes reveal the legacies of past economic booms, with large areas increasingly dominated by intensively managed patches of açaí agroforestry, a process some have called the "acaization" (açaização) of the Amazon estuary. Up closer, we see clearly defined forest farms where careful managers take up unmanaged forest patches (producing an average of 1 400 kg/ha/year, or 200 açaí clumps/ha) and intensify production to as high as 12 000 kg/ha/year, or 1 200 palms/ha. Although the productivity is modified year to year, the extent of these intensively managed patches has spread across the region in recent decades and is now the dominant land use, all done without external capital or agricultural extension agents.

Widely available throughout urban stalls and restaurants in the 1990s, açaí came under the radar of food companies who saw the potential to sell it as an energy and health drink in national and international markets, where products deemed both socially and environmentally responsible are fashionable and may reach astounding prices. For instance, pills and vitamin supplements claiming the health and anti-aging benefits of açaí can reach US$50 for a 60-capsule container. The combination of international interest, national consumption and regional urban demand of açaí as a staple has caused the overall demand for açaí fruit to skyrocket in recent decades.

Ironically, companies and many Brazilian agencies, both new to the açaí business, and the media at large, still give the impression that açaí is extracted from native forests. They often believe that they need to guide the riverine caboclos in intensifying production. In reality, the production systems being developed by companies and government institutions are built upon those designed over the years by riverine caboclos. The new management and planting techniques, such as the agronomically sophisticated "roçados de várzea," (floodplain gardens), are based on local knowledge of the floodplain forests. The initiatives and efforts of the riverine caboclos to intensify production since the 1970s are responsible for the present high-density açaí "native" forests. Caboclo ingenuity has allowed production to reach its current levels in national and international markets.

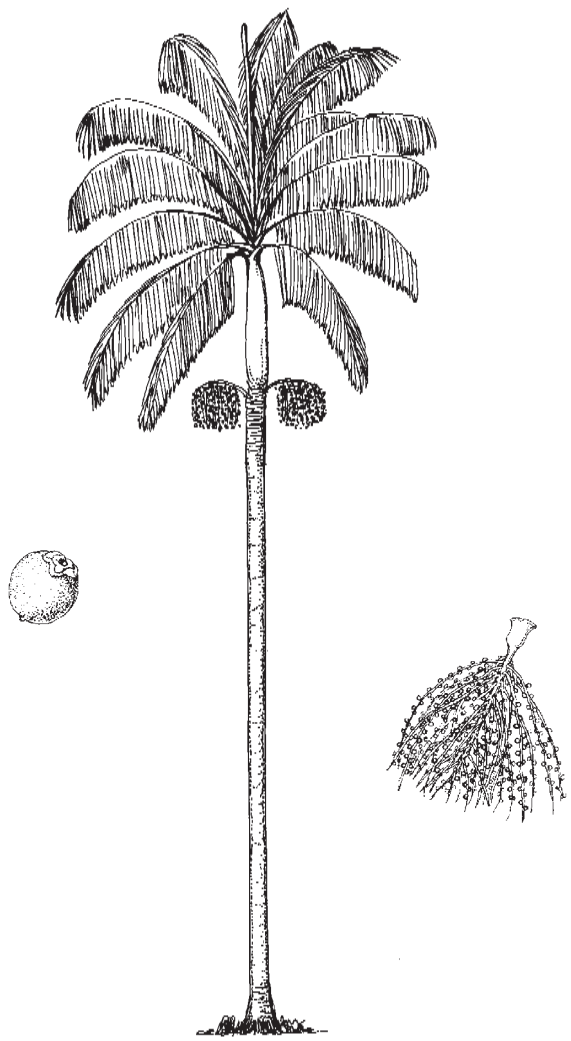
However, with the expansion and industrialization of açaí, these same producers are the ones that receive an ever-decreasing proportion of this enormous and growing economy. The story of açaí fruit and its producers demonstrate an important lesson for sustainable development of the Amazon. It is possible to value the forest and increase production by improving on local techniques, but merely exporting unprocessed resources is not enough to generate local development. The region needs a "transformative economy" where the value of the fruit (and other products) can be aggregated locally. Incentives towards a transformative economy could help increase the economic return for those who produce as well as encourage the creation of regional businesses and create jobs for both rural and urban people.



[1] Brondizio, E. 2008
[2] Weinstein, S. 2000
[3] Clay, J.W.C.; Clement, C.R. & Sampaio, P.B. 2000
[4] Poulet, D. 1998
[5] Padoch, C. *et al.* 2008
[6] Jardim, M.A.G. 1996
[7] IBGE 2006
[8] Jardim, M.A.G. 2000
[9] Pollak, H; Mattos, M. & Uhl, C. 1997
[10] Murrieta, R.S.S.; Dufour, D.L. & Siqueira, A.D. 1999
[11] http://www.sambazon.com/nutrition/frozenPure.jpg (accessed August 14, 2008)
[12] Calzavara, B.B.G. 1987
[13] Del Pozo-Insfran, D.; Percival, S.S. & Talcott, S.T. 2006
[14] Jardim, M.A.G. 1995
[15] Brondizio, E.S., C.C.M. Safar & Siqueira, A.D. 2002
[16] Brondízio E.S. & Siqueira, A.D. 1997

Açaí (solitary)

Euterpe precatoria Mart.



Evandro Ferreira

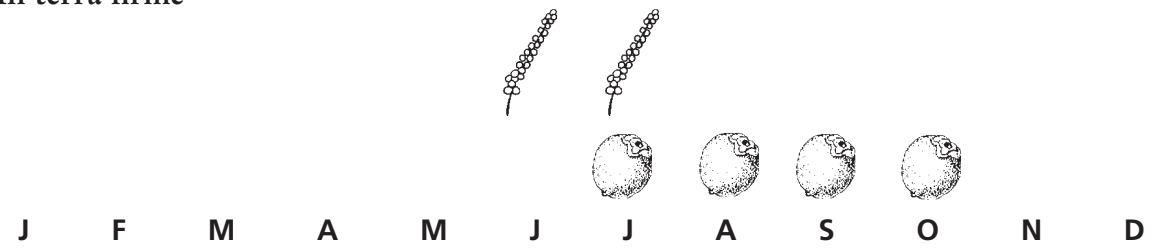
Indians and rubber tappers in Acre have loved the rich, purple juice made from the berries of this palm for generations, but it has only recently begun to appear in the markets. Urbanites have also discovered açaí and are becoming accustomed to serving it – sometimes as a sweet, and sometimes as a savoury – at every meal. The solitary açaí that grows in Acre is different from the multi-stemmed açaí that is found in Pará. As its name would indicate, solitary açaí grows a single stem, or trunk, and is generally taller than the açaí from Pará, reaching heights of more than 23 m. It is native to the western Amazon and generally found in mature forests, occurring in wetlands, flooded forest and terra firme forest. Solitary açaí is only slightly resistant to fire and is rarely found in deforested areas. The heart of this palm is a great delicacy, which, sadly, has led to a massive reduction in its native population.

ECOLOGY

Flower and fruit seasons

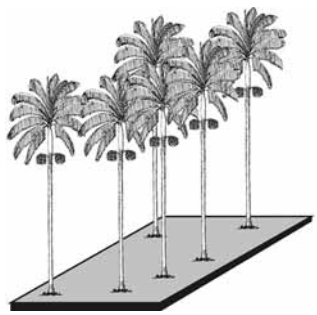
In wetlands

In terra firme

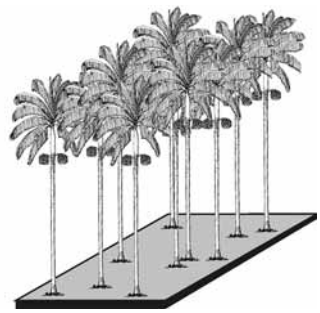


The flowers and fruits can be found throughout the year, but there are seasonal peaks of production. In Acre, the solitary açaí growing in flooded areas produce first, from March through June, then the palms growing on terra firme start to produce, from June through October.[1]

Density



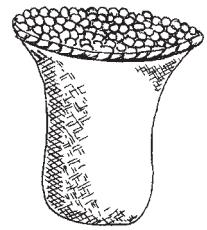
39 palms/ha in terra firme



57 palms/ha in wetlands

The greatest density of palms occurs in swampy areas. For example, in wetland areas of Epitaciolândia, 57 productive individuals were found per hectare,[2] while in the terra firme forest there were only 39/ha.[3] Another study in Acre found adult densities of 23 palms/ha in terra firme forest and 60 palms/ha in flooded forests.[4] It is possible to find up to five times as many solitary açaí palms in the flooded areas as in the terra firme.

Production



8 kg of fruit/palm

During the year, each palm produces between 2 and 6 bunches of fruit. One hectare of terra firme forest can produce more than 140 kg of fruit, and in flooded forest the production can reach more than 270 kg/ha.[5] Despite this, the large, meaty berries of the terra firme palms are more sought after than the smaller and more abundant variety that grows in the flooded forest. A palm from the flooded forest produces an average of 7.5 kg of fruit, while a palm from the terra firme produces 8.5 kg of fruit. The perfect time to collect açaí is when the fruit are almost black and beginning to fall. After being harvested, the fruits should be kept out of the sun. They can last for up to three days before they begin to turn.

Economic value

In Rio Branco, the capital of the state of Acre, the berries from solitary açaí were sold in 2005 for US$2–2.50/12-kg can. In August 2002, there were 19 places to buy açaí equipped with machines to extract the juice from the seeds; these sold a total of 7 500 litres/week, for between US$0.54 and US$0.72/litre. Based on the sale of açaí juice, we can deduce that 22 tonnes of açaí fruit were sold each week in Rio Branco during that year. Solitary açaí has a lovely white seed that is in high demand by local artisans for jewellery-making. Half a kilogram of polished and punctured açaí seeds sold for US$3.40 in 2004. Necklaces made from guaraná, coconut and açaí are being sold as far away as New York City. The most elaborate and spectacular of these necklaces can cost as much as US$167.

Uses

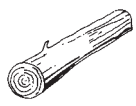
Fruit: Palm berries are used to prepare açaí juice, ice cream and other frozen ice treats, and chicha, a fermented drink loved by local indigenous people. The juice can be served as a cold soup; thick, unsweetened and with farinha added, or thinner with sugar as a beverage.

Seeds: Jewellery made from pure white açaí seeds has become a fad across Brazil, and the most popular seed is from single açaí. Multi-stemmed açaí seeds are violet.

Palm heart: Palm hearts can be eaten fresh, alone or in salads.

Oil: In Peru, some Indians use the oil as a beauty product for hair.[6]

Leaves and roots: The juice obtained from pressing new roots and new leaves is used to cure snake bites, as well as to treat anaemia.[7] In Bolivia, the leaves are used by Indians to make brooms and as roofing for houses.[8] In Peru, the root is used to cure liver and kidney disorders.[9]

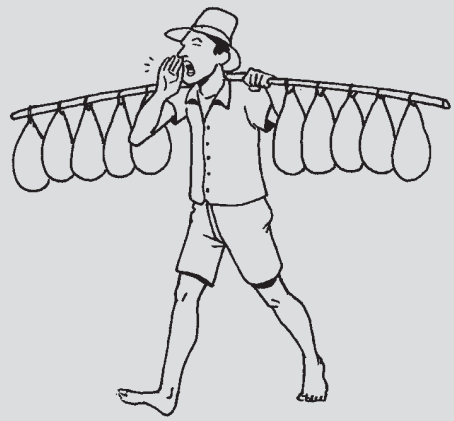


Trunk: The trunks are used as beams for house construction in rural areas.

NUTRITION

Since the rubber era, single açaí has been adored and consumed in great quantities by rubber tappers, who after a long day of walking through the forest look forward to large gourds of açaí juice with their meals, often accompanied by farinha, seasoned with pieces of fried meat or salted shrimp. Açaí continues to be very important in today's diet: the 111 families in the Acre community of São Luiz do Remanso consume approximately 1 665 kg of fruit/year.[10] Many people in Acre drink up to one litre/day of açaí, which is impressive considering that açaí juice is loaded with calories: from 80 calories/100 g of the thin, commercial type, to 265 calories/100 g for the thick kind.[11]

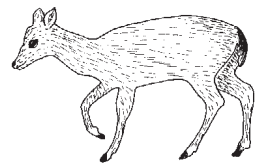
Fresh açaí on every corner



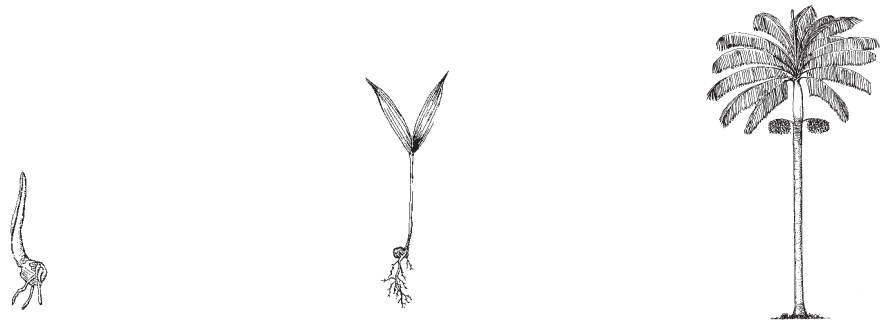
These days you do not have to be concerned about drinking açaí in the streets of Rio Branco. The majority of açaí vendors use clean "de-pulping" machines and mineral water to extract the juice and store it in refrigerators. You can also find açaí juice for sale in the supermarkets. This is a recent improvement, however. In the past, açaí pulp was removed from the seed by hand. The vendor would then tie 15 to 20 bags of freshly squeezed juice on a pole to carry on his shoulders as he walked through the streets under the blazing equatorial sun, calling out, "Açaí! Açaí!" The juice would bake all day inside plastic bags and was often spoiled by the time it reached the table.

WILDLIFE

According to the locals who live in the communities of Dois Irmãos and Caquetá, parrots, macaws, toucans and curassows are the primary dispersers of solitary açaí seeds throughout the forest. Scientists agree and discovered that açaí composes 59% of the red brocket deer's diet and 80% of the grey brocket deer's diet.[5]



MANAGEMENT



germination
30–40 days

growth
5 m/year

production
4 years

In comparison to multi-stemmed açaí, there are few studies about the management of solitary açaí. However, scientists do have one important tip: If you collect solitary açaí bunches at the height of the season and let them fall the rest of the year, everyone wins – the animals can eat, the açaí can reproduce and people can have their beloved juice.[2]

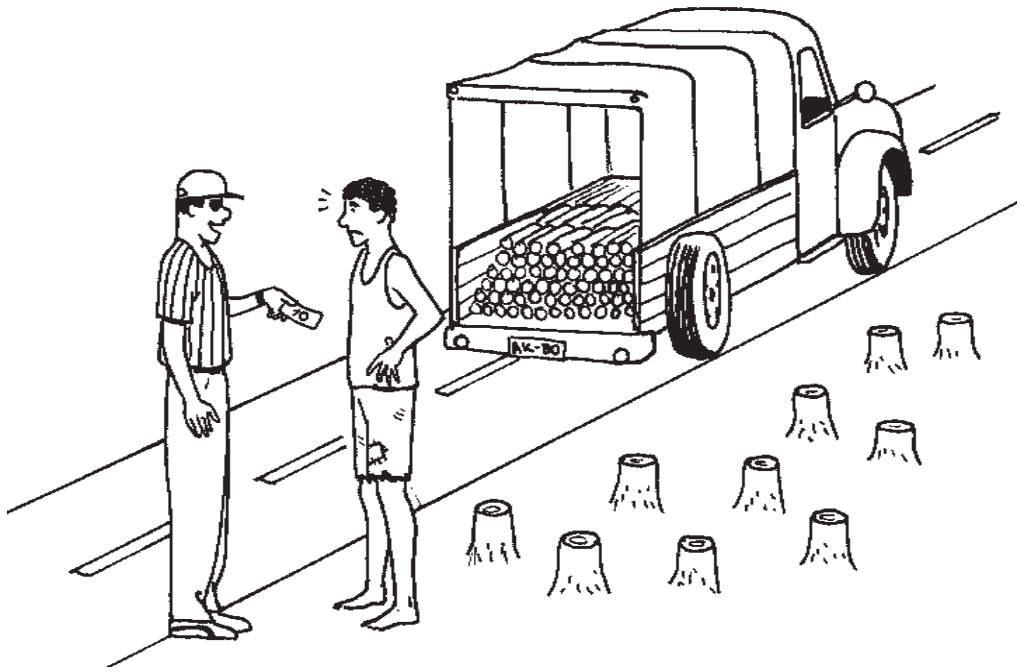
Downward spiral: prices and açaí stands

The process of extracting palm heart results in the death of solitary-stemmed palm trees. There are no examples of sustainable palm heart harvesting in the whole state of Acre.

Along the road that links Acre to the state of Amazonas (BR-317), extraction of palm heart destined for the cities of Rio Branco and Senador Guiomard practically destroyed the solitary açaí population by the end of the 1990s. In those days, palm heart merchants travelled along the back roads in the countryside convincing local farmers to sell their açaí palms. In 1994, the going price was US$0.22/palm stem, already extracted and prepared for sale. If the merchants extracted the palm themselves, however, the price fell to US$0.11. The owners of those palms have had to wait many years for them to grow back to a reasonable size.

In Bolivia, predatory exploitation threatens the regional extinction of açaí.[12] Palm heart producers in Bolivia should take a lesson from Acre, where the palm heart companies went out of business because the stock was decimated. The

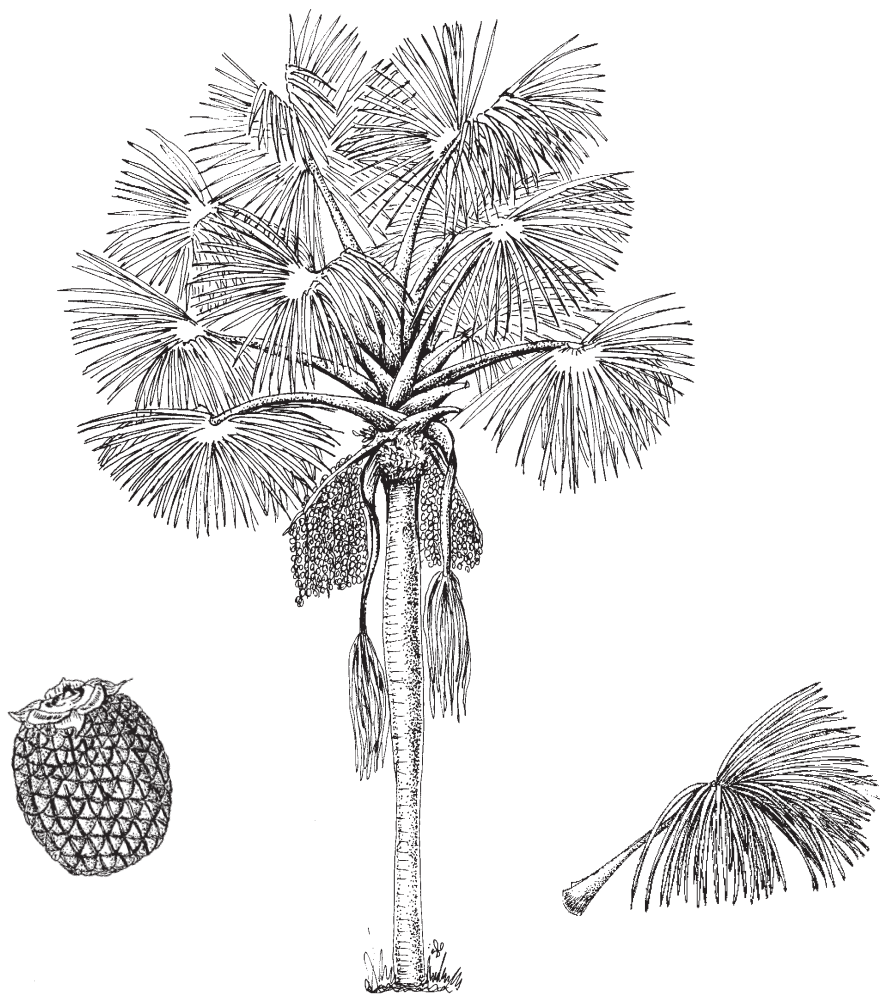
increasing popularity of açaí juice is making the managed harvest of pulp from this marvellous palm more and more attractive.



1 Costa, J.A. 2001 / Denslow, J.L. 1980
2 Costa, J.A. 2001
3 Denslow, J.L. 1980
4 Rocha, E. 2004
5 Rocha, E. 2001
6 Bodley, J.H. & Benson, F.C. 1979
7 Ming, L.C.; Guadêncio, P. & Santos, V.P. 1997
8 Boom, B.M. 1987
9 Mejia K. 1992
10 CTA 1997 / CNS 1993
11 Bovi, M.L.A & De Castro, A. 1993
12 Zuidema, P.A. & Boot, R.G.A. 2000

Buriti, moriche palm

Mauritia flexuosa L.f.



Among the varieties of palm species in Amazonia, buriti present the most elegant and lovely specimens… the buriti has such noble and poetic lines that distinguish it above all others.

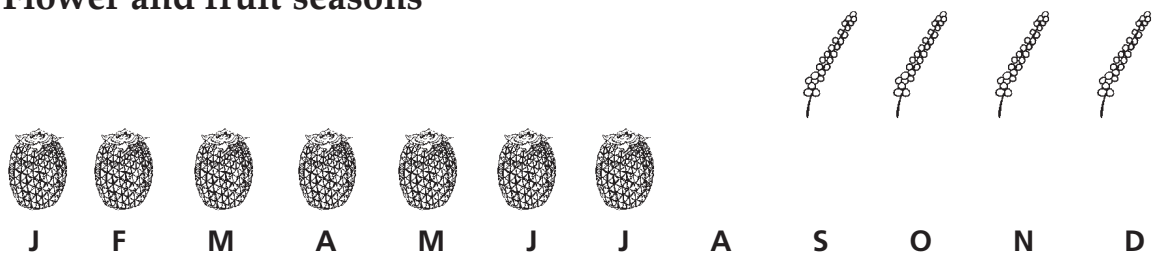
A. Lustosa, Archbishop of Pará, 1930

Margaret Cymerys
Nivia Maria de Paula Fernandes
Onofra Cleuza Rigamonte-Azevedo

The buriti is one of the largest and heftiest palms in Amazonia, reaching 20–35 m in height and 30–50 cm in diameter. The trunks are so massive that when felled they are used as bridges. People, as well as a wide assortment of animals, enjoy its nutritious fruit. The leaves, stems, seeds and oil are also used for a plethora of products. The buriti palm plays a celebrated role in many of Amazonia's popular festivals, when adults and children alike parade through the streets with brightly painted figurines carved from the buriti stem. Buriti is distributed throughout Amazonia, from the north of South America extending to the northeast and central south of Brazil. This palm prefers wetland areas, seasonally flooded forests, stream banks and riversides, where it is found in abundant concentrations.[1]

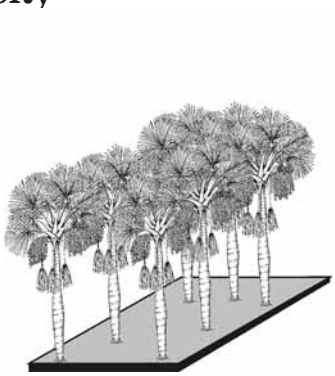
ECOLOGY

Flower and fruit seasons

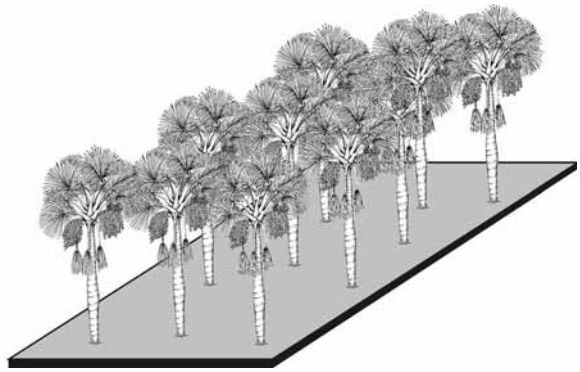


The buriti is a dioecious species, having both male and female plants. The male palms flower in the same months as the female, but without producing fruit. Near Belém, buriti flowers in September through December and produces fruit from January through July, sometimes producing again in November or December. The buritis in Acre flower from April through October. Fruit maturation can be heterogeneous in the same plant, varying from 7 to 11 months. Ripe fruits can be found from March through October.[2]

Density



60–70 fruiting palms/ha



290–335 fruiting palms/alqueire

The buriti occurs with greater frequency in wetland areas. It is common to find approximately 60–70 female buritis and 75–85 male buritis/ha.[2] Extrapolated to alqueires, this density becomes 290–335 female buritis and 360–410 male buritis/alqueire.

Production

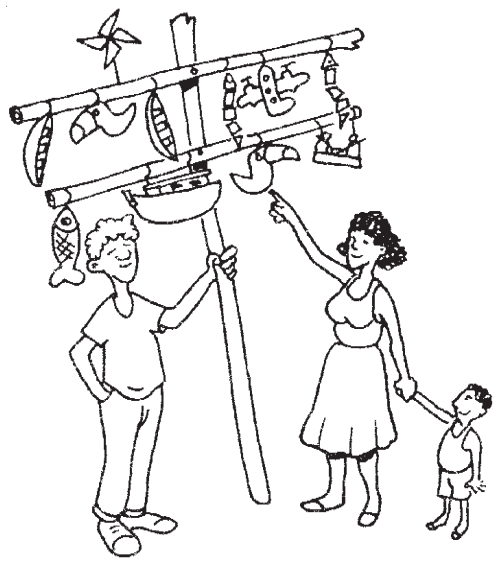
average of 200 kg/palm

Buriti palms are extremely productive: one buriti palm can produce between 40 and 360 kg of fruit/year. If a hectare of buriti is managed, it can produce between 2.5 and 23 tonnes of fruit/year. Based on forest inventories in Acre, it has been estimated that annually a female buriti palm produces between 1 and 9 bunches of fruit, and each bunch has from 600 to 1 200 individual fruits.[2] Considering an average of 64 female palms/ha and an average production of 200 kg of fruit, it is possible to obtain 384 kg of oil and pulp/ha. A buriti palm lives a long and fertile life – production declines only after 40–60 years.

ECONOMIC VALUE

Street corners in Iquitos, Peru, are dotted with women selling buriti frozen ice treats. In 1985, it was estimated that these sellers earned about US$11/day. By the end of the month, the women's salary was eight times the minimum wage.[3] In the western Amazon, the people of Iquitos enjoy eating buriti as much as people from the eastern Amazonian state of Pará enjoy açaí. In Belém, in 2007, 1 kg of pulp cost US$2.60 and a bunch of 15 fruits cost US$0.52. A small basket of cooked buriti fruit, sold from January through May, costs US$5. One litre of buriti juice costs from US$0.52 to US$1, and a 5-kg bag of grated buriti for preparing juice costs up to US$8. Prices for toys made from buriti vary from US$0.30 to US$300.

Fanciful toys of buriti



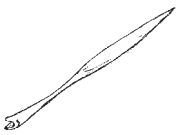
During the second Sunday of October each year, fantastically coloured animals made from buriti adorn the streets, parks and sidewalks in the city of Belém. It is Círio de Nazaré, one of Brazil's most renowned religious festivals, in which millions of people line the streets to see the "Saint", a small wooden statue of Mary and the infant Jesus. As the Saint passes, they make promises and wishes for the year to come. Traditionally, vendors parade around the streets with large crosses made of buriti on which hang scores of buriti folk toys. In 2006, an estimated 36 000 buriti toys were sold, generating over US$349 600. In 2007, there were more than 90 different kinds of buriti toys for sale during the Círio de Nazaré, such as boats, canoes, animals and even radios, computers and airplanes. Sales rose to 51 000 pieces that year, earning over US$520 000 in revenue. In the area of Bacarena, hundreds of families are involved in the production and sale of these hand-crafted figurines. The toys are very popular in other regional festivals as well, especially the Muritifest, in Abaetetuba, Pará, a festival devoted exclusively to the celebration of this colourful craft. In recent years, their fame has spread across Brazil, and stores as far away as São Paulo and Rio de Janeiro have begun to commission buriti crafts for sale.

USES

Pulp: The pulp is used in  juice, sweets,  ice cream and  other frozen ice treats.

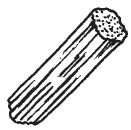
Seed: The seeds appear in buttons, crafts and jewellery (with gold and silver), in addition to having a role in the production of alcohol fuel.[4]

Oil: The oil is used to fry fish and to make soap and cosmetics. It also acts as lamp fuel. Buriti oil is said to have purifying and detoxifying qualities.

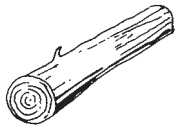


New leaves: When they are still closed, the new leaves are called "eyes". These are used to make cords, baskets, belts, purses, mats, hats, sandals, book covers and hammocks. In the Bragança region of Pará, many leaves are extracted to make tobacco pouches. Leaves are also used as organic fertilizer.

Adult leaves: In Acre, the stalks are often used to make kites. In Pará, the leaves are used to weave colanders and sieves (tipiti) for extracting tucupi liquid from manioc root used in regional cuisine. In the past, the Tupinambá Indians boiled buriti leaves to obtain a tawny brown powder used as a salt substitute.[5]



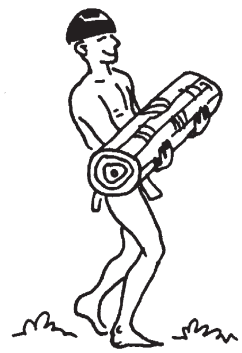
Stems: The stem supplies a light, soft material used in crafts. The "branch" has a spongy inner part that is used in the manufacture of toys, toilet paper and birdcages. Stems can reach up to 4 m in length.



Trunk: The trunk is used for bridge construction and, because it floats, the trunk can be used to transport other logs along rivers. Male buritis are often selected so as not to destroy fruiting trees. Rotten buriti palms are also highly prized. Children and adults scout out logs decaying in the water to collect wood eating mollusks called turus. Containing a high concentration of protein, these marine bivalves also known as shipworms are considered a delicacy both raw and cooked.

Wildlife: The fruit of buriti is an important source of nutrition for many animals, including tapir, peccaries and deer.

Buriti in Apinayé Indian weddings



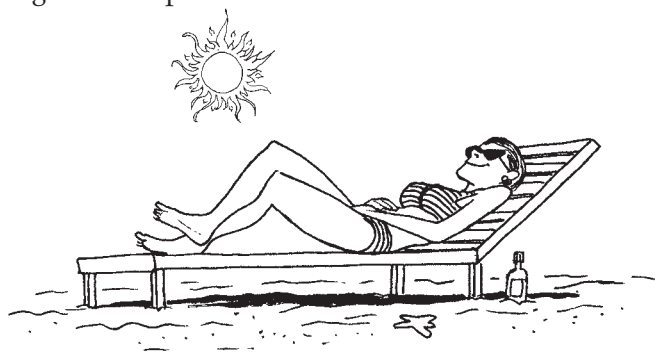
Husbands and wives to be in the Apinayé Indian tribe await and greet the fruiting of the buriti palm with great happiness, as this is the season during which the Apinayé hold their finest parties and weddings.[6] When a man from the Apinayé Indian tribe wants to marry, he must pass a tough test. To prove himself worthy of his bride, he publicly demonstrates his vigour by carrying a 1-m (or more) long buriti trunk from the forest to the centre of the village. When, and if, he arrives in the village with the buriti trunk, the sister and godmother of the bride proudly escort him to the bride. The contented husband and cheerful bride then share a meal to consummate the marriage.[7]

Sunscreen, deodorant and electricity

Palm researchers discovered that the buriti fruit produces two types of oil widely used in the chemical and food industries. Oil extracted from the palm seeds are high in lauric acid, a saturated fatty acid often used in the production of soaps and shampoos. The oil extracted from the fruit pulp is high in oleic acid, a monounsaturated omega-9 fatty acid found in many vegetable oils. It is estimated that with a density of 150 female plants/ha, the buriti can produce 3.6 tonnes of vegetable oil/ha. This yield is far superior to the production of the most commonly used vegetable oils in the world, such as soy, sunflower and peanut, though it is less than the yield from the palm oil, dendê.[8]

Buriti vegetable oil can also be used to produce sunscreen because it absorbs electromagnetic radiation between the wavelengths of 519 nanometres (green) and 350 nanometres (ultraviolet), rays which are harmful to human skin.[9] Currently, cosmetic companies are selling buriti oil over the Internet to re-hydrate and revitalize the skin for US$23 for 8 oz and US$256 for a gallon[10] and also utilizing it in the production of natural deodorants.

For remote communities in Amazonia, buriti oil could represent a source of alternative electricity. In Rondônia, buriti oil is used in the production of efficient and low-cost electric energy in a pilot project developed by the Federal Universities of Brasília and Rio de Janeiro.[6]



NUTRITION

Buriti for healthy eyes and body

Apinayé Indians commonly walk through the forest with woven baskets full of buriti fruit. When they feel like a snack, they remove the skin with their teeth and suck on the pulp.[11] They are clever to do so as the nutritional richness of buriti fruit is far greater than most supermarket snacks. Buriti possesses one of the highest quantities of carotene among all the plants of the world;[12] it has 30 mg of carotene per 100 g of pulp[13] – 20 times more than the amount in the equivalent weight of carrots.

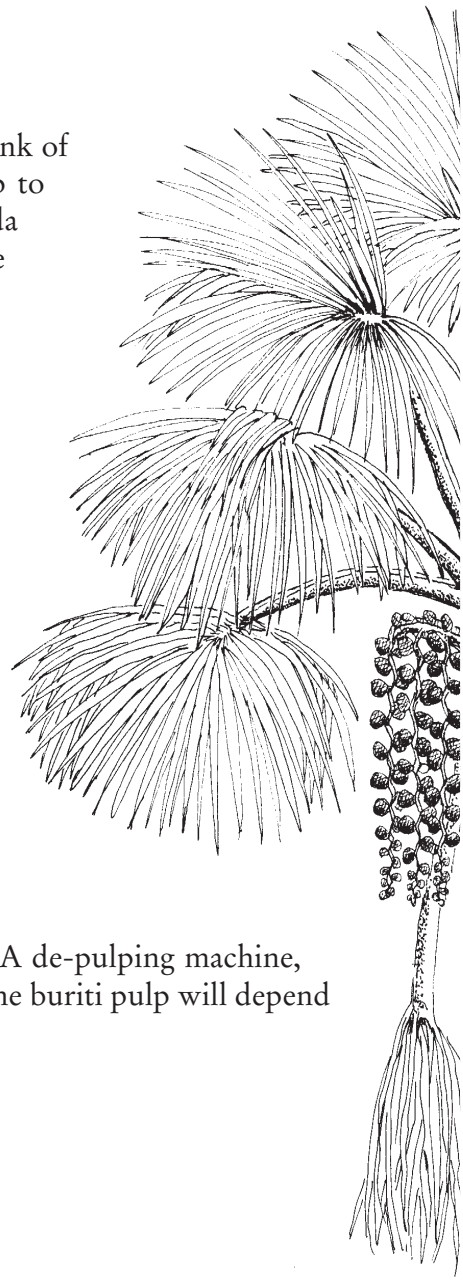
However, in certain regions of Brazil, vitamin A deficiency is a frequent problem, leading to illnesses, such as eye and mouth infections, toothaches and poor night vision. In northeast Brazil, children are able to combat these deficiencies by eating sweets – buriti sweets. One group of undernourished children was given buriti sweets for 20 days. In a short while, the symptoms caused by vitamin A deficiency disappeared.[14]

The pulp of buriti also offers good quality protein. Almost equivalent to corn for nourishment, the pulp of buriti is composed of 11% protein. Due to its outstanding nutritional value, the fruit is now being used in the recuperation of malnourished children.

Oil: How do you extract it?

Buriti oil has many uses. It is expensive to purchase, so it is worthwhile to know how to express the oil at home. To extract buriti oil, mash each fruit with a spoon or a piece of wood. Place the fruit in a drum or can filled with water and cover it with green leaves. Place the can over a fire or in the sun for four or five hours, without stirring, until the fruit softens (do not allow the water to boil). When very soft, remove the fruit and scrape the pulp off the skin with a spoon. Place the pulp in water and heat; when the oil begins to rise, remove it with a spoon. This oil is great for frying fish, and the leftover fibres and pulp are an excellent fertilizer for the field or garden.

Recipes



Buriti sugar

In certain regions of Pará, people bore holes in the trunk of the male buritis and collect from 8 to 10 litres of sap to produce a light yellow sugar. Don Antonio de Almeida Lustosa, Archbishop of Pará, wrote in the 1930s: "The caboclo cuts down the male palm and punctures its trunk to reach the sap." The sap is thickened by evaporation, transforming it to honey.[9]

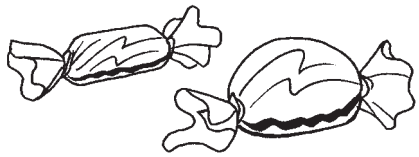
Buriti sago

The interior of the buriti trunk can be ground up to form starchy flour used to prepare porridge similar to sago, a staple food for many people in Papua New Guinea. The Native Amazonians call this ipuruna flour.[7]

Buriti pulp

Buriti pulp can be made at home. Place the fruits in warm filtered or boiled water. Once soft, squeeze the pulp out through a sieve or mash it with your hands. A de-pulping machine, like those used for açai, works well. The thickness of the buriti pulp will depend on the amount of water used.

Buriti sweets

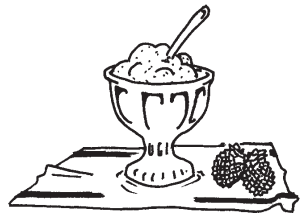


Ingredients:
– 10 cups of buriti pulp
– 10 cups of sugar
– 1/2 cup of water
– ground cloves to taste

Preparation:
Mix the pulp with the sugar, adding water while it is cooking. When the sweets are close to ready (when the mixture begins to pull away from the bottom of the pan), add powdered clove. If you prefer the sweets in tablets, remove the batter from the pan, spread it on a clean cutting board and when cool, cut it into pieces.

In the Northeast of Brazil, these delicious buriti sweets are sold in small boxes made from buriti branches. In Teresina, capital of the state of Piauí, the sweets are commonly found in markets, sold in small packets or in large cans.[8]

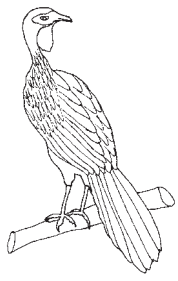
Buriti frozen crème



Ingredients:
– 700 g of buriti pulp
– 2 cans of sweetened condensed milk
– 2 cans of thick cream
– 1/4 cup of lemon juice

Preparation:
Place the pulp, condensed milk and cream in a blender. Bit by bit, add lemon juice to give consistency to the cream. Mix until it acquires the desired consistency. Pour the mixture into a bowl, and cool it in the refrigerator for several hours.

WILDLIFE



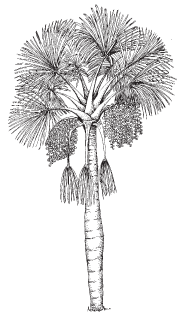
Large birds, such as chachalacas and guans, eat the flowers of the buriti, and dead standing buriti serve as important nesting spots for some parrots. A study in southeastern Peru found that 47 of 50 known nests of blue and yellow macaws (*Ara ararauna*) and all the observed red-bellied macaw (*Orthopsittaca manilata*) nests were in buritis.[15] Fork-tailed palm swifts (*Tachornis squamata*) on the other hand make their nests in the dead leaves hanging from the buriti palm.

The fruits are sought after by a multitude of other wildlife. Knowing this, cunning hunters set up rifles with trap lines beneath buriti to capture the deer, peccaries, tapirs, pacas or coatis that visit the palm for fruit. Monkeys, tortoises and even fish also dine on buriti. A valuable study in Peru ranked the importance of different forest fruits in animal diets.[16] Buriti came first for the Brazilian tapir, 5th for the white-lipped peccary, 10th for the collared peccary, 16th for the grey brocket deer and 18th for the red brocket deer. To improve fruit production and attract game, Amazonians cut back the plants encircling the buriti and place organic material at the base of the palm.

Management

germination
1–4 months

growth
in shade initially, then sun



production
7–8 years

To increase the rate of germination, seek out the seeds of mature bunches of fruit that are still attached to the palm. They should be the colour of red wine. After removing the skin and pulp from these fruit, leave the palm seeds to soak in water for at least 12 days. Next, place them in the sun to dry for one day. Bury the seeds 2 cm down in the sand and wet them at least twice a day. After 24 days, the seeds will begin to germinate, and after 42 days, 95% of them should have sprouted.[2]

The buriti sprouts can be planted in flooded soils, but they will not survive if they are always submerged in water. The seedlings also require plenty of sunlight; in the beginning, the sprout uses nutrients from the seed to grow and can tolerate shade, but it requires sun to grow into adulthood. To develop, the buriti benefits from organic fertilizer that can be obtained from the palm itself.[2]

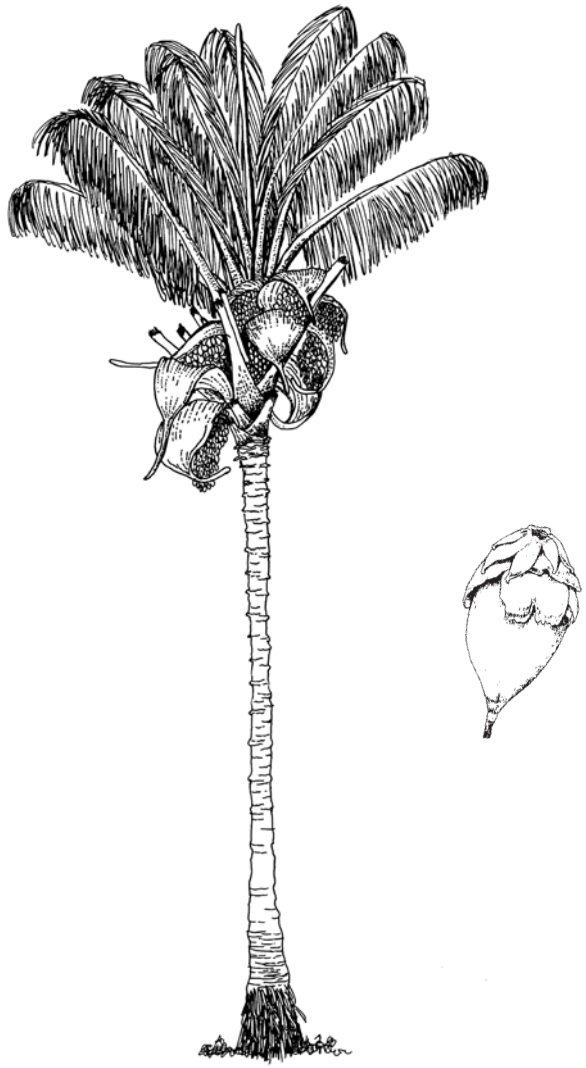
Near Iquitos, Peru, the tremendous popularity of the fruit has caused some collectors to cut down many of the buriti palms surrounding the city to collect the fruit rapidly. Consequently, to fill the high demand of Peruvians in Iquitos, the fruit must now come from long distances, up to three days by canoe. As the subsistence and market value of the fruit is substantial, it makes sense to collect them without harming the tree so as to guarantee production year after year.

Managers of buriti palm offer the following suggestions to help them grow. Cut back the plants without economic value to provide more space and sunlight for the productive buriti to grow. It is possible to cut down some of the male buriti palms in order to harvest the sap, utilize the wood and make other products, but be sure that at least 15–20% of the remaining palm trees are male to pollinate the females. To improve the quality of the fruit, collect the seeds of the best specimens and seed them in open areas.[11]

[1] Henderson, A. 1995
[2] Paula-Fernandes, N.M. 2001
[3] Padoch, C. 1988
[4] Pesce, C. 1941
[5] Levi-Straus, C. 1997
[6] Castro, A. 2000
[7] Cavalcante, P. 1991
[8] Lleras, E.E. & Coradin, L. 1988
[9] Moreira, G.C.; Morais, A.V. & Matias, J.G.N.S. 1998
[10] http://www.grasshuttreasures.com/amazonoils.html 2008
[11] Balick, M. 1986 and 1988b
[12] Santos, L.M.P. 2005
[13] Lima, M.C.C. 1987
[14] Pio Correa, M. 1926
[15] Brightsmith, Donald J. 2005
[16] Bodmer, R. 1993

Inajá

Attalea maripa (Aubl.) Mart.
[syn.: *Maximiliana maripa* (Aublet) Drude]



Margaret Cymerys
Evandro Ferreira

The inajá palm is common in Amazonia and occurs in abundance in terra firme with poor sandy soils. Extremely resistant to fire, inajá is often found in pastures, secondary forests and on community lands, sometimes in conjunction with other palms, such as babaçu (*Attalea speciosa*), uricuri (*Attalea phalerata*) or jaci (*Attalea butyracea*). Inajá is easily distinguished from these similar palms by its coated fruit, the long thin stalks of the fronds and the spathe, which has a long pointed tip. Inajá can reach 14 m in height and 69 cm in diameter.

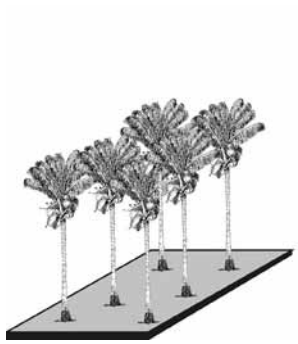
In the past, many houses and farinha work sheds were covered with palm fronds from inajá. The fruit is sought out by wild and domestic animals alike, and for this reason hunters often use it as bait. Those who protect this palm are increasing the amount of food available for wildlife.

ECOLOGY

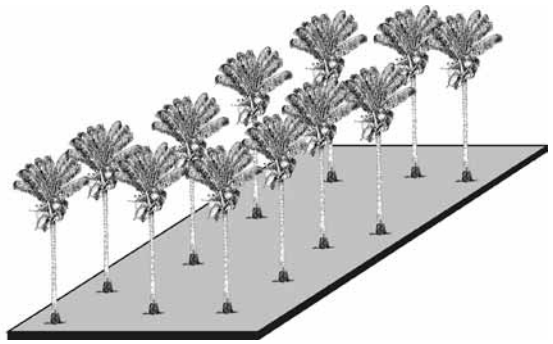
Flower and fruit seasons

In the eastern Amazonia, inajá flowers from October through March. The fruit mature from January through March of the following year. In the western Amazonia, inajá flowers around July and starts to bear fruit in November.

Density



60 palms/ha

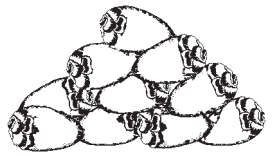


300 palms/alqueire

In primary forests, inajá occurs in low densities and prefers areas of terra firme. Pastures in the state of Acre were found to contain between 16 and 100 palms/ha.

Production

One palm normally produces 5 or 6 bunches of fruit/year, with 800 to 1 000 fruit/bunch.



An average of 5 000 fruit/palm

ECONOMIC VALUE

There is not a large market for inajá fruit, but it is sold at the street fairs of the city of Belém at the start of the year. In March 2004, 30 fruit could be purchased for US$0.34 at the large Ver-o-Peso market. During the height of the season, it was possible to find 20 fruit for US$0.20 at other open air markets. By 2007, 20 fruit sold for more than double what it was four years earlier costing US$0.52. In the Praça da Rupública, a central square in the city, jewellery utilizing inajá seeds is often sold, fetching high prices. In 2008, a 60 kg sack of seeds for artisans sold for US$89. In 2004, a ring sold for US$0.34, earrings cost US$1.36, bracelets sold for US$2 and necklaces cost US$5. By 2008, necklaces were selling for US$2–18.

USES

Fruit: The fruit provides food for people, livestock and wildlife. In the past, the fruit was also used as fuel in the smoking of natural rubber latex. The pulp of the mature fruit was also used to prepare a rustic soap, but this practice has subsided owing to the availability of commercial soaps.

Fronds: Inajá fronds are used as roofing for temporary houses. Depending on the size of the structure, 120–250 leaves may be needed. Leaf steams are used to make fish traps.

Palm hearts: People enjoy eating the palm hearts, and they are also fed to cattle to fatten the animals, increasing milk production.

Spathe: The bract surrounding the inajá fruit cluster is used as a container that can last up to three months. It is used to collect water and to hold rations for pigs, chickens or horses. Children also like to play with them.

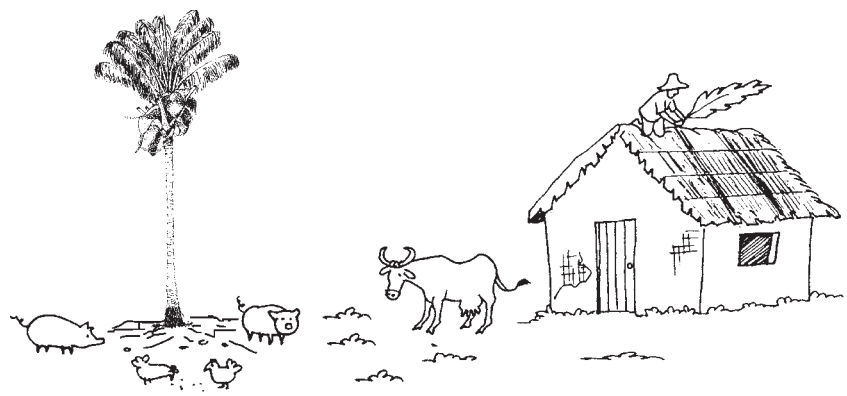
Inflorescence stalk: The inflorescence stalk is the stalk connecting the fruit or flower cluster to the tree. It can be used like a feather duster once it is cut from the tree and the fruit is shaken off.

In contrast to its use in the eastern Amazonia, inajá is rarely utilized in Acre. This palm is less accessible to rubber tappers or communities along the rivers because of its low density in the forest; it is only abundant on cattle ranches. Still, inajá palms are important for these groups as a source of food for game species in the area. The fronds are not used much by the rubber tappers because they find the leaves deteriorate too quickly.

House of straw

Jurandir Galvão

As recent as the 1980s, almost all of the houses in the rural areas of Belém were covered with fronds from inajá palms. Today, the inhabitants use a mixture of roofing tiles, wooden shingles and palm fronds to build their houses. The traditional folks say that the best time to collect the fronds is during the time of the new moon or when the nights are darker. That way the leaves break down more slowly and are less susceptible to insects. However, the palm frond roofs remain vulnerable to fire, a significant disadvantage.



NUTRITION

Inajá fruit can be eaten straight from the tree or cooked. Most people like to eat the raw fruit with farinha. Mature fruit have a 15% oil content. The pulp, light and sweet in flavour, is also used to prepare a mush that is given to individuals suffering from general weakness. Inajá pulp is a good source of protein and calories, thus it has become an important part of the life of the rural people of the Amazon.

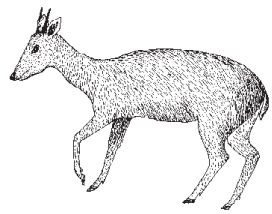
Oil extraction

Inajá fruits have an oil similar in quality and use to that of the babaçu palm. The red-orange oil's spicy taste makes it desirable for cooking. The oil can also be used to produce soaps. However, inajá oil is really only used when other types of oils are scarce.[1] Mechanical equipment can extract up to 23% of the oil from the inajá. The process involves heating bunches of fruit in steam for eight hours and then kneading the fruit to remove the pulp. The pulp is then heated to more than 90ºC and pressed to extract the oil.

Recipe for inajá fruit drink

Peel the fruit, scrape the pulp off with a spoon, mash it up with water and add sugar to taste.

WILDLIFE



Inajá fruit are used as bait to attract animals. The mature fruit are spread on the ground by hunters for two or more days, after which they return to wait in a hide for the game to arrive. In Bragança, the hunter João Lima would travel 50 km to visit his parents in Capanema. During these visits, he always brought bunches of inajá fruit to spread in the forest near their house. Six days later, his friends enjoyed a good meal of game. Inajá fruit is well liked by agoutis, pacas, peccaries, deer, armadillos, coatis and monkeys and is one of the fruits most frequently consumed by tapirs. They also eat the seeds.[2] Cattle, pigs, squirrels and opossums also feast on inajá. The seeds are dispersed by rodents and other mammals. Pigs and cows swallow the fruits during the day and regurgitate the seeds at night. Rodents serve an important role because they bury the fruits for later use but often do not retrieve them. These fruit form a dormant seed bank that can later germinate.

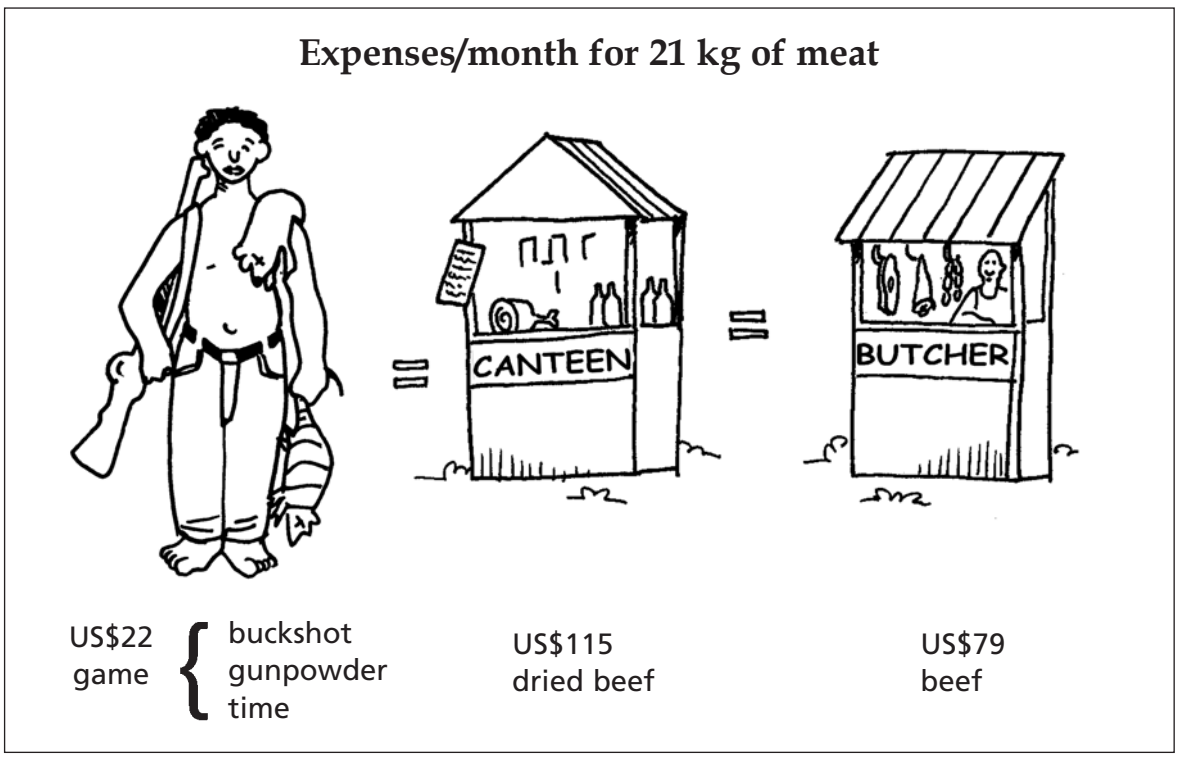
Invisible income from game

Even though it is illegal to hunt in Brazil, subsistence hunting – a necessity for many rural families – is tolerated. But commercial hunting of any type is not permitted. Even if subsistence game is not sold, it can be seen as a source of income because it frees up money that would have been used to purchase meat. A family that has game available on their land can have food in their stomach and money in their pockets.

The majority of the families living in the rural river community of Rio Capim, Pará, will buy meat at some point during the year. But families with hunters do not need to use their earnings on store-bought meat, thus saving on their food bills. Most families make their income by growing and processing the local staple, farinha. So the forest farmer can assess how much less farinha the family would need to produce if the family's diet is supplemented by game.

In 1995, an expert hunter from the region was able to catch about 35 kg/month of game. About 40% of the game weight is inedible (such as bone, skin and hair), leaving an equivalent of 21 kg of game meat. If he had purchased the same 21 kg of meat for his family at the town butcher's shop, he would have paid US$3.75/kg. Thus, it is as if he earned US$79/month from his forest. Or, if instead of meat, he had purchased dried beef, which can usually be found locally in the community canteen, it would have cost him US$115/month, or nearly US$1 400/year. This family saved the same amount of money that they could have earned from the sale of eight bags of farinha per month.

The cost of game compared to the price of meat or dried beef



Of course, not all the families in the Rio Capim community have hunters and not all the hunters catch a lot of game. Thus, not everyone gains as much as this family with a skilled hunter. But based on the consumption of game in the entire community, we can calculate the amount an average family saved on food because of game, and how much the community as a whole gained from their forests.

The forest's gift of game

Group	Time period	Game (kg)	Meat from game (kg)	Beef US$3.75/kg (US$)	Dried beef US$5.50/kg (US$)	Farinha US$15/sack (no. of sacks)
Hunter's family	month	35	21	79	115	8
	year	420	252	945	1 386	92
Average family	year	94	56	210	308	20
Community	year	2 808	1 685	6 319	9 267	618

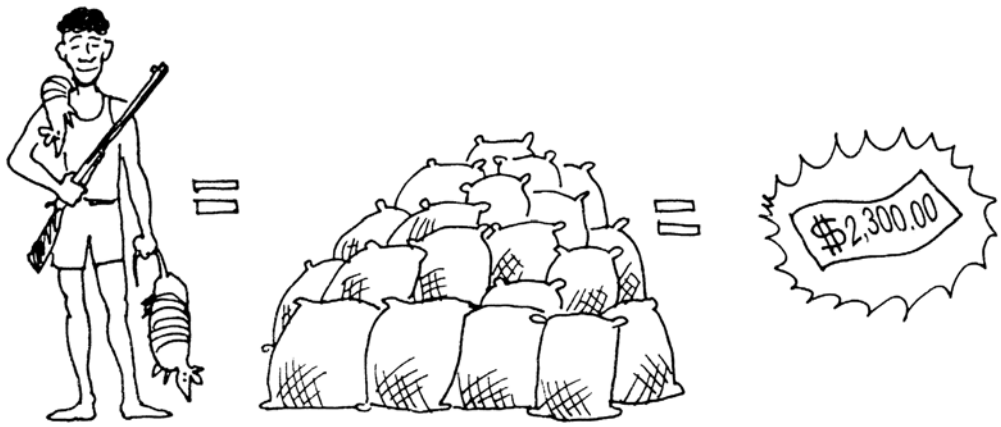
Money in your pocket and food in your stomach

In one year, 30 families living in a community along the Capim River captured a total of 2 808 kg of game. An average family caught 94 kg of game in a year and were able to consume about 56 kg of game meat. Purchasing this meat at the closest meat market would cost US$210/year, or about US$17/month. If the family could not make the trip to town and had to purchase dried beef from the community store, it would cost about US$308/year, or the equivalent of 20 bags of farinha. Due to the forest wildlife, the entire community gained the equivalent of 620 bags/year, almost 52 bags of farinha/month.

The villagers were able to save a lot of money thanks to the animals that live in their forest. And this is not a unique case. In Chino, a community in the Peruvian Amazon near a community forest reserve, 34 families captured on average 54 kg/month of game, or more than 600 kg/family/year.[3] Also, a hunter in a neighbouring community caught more than 700 kg of game in a year. At the time, this quantity was equal to about 155 bags of farinha, or US$2 300 for dried beef.

But the forest can only offer these great benefits if it is protected. Forests are the home and food source of game animals. If the forest is cut down in an unsustainable manner, it becomes poorer and cannot support as many animals. The greater the area of forest, the greater the amount of game that can live there. Many wildlife species need a large expanse of forest so they can search for food throughout the year. Some trees will only bear fruit for one to four months out of the year. With this in mind, some communities work together to protect their patches of forest, uniting them into larger community forest reserves or connecting them using forest fragments as corridors. Part of the reserves may be designated free of hunting as a refuge for animals to reproduce. They work out community agreements so that only secondary forests are cleared for agricultural plots. The more resources that are available in the primary forest, the less slashing and burning is necessary to produce farinha.

Value of game and the equivalent value of farinha



700 kg of game = 155 sacks of farinha = US$2 300

Some animal populations are sensitive to hunting and may disappear with increased pressure. Animals that reproduce slowly, such as tapirs, howler moneys and other primates, macaws and parrots, should be captured rarely if at all. Other animals that have large litters each year (armadillos, agoutis, pacas, and collared peccaries) can be hunted more regularly.

Management

germination
90–180 days

growth
slow

production
after 4 or 5 years

Inajá is a slow-growing palm that starts to fruit only after four or five years, but both animals and people assist in dispersing it. To hasten the sprouting of inajá, leave the seeds in the creek for 30 days then they can be planted out in the fields. Generally, inajá is left standing in cleared garden patches to attract game and thus tends to be abundant in areas of swidden agriculture. These palms survive swidden agriculture and then spread in the secondary forest during the fallow period. Thus inajá can be managed to supplement food for wildlife in secondary forest and degraded pastures.

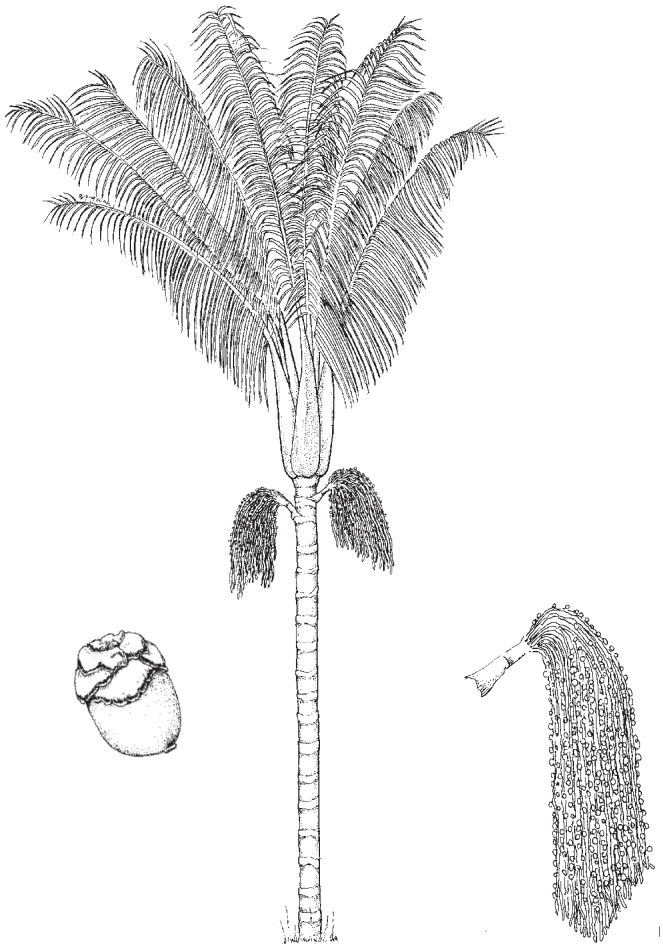
How palms survive fire

Throughout the Amazon it is possible to find various palm species mixed within pastures and in agricultural areas. Inajá, babaçu, jaci, uricuri and tucumã often form large stands and become invasive in farmlands due to the mature plants' natural resistance to fire. Their stems are very thick and hard. Their thick bark forms an effective barrier to the heat, protecting the inner part of the plant. Initially the plant grows down into the soil and the new leaves appear only after some time. Because the apical meristem, the part responsible for producing the new leaves, remains buried, it is protected from the fire. Therefore, when people burn the land, it encourages the development of these palms and eliminates other competitive plants. If fires are set annually, it stimulates seed germination, and with time the land will be covered with large quantities of palms, generally of a single species. That is how we now find the large concentrations of palms in the Amazon region. In the forest, where the fire cannot penetrate, palms occur in much lower densities and grow more slowly.

[1] Blaak, G. 1984
[2] Oglethorpe, J *et al*. 1997
[3] Bodmer, R.E. 1989

Patauá

Oenocarpus bataua Mart.



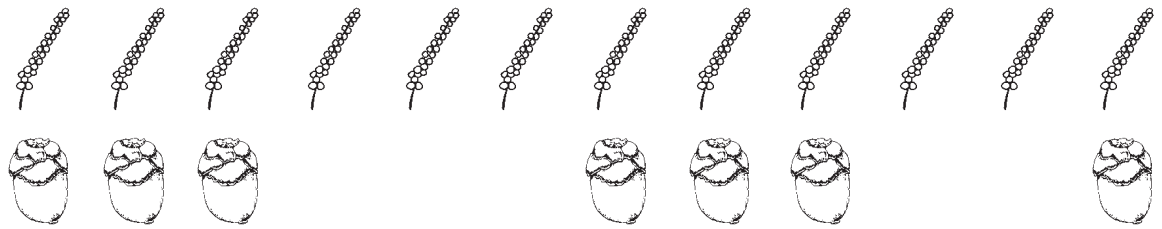
Daisy A. Pereira Gomes-Silva

The scientific name for patauá (*Oenocarpus*) means "wine fruit". *Oeno* is the Greek goddess of wine and *carpus* means fruit. *Bataua* is the common name used for patauá in a few countries. Patauá is most loved by caboclo communities, who use it to make juice and oil. The juice is consumed with game meat and farinha, and the oil is used to fry fish. Only the juice is sold in cities, but if you find the delicate and delicious patauá oil, it can be used instead of olive oil in salads and sautés, as its scent and flavour are similar.

The patauá tree is a palm that prefers humid soils. It grows for many years in the shade of the forest. As an adult, however, it needs light. Patauá palms can be found in Peru, Bolivia, Colombia, Ecuador and Venezuela. In Brazil, they grow in the states of Acre, Amazonas, Pará and Rondônia. Patauá can grow up to 25 m in height, possessing only one stem with very large leaves that can extend up to 10 m in length. The small white flowers and fruit are arranged in a horse tail and can have up to 350 racemes on which the fruit are attached.

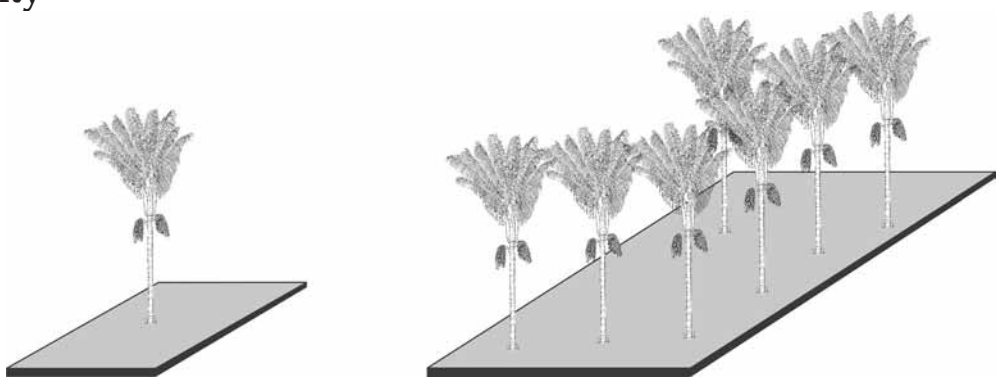
ECOLOGY

Flower and fruit seasons



In Acre, patauá's fruit season is more intense from December through March, which are rainy months, but fruit can also appear from July to September. The fruit takes from 10 to 14 months to ripen and mature. For this reason it is not difficult to find plants with both flowers and fruit at the same time.[1]

Density



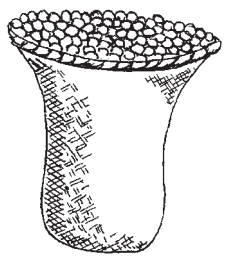
1.5 palms/ha

7.5 palms/alqueire

The patauá occurs both in upland dry forest, swamp forests and along streams. It is found sparsely in upland dry forest, with 1–2 palms/ha,[2] but in lower elevations it can become a dominant species with up to 100 species/ha. In Acre, patauá occurs throughout the state, and in the Chico Mendes Extractive Reserve, 48 palms/ha were found in the marshier areas, while 16 palms were found in dry forest. In Pará, in the past, the patauá was overexploited and nearly disappeared in some locales. But in other areas, like the lower Tocantins, it is possible to find large patauá palms that are used both for their juice and their oil.

Production

The patauá takes from 8 to 15 years to bear fruit[3] and produces up to three bunches of fruit/year, with about 16 kg of fruit/bunch.[4] A study in Ecuador found that the production of patauá palms varied from approximately 500–7 000 fruits biennially.[5] Patauá fruit, as with the fruit of other palms, is measured in 18-litre cans. About 13 kg of fruit fit into one can. In Colombia, the collectors go on a special diet before they go in to harvest patauá, and only women who refrain from certain foods are allowed to extract the oil.



an average of 32 kg/tree/year

ECONOMIC VALUE

In Rio Branco, in Acre, it is common to find patauá for sale together with açaí and buriti, both in the informal markets and in the supermarkets. A can of fruit (18 litres) costs about US$2 when purchased directly from collectors. A litre of juice is sold for about US$0.80. In Belém there is also a market for patauá. If you like, stop by the Ver-o-Peso market and pick up a litre of juice for about US$1.

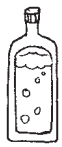
The seeds can also be used to make jewellery. In 2008, necklaces and earings made with patauá sold for US$2–6. Bracelets sold for a bit less, US$2–3. And in 2007, 500 g of the seeds sold for US$1.

These days, in Brazil, sales of patauá juice exceed those of oil. During the Second World War there was a global shortage of olive oil, and Brazil exported more than 200 tonnes of patauá oil/year.[6] Unfortunately, during this period, the palms were cut to harvest the fruit, which killed off a large percentage of them. When the war ended, the sale of patauá oil fell. In Brazil it is rarely found for commercial sale, but in Peru sales are strong. You can buy the oil in Brazil from herb sellers for about US$2 or US$2.50/litre, but it is hard to find.

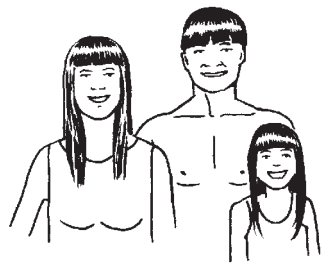
USES

Fruit: The fruit is used to make juice and oil. The fruits are round, almost oval-shaped, and have a pulp that can be white, green or purple.

Seeds: The seeds are used to make necklaces, bracelets and earrings.



Oil: The oil is used as a laxative and as a remedy for tuberculosis, asthma and other respiratory problems. The oil also acts as a hair softener. A famous researcher who lived in a Kayapó village said that the Indians became more beautiful, sleek and healthy in the patauá fruit season.[7] Residents of the Chico Mendes Extractive Reserve say that purple patauá contains more oil.



Heart of palm: The hearts of palm are eaten raw and served in salads.

Leaves: The palm leaves are used in construction. They provide a good covering, but last only two or three years because insects attack them. The fibres are used in the manufacture of hunting implements, cords and weaving.

Trunk: The trunks are useful for making bridges and garden fences. Indians also leave the trunks to rot so that *tapurus*, a type of edible larvae, will grow.

Fruit stalks: Once the fruit has been removed from the bunch, the remaining stalks can be roasted and ground up as a salt supplement for cattle.

NUTRITION

Patauá oil and olive oil contain similar fats. For this reason, patauá oil can be used as a substitute for olive oil.[3] Both these oils contain large quantities of healthy, monounsaturated fats and are increasingly sought after by consumers. For every 100 g of oil, patauá has 317 calories and 47 g of carbohydrates. Both patauá oil and juice have high concentrations of important proteins, comparable to milk and beef.[4] Patauá juice is oilier than açaí and bacaba (*Oenocarpus bacaba*), and is highly nutritious.[2]

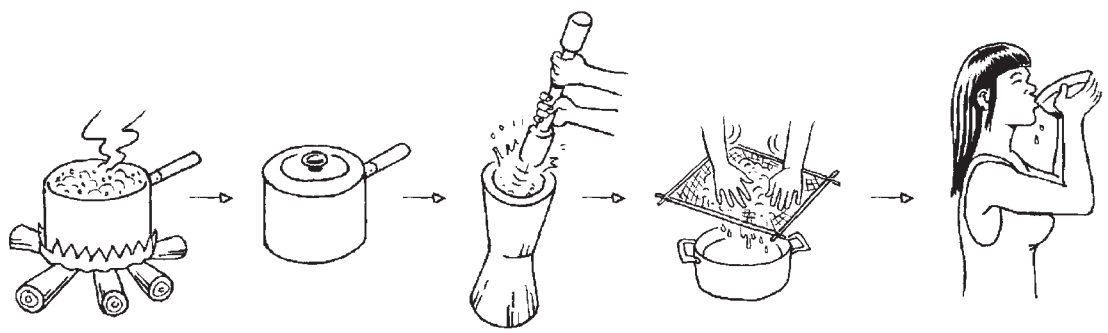
How does patauá oil compare with milk and beef?

Nutritional value	Milk (100 ml)	Beef (100 g)	Patauá oil (100 g)
Fat	3.5 g	10.8 g	12.8 g
Protein	3.1 g	27.5 g	3.3 g
Carbohydrates	5 g	0 g	47.2 g
Calories	120	235	317.2

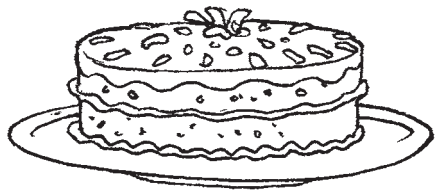
Recipes

Making juice – the slingshot test

Patauá juice looks like chocolate milk and is prepared in the same way as açai juice. First, select the mature fruits. A good way to test if the fruits are mature is to hit the basket with a slingshot; if a few fruits bounce out, it is a good basket of fruit. Soak the mature fruit in hot water over a low fire to soften. Remove the pan from the fire, cover and let stand for ten minutes. Crush the fruit with a mortar and pestle until the pulp separates from the seed. Finally, strain the fruit in a sieve to separate the remaining seeds. The juice is now ready to drink. In the city, the juice is sometimes made swiftly with an electric depulper.



Fabiana's cake

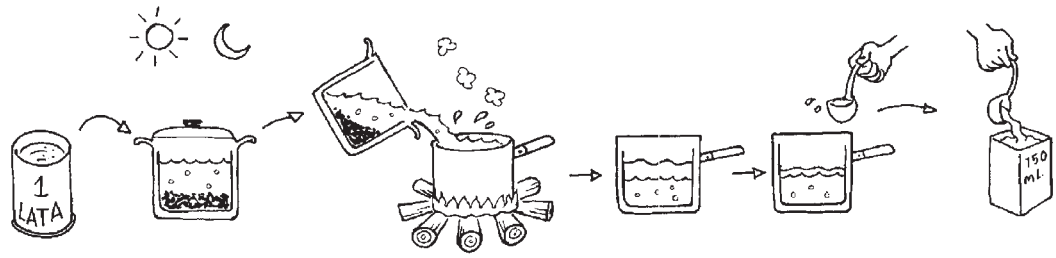


Ingredients:
- 2½ cups of flour
- 1½ cups of sugar
- 1 cup of patauá juice
- 3 egg whites, beaten stiff
- 1 teaspoon yeast

Preparation:
Mix all the ingredients well. Place the batter in a cake pan and bake in a hot oven. The patauá juice is used in place of milk and butter. The cake will look like chocolate, and is even better if you add some grated Brazil nuts.[8]

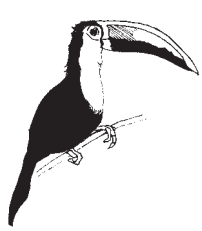
How to make oil

Everyone has his or her own recipe for extracting patauá oil. One basic recipe is to leave the juice to sour for a day so that the water will separate from the pulp. Some insist on keeping the container closed during this process, while others prefer to leave it open. The next day, the pulp is put in a pan and heated until the oil appears. It is also possible to use a *tipiti* (a strainer made of natural fibres commonly used to separate *tucupi* from manioc) to squeeze the pulp and remove the oil.[2] Using traditional methods, about one can of fruit produces approximately 150 ml of oil. But do not be too curious! Villagers from Acre say that only the person making the oil can look in the pan, otherwise the oil will not appear.



WILDLIFE

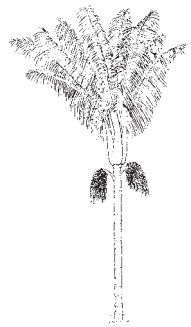
Hunters note that a lot of animals, like tapir, deer, white-lipped peccary, the Brazilian porcupine and various types of monkeys eat patauá. One study in Colombia found that the white-bellied spider monkey (*Ateles belzebuth*) relied heavily on patauá fruit.[9] Large birds, such as white-throated toucans, aracaris, macaws, guans, curassow and larger parrots, most appreciate this fruit. Other animals, such as Brazilian porcupines and monkeys, eat the fruit but not the seed, dispersing the seeds intact throughout the forest where they have the potential to germinate. But there are also seed predators, like peccaries, who crush the seeds when eating the fruit and in doing so eliminate their reproductive potential. People also help to disperse patauá seeds; after making juice, they often scatter the seeds onto the ground.[10]



MANAGEMENT

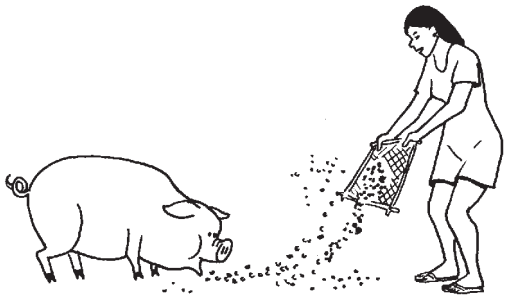
germination
14–52 days

growth
14–72 cm/year



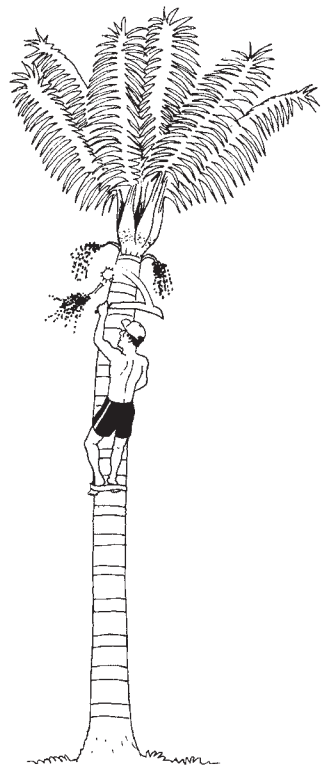
production
5–15 years

In the forest, the patauá palm grows slowly for the first few years. It can take more than five years for the first fruits to appear. Farmers say that you are guaranteed to get fruit within five years if patauá is planted out in the yard in full sun. The patauá palm can produce fruit two years after stem formation.[3] To collect the fruit, you need a climbing strap to secure yourself around the trunk of the palm while you shimmy up.



To manage patauá, it is important to leave some of the fruit behind for wildlife. As a general rule, it is best not to remove more than two bunches/palm. Because it is a slow-growing species, avoid cutting the leaves of the young palms.

After making juice or oil, spread the seeds near your house or anywhere you might like to start a plantation. Some river folk believe that to get the best oil, the leaves of the palm should be closed when you collect the fruit.



[1] Pedersen, H.B. & Balslev, H. 1993
[2] Balik, M.J. 1986 and 1988a
[3] Gomes-Silva, D.A.P. 2001
[4] Clay, J.W.C.; Sampaio, P.B. & Clement, C.R. 2000
[5] Miller, C. 2002
[6] Pereira, P.G. 1951
[7] Balik, M.J. 1988a
[8] Peneiredo, F.M. 2002
[9] Stevenson, P.R.; Quiñones, M. J. & Ahumada, J.A. 2000
[10] Zona, S. & Henderson , A. 1989

Pupunha, peach palm

Bactris gasipaes Kunth

Margaret Cymerys
Charles R. Clement

The pupunha palm was one of the first plants domesticated by Native Amazonians in pre-Columbian times,[1] probably in southwestern Amazonia. It is believed that pupunha was domesticated primarily for its durable, striped wood, which is still valued for handicrafts, and only later for its fruit. The original fruit was oily, but with advancing domestication acquired more starch. Over time, the spiny palm, with its brightly coloured nutritious fruit, spread throughout the lowland humid tropics of South America and southern Central America, gaining new names along the way. It is called pupunha in Brazil, *pijuayo* in Peru, *chontaruru* in Ecuador, *chontaduro* in Colombia, *gachipaes* in Venezuela, *pejibaye* in Costa Rica, and peach palm in English. The tender leaves above the growing point of the stem are also extracted to supply the national and international demand for palm hearts.

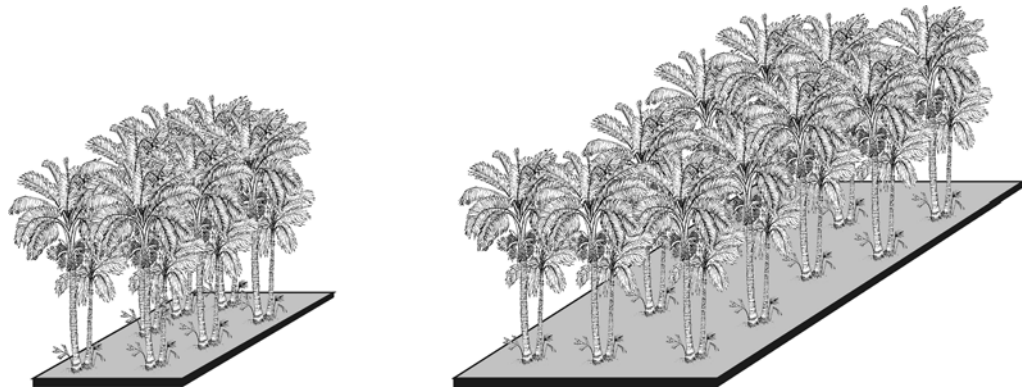
The pupunha palm reaches 20 m in height. The plant grows in multi-stemmed clusters containing up to 15 spiny stems, each attaining approximately 10 to 25 cm in diameter and crowned with 15 to 20 pinnate leaves. The shiny-skinned fruit comes in a multitude of vibrant colours: red, yellow, orange, white and even striped. The size of the fruit varies greatly, weighing from 10 to 200 g, with the smaller fruit containing more oil and the larger fruit more starch. Seedless types also exist.

ECOLOGY

Flower and fruiting seasons

In Central Amazonia, pupunha generally flowers from August through October, and produces fruit from December through March, occasionally until April. In other regions, the flowering and fruiting season varies according to local climate. Some trees produce fruit between the main seasons, especially in nutrient-rich soils or in years with heavy rainfall. During the flowering season, pupunha's small cream-coloured flowers are visited and pollinated by thousands of weevils, a kind of very small beetle.

Density



100 palms/ha

500 palms/alquiere

The high density of pupunha in agricultural systems directly reflects the demands of people for the palm and their use and management of it. Typically, a few plants are interspersed with other fruit trees in agricultural fields or in home gardens. Commercial plantations for fruit generally have 400 palms/ha, requiring fertilizer and intensive management. Commercial plantations for palm heart generally have between 5 000 and 10 000 palms/ha and require even larger inputs of fertilizer and more intensive management. In addition, operators must have significant business experience to ensure that the plantations run smoothly.[2]

Production

The pupunha palm produces between 5 and 10 bunches of fruit per year. However, some palms growing in rich soil may produce up to 25 bunches in a year of heavy rain. Each bunch weighs between 2 and 12 kg and contains between 100 and 400 fruits/bunch. A single pupunha palm can produce from 10 to 120 kg of fruit. The harvest from 1 ha can vary between 4 and 10 tonnes/year. Low production can be caused by insufficient pollination, lack of rain, lack of fertilizer, compacted soil, or a combination of these conditions.

500 to 1 000 fruit/palm

A plantation of 5 000 palms/ha for palm heart production can produce 1.2 tonnes of export quality palm heart/year. In addition to palm heart, the pupunha produces from 2 to 3 tonnes of tender stem, which is the part just below the palm heart.

ECONOMIC VALUE

Pupunha fruit is enjoyed not only by Native Amazonians but also by rural and urban people throughout its region. Bunches of colourful pupunha fruit are sold in open-air markets, at roadside stands and in supermarkets. Cooked pupunha is sold as a nutritious snack in cafés, on street corners and along local beaches. In the Belém market in 2008, 1 kg of pupunha sold for US$1.20–2.40. Prices have remained stable since 2004. Prices in Manaus are somewhat lower, and pupunha is sold by the bunch, not the kilogram. A bunch costs between US$2.40 and US$12, depending upon the size. Production is often higher than demand. In the state of Amazonas, the pupunha harvest in 1999 was double the market sales, representing a large excess, which though unsold was often used as feed for pigs, chickens, ducks and fish. Pupunha commands a much higher price in Colombia, perhaps because in Colombia it is reputed to have aphrodisiacal properties.[3]

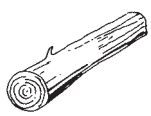
The demand for palm heart is very strong in southeastern Brazil, the national and world centre of consumption. Processing plants send teams to harvest palm heart in the farmer's field and pay as much as US$3.50/stem. In Amazonia, however, demand is much lower, and the price for a stem varies between US$0.30 and US$0.60 at the farm gate.

USES

Fruit: Cook with salt for 30 minutes in a pressure cooker or 60 minutes in a pot. The cooked fruit is also made into a jam for sale. Pupunha pulp can also be ground into a flour and used to make bread, cake, or as domestic animal feed.

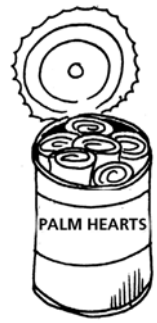
Palm heart: Pupunha is cultivated for palm hearts in southeastern Brazil, especially in Bahia, Espirito Santo, Rio de Janeiro, Minas Gerais, Mato Grosso do Sul, São Paulo, and Paraná, as well as in Costa Rica and Ecuador.

Oil: The oil is used to beautify hair. In Oeiras-do-Pará, the oil is used as a cure for earaches and sore throats.



Wood: The wood is black, with yellow streaks, and attractive when it is well worked, and is used for furniture and handicrafts.

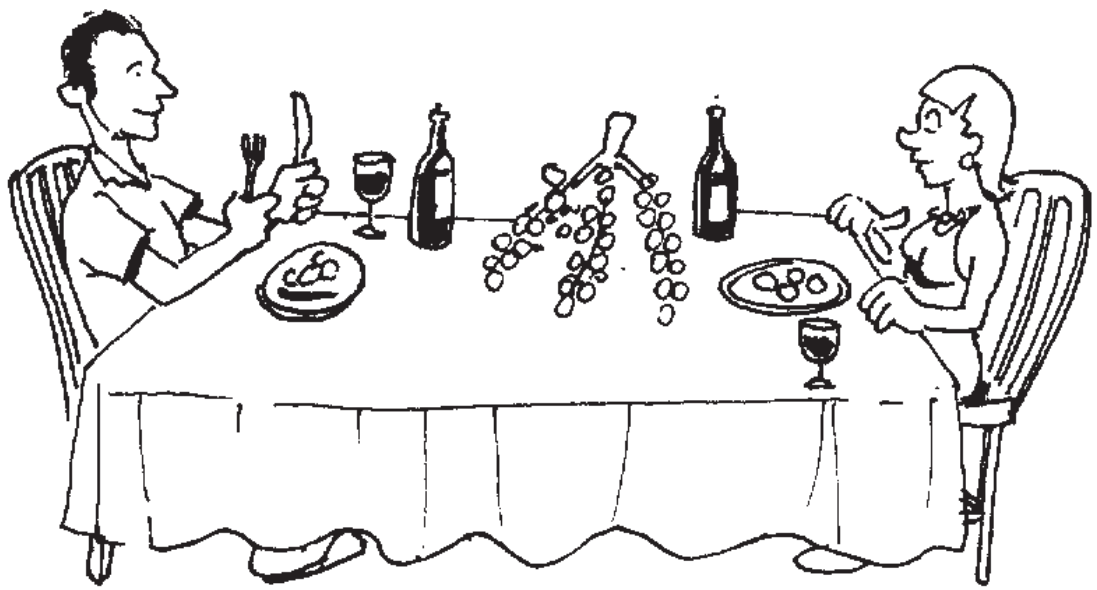
Pupunha palm heart



The advantage to using pupunha for palm heart production in relation to other palms in the same genera is that pupunha forms high quality palm hearts quickly and is a multi-stemmed palm, which allows the palm hearts to be harvested without killing the palm. The initial palm is cut after 12–18 months in the field, and new stems that can be harvested for palm hearts are produced 6–9 months later.

NUTRITION

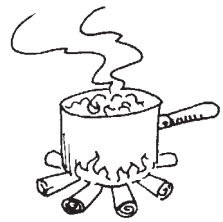
The large pupunha fruit consists of 90–95% pulp and 5–10% seed. The colour of the pulp varies from creamy to orange, depending upon the amount of beta-carotene, the main ingredient of vitamin A. The pulp varies in texture depending upon the amount of water, starch and oil. The fresh pulp has between 1% and 9% protein, 2% and 30% oil and 10% to 40% carbohydrates, principally starch. The nutritional value varies among the different fruit types; for example, the redder the pulp, the more carotene it possesses, contributing to good eyesight as well as healthy hair, skin and nails. Pupunha also contains the mineral elements potassium, selenium and chromium, respectively corresponding to 12%, 9% and 9% of daily recommended allowances.[4]



Recipes

Pupunha purée[5]

Ingredients:
– 500 g cooked pupunha
– salt to taste
– butter or oil to fry the onions
– 250 ml milk
– 1 medium onion
– 1 tomato
– 1 bunch of cilantro



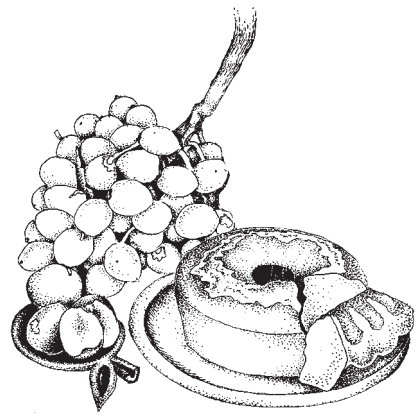
Preparation:
Cook the pupunha in water with salt for 30–60 minutes, remove the skin and mash the pulp with a fork. Fry the chopped onion in butter and add the tomato, cilantro and salt. Mix together. Finally, add the pupunha and the milk, and let them simmer until they form a puree.

Fried pupunha

Pupunha can also be prepared like French fries. Cut the boiled fruit into thin slices, fry the slices in hot oil, and eat them with salt.

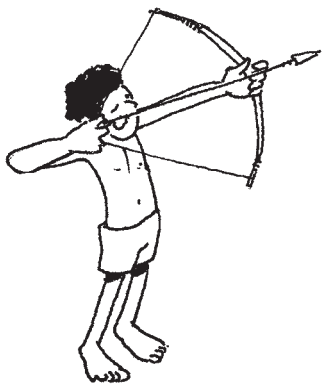
Pupunha cake

Ingredients:
– 2 cups cooked mashed pupunha
– 2 cups coconut milk or cow's milk
– 5 eggs
– 1 tablespoon butter or margarine
– 2 cups sugar
– wheat flour as needed
– pinch of salt

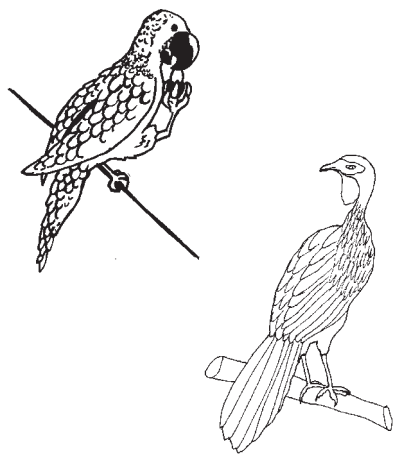


Preparation:
Beat the pupunha and milk in a blender for five minutes. Place butter, sugar and egg yolks in a bowl and beat them well. Beat the egg whites in a separate bowl. Next, mix all the ingredients together with the beaten egg whites and add the wheat flour until the dough becomes stiff. Place the dough in a buttered cake mould and bake for 30 minutes or until the cake becomes golden brown and a toothpick comes out dry.

WILDLIFE



Many wild animals enjoy pupunha fruit. Deer, agoutis and large birds, such as guans, eat the fruit when it falls from the palm. By attracting game, the pupunha tree helps to sustain the people who live nearby. Because various parrot species love to feast on the fruit, the trees also help to maintain these often endangered birds.



Pupunha festivals

The Native Amazonian tribes of the upper Solimões and Negro rivers, in the Brazilian state of Amazonas and nearby Peru and Colombia, have celebrations during the pupunha harvest. The festival is replete with foods made with pupunha flour and boiled pupunha fruit. A special drink, called *caissuma* in Brazil and *masato* in Peru, is made from fermented pupunha fruit. It has the scent of fresh ripe peaches and the alcoholic content of beer. When sniffing freshly brewed *caissuma*, the naturalist and explorer Alexander Von Humboldt detected a familiar aroma and identified it as peach. Thus the European names for pupunha all mean 'peach palm': *palmeira de pêssego* (Portugal), *palmera de melacotón* (Spain) and peach palm (England).

MANAGEMENT

germination
30 days to 2 years

growth
1 m/year

production
7 years

The pupunha palm is native to the humid tropics, where it grows in a variety of soils in various climates. It grows best in rich volcanic soils along the Andes and in Central America, as well as in soils created by Native Amazonians, called Amazonian dark earth *(terra preta*), but can also produce well on the poorer clay soils typical of Amazonia in the first years after clearing and burning. In southeastern Amazonia, pupunha produces fruit with only 1 700 mm of rainfall, but more abundant harvests occur in northwestern Amazonia, where over 3 000 mm of rain is common. Extreme droughts, such as those occurring during El Niño events, can eliminate fruit production.

Planting pupunha

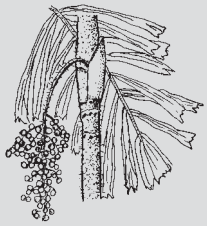
To plant pupunha, first wash the seeds to eliminate any pulp residue. Next, place the seeds in a shady, well-ventilated place to dry for 24 hours. Plant the seeds inside plastic bags or in beds with sandy organic soil. When planted this way, germination takes place in 1–3 months, in contrast to the couple of years it can take in the wild. The seedlings are ready to be transplanted to nursery bags when the first leaf opens. The nursery bags should have 1–3 kg of organic, rich clay-sand soil. After 6–9 months, the seedlings are ready for planting in the ground. They should be planted at the beginning of the rainy season. Pupunha generally begins to produce fruit after the third year and produces regularly after 6 years.

Pupunha palms grow in multi-stemmed clusters. Considering that pupunha's stems re-grow rapidly, its management consists of removing old or excessive stems and those that are too high for collecting fruit easily. Thus, while renewing the vigour of the palm cluster, farmers can take advantage of the palm heart for food by pruning off young offshoots. Likewise, they can use the trunks of the palm for wood when they remove older tall stems. This management technique, known as thinning, encourages the production of more vigorous and productive plants by catalysing the growth of new stems. For best results, only the four best young stems should be left to grow during annual management.

Native Amazonians often plant pupunha in manioc fields. After the manioc is collected, the pupunha is left to attract game, as well as to offer a source of food for the family. Agroforestry systems such as this illustrate the success in planting pupunha in association with other products, such as pineapple, passion fruit or herbs.

Wild pupunha (chica-chica)

Douglas C. Daly

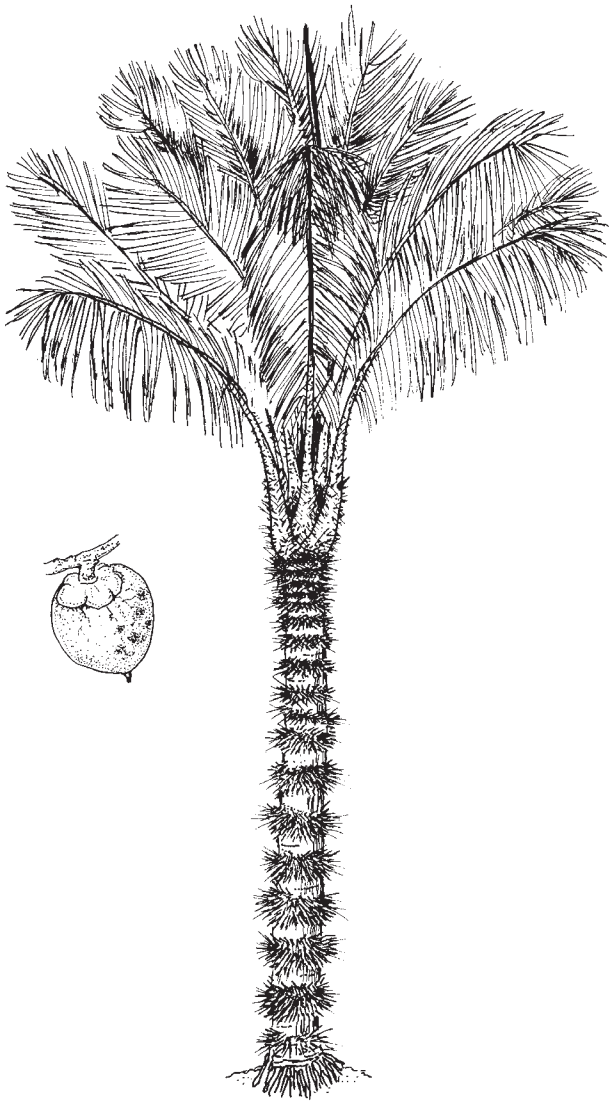


Wild pupunha (*Aiphanes aculeata*) also seems to have economic potential, as its pulp is sweeter than pupunha. In addition, its seed is also edible. The fruits of the wild pupunha are sold in Colombia, both for the seeds and for the pulp, which is used to make sweets. Wild pupunha grows 3–10 m in height. Its fruits are red, orange or white, with orange pulp, suggesting the presence of carotene. The species occurs in upland dry forests and other open forest types. The native distribution accompanies the Cordillera de la Costa, in Venezuela, and the eastern foothills of the Andes, from Colombia to Bolivia, including Acre in Brazil.

[1] Mora Urpí, J.; Weber, J.C. & Clement, C.R. 1997
[2] Mora Urpí, J. & Gainza Echeverria, J. (Eds.) 1999
[3] Clement, C.R. 2008
[4] Yuyama, L.K.O. *et al.* 2003
[5] Kerr, L.S. *et al.* 1997

Tucumã of Amazonas

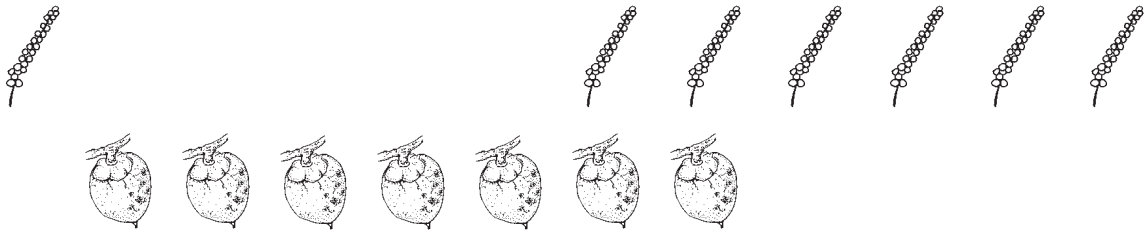
Astrocaryum aculeatum G. Mey



Joanne Régis da Costa
Johannes van Leeuwen
Jarbas Anute Costa

Tucumã of Amazonas is among the larger palms, reaching up to 25 m. It is covered with long, nasty spines to discourage visitors who would climb its trunk to reach the large, meaty and nutritious fruits loved by people and animals alike. Tucumã of Amazonas grows easily in the poor soils of the terra firme where it can produce, without fertilizer, for years. Its high tolerance to fire and its abundant seed production make it a common sight in disturbed areas like agricultural fields, pasture and secondary forest. Tucumã of Amazonas occurs primarily in the Brazilian states of Amazonas, Acre, Rondônia and Roraima, but also in a few parts of Pará, Brazil, in Peru and in Colombia. This palm is also known as *Astrocaryum tucuma*.

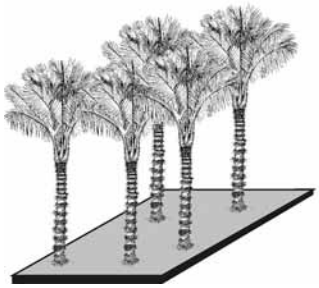
ECOLOGY



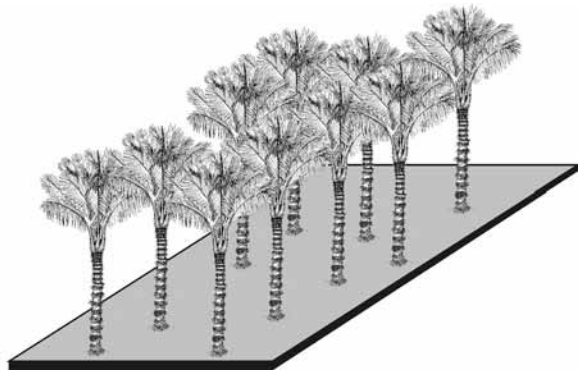
Flower and fruit seasons

J F M A M J J A S O N D

Near Manaus, tucumã of Amazonas usually flowers from June to January, and produces fruit from February to August.[1] There are palms that produce out of season, however, and in Manaus, there are tucumã of Amazonas fruits for sale all year long.



10 reproductive palms/ha in the forest

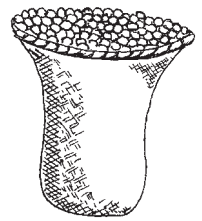


50 reproductive palms/alqueire in the forest

Density

In primary forest there may be up to 10 adults/ha.[2] In secondary forest and pastures, where the original forest may have had only a few scattered palms, agouti and fire help in the formation of new groups of tucumã of Amazonas palms. Farmers sometimes plant large groves exclusively of tucumã of Amazonas, numbering in the hundreds per hectare. Generally, the density of this species is twice as high in secondary forest than in terra firme.[2] A study in the area of Manaus found an average of 30 palms/ha in disturbed areas, with the highest densities (43/ha) in secondary forests.[3]

Production



an average of 720 fruits/palm (12 kg)

One palm produces on average 3–4 bunches of fruit/year, though some palms produce only two bunches while others produce up to seven. The size of the bunch varies; an average bunch contains about 240 fruits, but there are bunches that contain from 35 to 700.[1] The weight of a single fruit also varies greatly, from 20 to 100 g.[4] In a two-year study on a population of tucumãs in Manaus, the average productivity per palm was 12 kg/year.[3] Ten percent of the

most productive palms produced over 28 kg/year. An exceptionally good tree can produce up to 50 kg/year.[5] And although, in the Manaus study, tucumã had a greater density in the secondary forest, the percentage of productive palms was highest in pastures (93%) and home gardens (88%) versus fallow plots (66%) and secondary forest (50%). Fructification begins late, when the plant is close to seven years old and is between 6 and 9 m tall.

Tucumã inventory: indigenous knowledge complements scientific

Researchers working jointly with an indigenous tribe wanted to help them calculate how many productive tucumã palms were in their area. They used a mapping method with an excessively complicated name: "Post-exploratory systematized forest inventory with multiple beginnings". The researchers discovered that in an area where there should have been about 400 tucumã palms, their survey only located 16! While they asked themselves where the others were, a hard rain began to fall. As they stood around looking at each other and getting drenched, they decided that their method with the complicated name was worthless. One of them decided to inquire of the Indians: "Do you know where the tucumãs are?" The Indians swiftly proceeded to identify and map every tucumã palm in the project area.

The researchers planned to study how much each palm produced per year and multiply this amount by the number of tucumã palms in the area. The indigenous artisans would use this information to calculate how much material they would have to work with for the year and how much they could earn selling it at the market.

Scientists complicate, Indians elucidate!

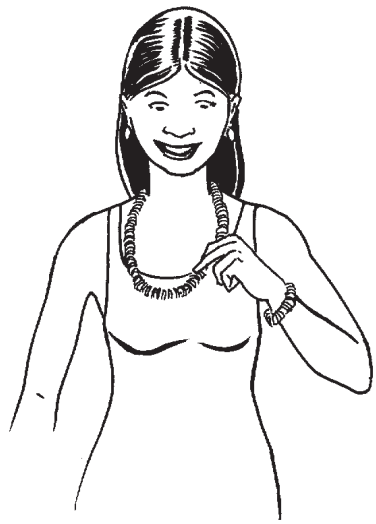
ECONOMIC VALUE

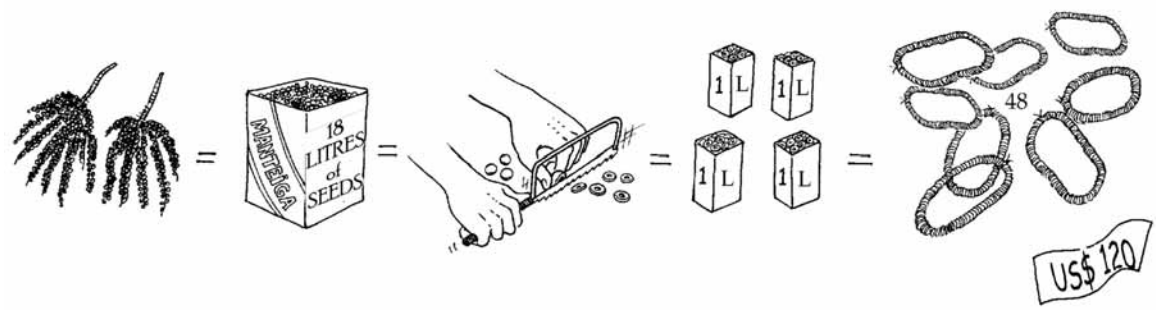
Tucumã of Amazonas has always sold well in Manaus, but since local cafés started serving sandwiches with tucumã instead of cheese, it has become even more popular. During the fruit season of 2003, the fruit sold in the street markets of Manaus for about US$0.70/dozen, US$1.30–3.30/100, and from US$4–26/50- to 60-kg sack. Out of season, 100 fruits are never sold for less than US$2.60, or a sack for less than US$13 and up to US$33. One kilogram of pulp sells for about US$7 all year round. A complete regional breakfast, including a tucumã sandwich, costs from US$1.50 to US$3. In the lower Tocantins region, in Oeiras, Pará, where it is known as *jabarana*, people adore tucumã of Amazonas and use it in place of dried meat in some traditional dishes. You will see people lining up to buy *jabarana* in these parts, and many families support themselves exclusively on the sale of this delicious fruit.

Vendors in Manaus distinguish three qualities of tucumã of Amazonas: bad, good and excellent. A sack of good tucumã sells for up to five times the value of a bad sack. Tucumã of Amazonas is widely sold in the cities of Porto Velho (Rondônia) and Rio Branco (Acre), where you can buy a little basket of 12 fruits for US$0.30.

Crafts of the Apurinã

In Acre, the Apurinã Indians make beautiful necklaces of tucumã. To make 48 necklaces, they use about two bunches of fruit, or one can (18 litres) of seeds, which, after they are cut, make 4 litres of beads. In 2005, each necklace fetched from US$2 to US$3. Each tucumã season the Apurinã are careful to collect only enough seeds to produce their crafts and in so doing assure their families' income and the conservation of the forest.





USES

Fruit: The fruit pulp is famously eaten in the tucumã sandwich and also as a filling for tapioca pancakes.

Seed: The seeds are used to feed domestic animals, smoke rubber and make necklaces and bracelets. The Apurinã Indians say that the black skin of the fruit contains energetic properties and wards off evil spirits. The seed cannot be used to make rings as its diameter is too large; however, another species found in Amazonas and Acre called tucumã-i (*Astrocaryum acaule*) is smaller and perfect for ring making.

Leaves: Tucumã leaves are woven into mats.

Trunk: The trunk is very sturdy and ideal for rural construction.

Differences between tucumã of Amazonas and tucumã of Pará

	 **Tucumã of Amazonas (*A. aculeatum*)**	 **Tucumã of Pará (*A. vulgare*)**
Number of stems	1	2–20
Stem diameter	15–33 cm	15–20 cm
Colour of bark and fruit	green, yellow	orange
Length of fruit	4.5–6 cm	3.5–4.5 cm
Diameter of fruit	3.5–4.5 cm	2.5–3.5 cm
Colour of pulp	orange or yellow	orange
Consistency of pulp	compact, firm	pasty and oily, a bit fibrous

NUTRITION

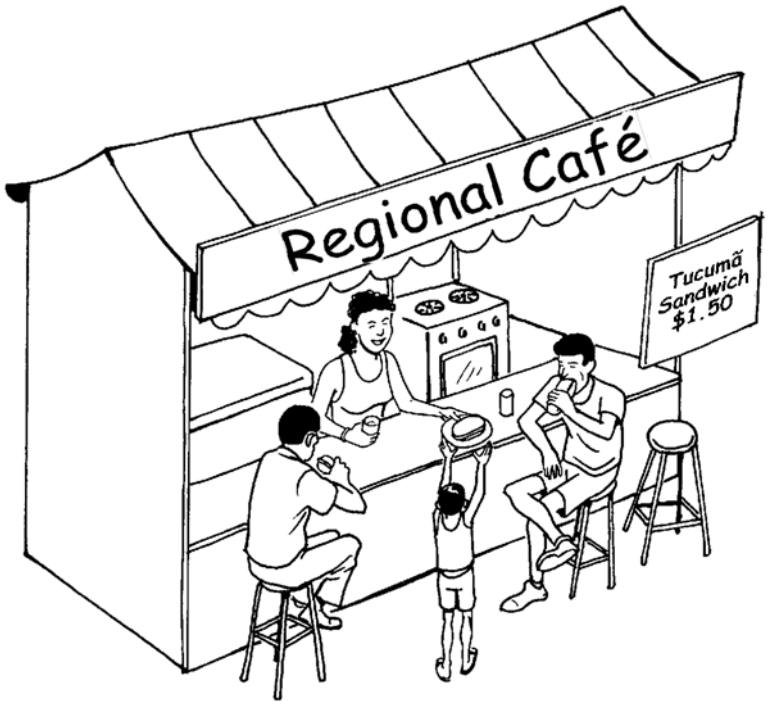
Tucumã pulp is loaded with calories, protein and vitamin A. Fresh pulp contains 3.5 mg of carotene/100 g.[4] Vitamin A is created in the process of digesting carotene, which strengthens the eyes to help you spot tucumã fruits way up near the top of the palm. The pulp represents 22% of the fruit's weight[6]; it is 9% protein and 55% oil.[4]

Tucumã sandwiches: the rage in Manaus

The first regional café opened in Manaus in the 1980s. It served a special weekend brunch with traditional Amazonian foods like manioc, corn, sweet potato, cará (a yam), pupunha, banana, Brazil nuts, eggs, fruit, sandwiches and a variety of juices. More and more regional cafes started to pop up and today you can find a fair number, both in Manaus and in other cities, some of which are quite chic and expensive. These cafes are always trying new recipes, one of which is the tucumã sandwich in which tucumã replaces cheese. Customers also enjoy the tucumã tapioca pancake, which is made from tapioca gum and filled with tasty tucumã pulp. Tucumã sandwiches represent from 60% to 80% of all the sandwiches

sold in regional breakfasts, while between 16% and 30% of all tapioca pancakes sold are filled with tucumã. This trend spiked sales of tucumã pulp, as many wanted to enjoy the sandwiches and tapioca pancakes at home.

For a long time, only older, experienced people would buy tucumã in the market. How to tell which fruits were ripe was considered something of a family secret, handed down from parents to their children. Tucumã was never considered to be good for a quick snack, and most visitors from out of town never tried it. But the recent fad of tucumã sandwiches has changed that, and now you can see all kinds of people snacking on tucumã everywhere you go, addicted to its rich, savoury flavour. Who knows if tucumã's newfound celebrity status will last, but for the older folks from the region, tucumã eaten straight off the seed will always be a favourite.



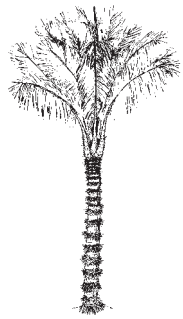
WILDLIFE

Many wild animals, like macaws, parrots, curassows, deer, peccaries, agouti, paca, armadillos and monkeys, eat tucumã. Agouti are the principal dispersers of tucumã seeds. Like squirrels, they bury the seeds for later and some of these seeds end up germinating. Other animals also like to eat tucumã seeds. If you want to help animals survive lean times between fruit seasons, save your tucumã seeds and break them open for the forest animals when there are few fruits available.

Management

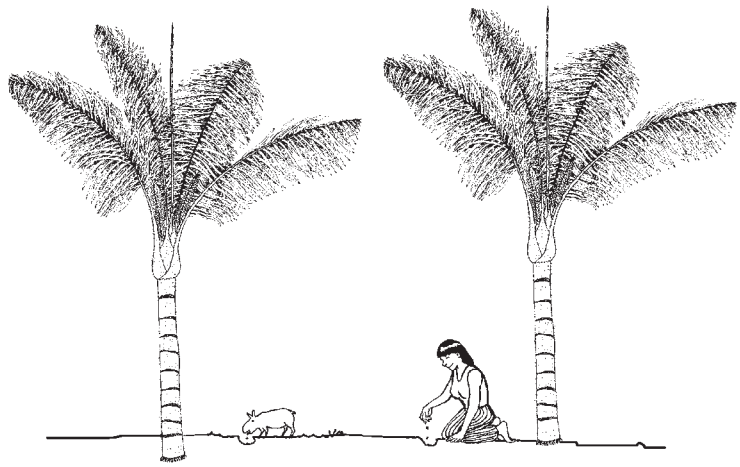
germination
30 days to 1 year
(with treatment)

growth
1 m/year



production
7 years

Farmers mainly tend tucumã palms that grow naturally without being planted. When they burn a piece of land to prepare agricultural fields, the heat helps tucumã seeds to germinate. There are people who plant tucumã as well. It is simple – just follow the agouti's example: open a little hole in the earth with a knife and drop the seed inside, then cover it up. Germination takes up to two years. In the beginning, the plant grows slowly and tolerates shade well. Choose the largest and most delicious fruits to plant from palms bearing substantial quantities of fruit.



How to encourage your plant to sprout

Sidney Ferreira

You don't have to wait around for years while your seed decides when it wants to grow. When the fruits are ripe, or even a bit overripe, remove the pulp, wash the pits and dry them in the shade for a week or two. Shake the pits to see if the seeds are loose inside them, then break the pits open and remove the seeds. Soak the seeds for 3–5 days, taking care to change the water each day to prevent them from rotting. Finally, plant the seeds in a raised flowerbed; within 30 days they will begin to germinate. When the sprouts have 4–5 leaves, they can be transplanted to a permanent location.

Tucumã management plan

Götz Schroth, Maria do Socorro Mota,
Ricardo Lopes, Aurélio Freitas

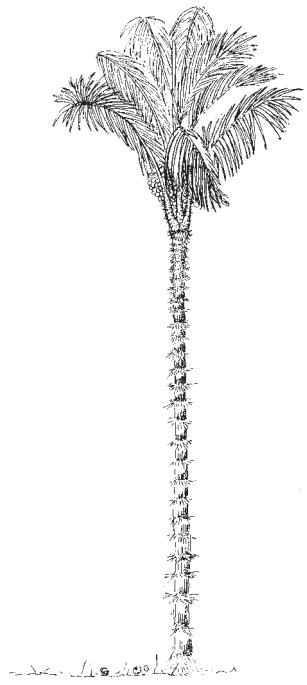
Eighty kilometres from Manaus, on the Pindorama ranch along the Preto da Eva River, a group of researchers managed and monitored 272 tucumã palms over a two-year period. The objective of the study was to increase the production of high-quality fruits to expand their markets. The management of spontaneous populations of palms that grow freely in pastures and secondary forest (in situ domestication) does not require financial investments and helps to improve the native population. The management plan called for the following steps:

1) Check the palm population for mature bunches every 10–14 days.

2) Clear away vegetation from around the base of the fruiting palms to facilitate fruit collection and monitoring. This will also reduce the density of palms. There should be at least 2 m between individual palm trees.

3) Monitor the productivity and quality of the fruits; identify individuals that combine high quantity and quality.

4) Eliminate palms that produce fruits of inferior quality (bitter or without flavour) but maintain unique individuals that can be marketed for other ends. For example, keep some of the trees that produce smaller fruits useful for making crafts.



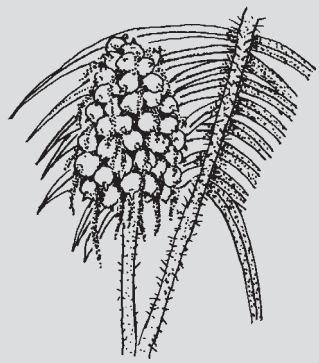
5) Collect all of the bunches, including the small ones, so as not to promote the regeneration of unsuitable individuals. Take care to eliminate excessively high palms whose fruits are difficult to collect, with the exception of the ones which produce lots of tasty fruits.

6) Use a rotating system of fruit collection, excluding a part of the collection area each year in order to facilitate the natural regeneration of the palms and preserve the fauna that feeds on the fruits (agoutis, pacas and others).

7) Eliminate individuals of the species tucumã-i (*Astrocaryum acaule*) that form hybrids with tucumã.

Murumuru: cousin to tucumã

Douglas C. Daly



The murumuru (*Astrocaryum murumuru* Wallace) is another palm of the same genus as tucumã. It is native to almost all of Amazonia. The pulp of the fruit is delicious and contains an oil with marvellous hydrating properties. Murumuru oil is being sold in Acre. One entrepreneur with a small factory in Cruzeiro do Sul is buying the fruits from Indians and producing soaps and other products in addition to selling the pure oil to cosmetic companies.

There is a single-stemmed and multi-stemmed murumuru, ranging between 1.5 and 15 m in height. The fruits are yellow with brown fur or with short black spines. The pulp is meaty and slightly fibrous, covering a hard pit which protects the oily seeds. The murumuru is an understorey palm from the terra firme, but likes to be near flooded areas like riversides, lakes and streams. In the forest of Alto Purús, a spineless murumuru can be found, a characteristic which would be valuable in domestication.

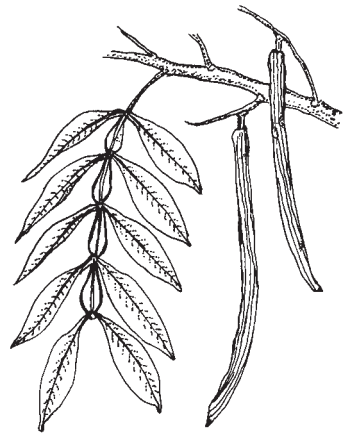
[1] Kahn, F. & Moussa, F. 1999
[2] Costa, J.A.; Duarte, A.P. and the Indigenous Community of Apurinã 2002
[3] Schroth, G. *et al.* 2004
[4] FAO 1987
[5] Milliken, W. *et al.* 1992
[6] Cavalcante, P.B. 1991

Diverse other species

Douglas C. Daly

Relatives of some of the best-known species of fruit trees also produce valuable fruits that should be more widely appreciated, and some parts of Amazonia are particularly rich in fruits. In the southwestern Amazon, the state of Acre constitutes a centre of diversity for various groups of fruit trees: in addition to the many ingás and the abius and abioranas, there are the cacaus (more than 7 species), the biribás and ata brava (more than 7 species), the cajás and cajaranas (5 species and 1 hybrid), the apuruís (8 species) and the araçás and azeitonas da mata (more than 23 species).

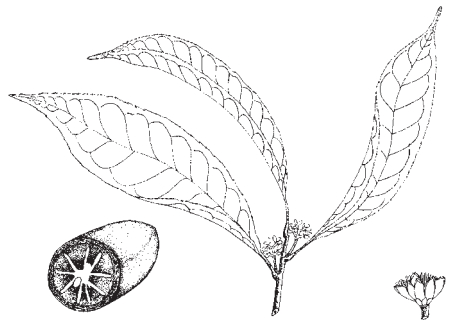
Some fruit species are unknown outside parts of southwestern Amazonia, like cajarana or cajá de jaboti (*Spondias testudinis*, known only in Acre, in Huánuco and Ucayali/Peru, and in Pando/Bolivia), envira caju (*Onychopetalum krukovii*, in Acre and Madre de Dios, Peru) and 2 atas bravas (*Rollinia calcarata*, only in Acre, and *R. mammifera*, in Acre and in San Martin/Peru). Finally, the so-called bacuri da várzea (a species of *Tovomita*), whose delicious fruit is common in the várzea or floodplain of the Purus river and a few smaller tributaries, has not yet been identified and may even be a species unknown to science. This highlights the importance and urgency of accelerating the inventory of the Acre flora.



At the eastern end of Amazonia is the state of Pará. As in the rest of Amazonia, the floodplains of Pará are rich in fruit trees, principally palms like açaí, buriti, patauá and murumuru, but also trees such as bacuripari (*Garcinia [Rheedia] brasiliensis*, a few araçás (e.g., *Eugenia feijoi*), the famous camu-camu (*Myrciaria dubia*) and a few ingás (for example, *Inga cinnamomea* and *I. nobilis*).

The people of Pará value several fruits with an oily pulp, among them uxi (*Endopleura uchi*), most common in Guyana and French Guiana, eastern and central Amazonia, and southern Venezuela, and two species of umari (*Poraqueiba paraensis* and P. *guianensis*), apparently nonexistent in western Amazonia. In contrast, *P. sericea*, very popular in Iquitos, Peru, occurs only in western and central Amazonia[a].

The following tables show some of the many species of great importance to Amazonian people that have been studied little or not at all.

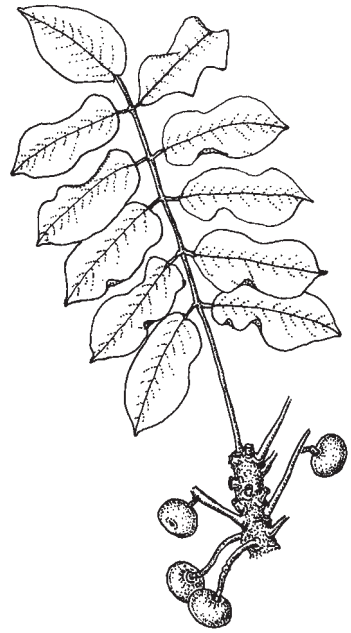


Abiorana, abiu, maparajuba and pariri (*Pouteria* spp.)

Amazonia has abiorana fruits of various sizes, shapes and colours – all edible. Abiorana trees contain white latex throughout, and many are large and valued for their wood. The majority of these species are not common; the best-known are *Pouteria caimito*, *P. glomerata* subsp. *glomerata*, and *P. macrophylla*, all known as abiu, and *P. pariry*, known as pariri. See the specific characteristics of each species below[1].

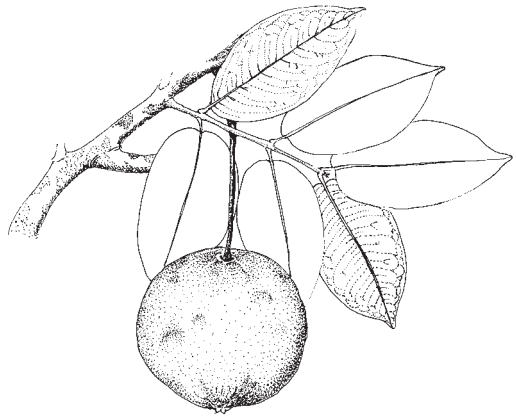
Species of *Pouteria*	Fruit	Occurrence	Tree size/fruiting season
Abiu *P. caimito* (Ruiz & Pavón) Radlk.	Elongate or globose, 2.7–7.5 cm long; apex sharp or rounded, base rounded or truncate; skin with or without hairs; smooth; 1–4 seeds	Various environments; widely cultivated in the Neotropics	Up to 30 m tall, but fruits from a young age / sporadic
P. glomerata (Miq.) Radlk. subsp. *glomerata*	Globose, 2.5–9 cm in diameter; apex and base truncate	River margins and várzea forests; widely distributed in Amazonia and Central America	Up to 30 m tall / sporadic
P. macrophylla (Lam.) Eyma	Flobose or slightly elongate, 2.5–3.5 cm long; apex and base rounded; smooth	Primary and secondary terra firme forests and semi-deciduous forests in Suriname, French Guiana and the Amazon of Brazil, Peru and Bolivia	Up to 30 m tall; has small buttress roots/ from October to February
Pariri *P. pariry* (Ducke) Baehni	Globose but slightly flattened, 9–10 cm in diameter; smooth; 2–3 seeds, each 3–4.5 cm long; pulp consumed fresh or in juices	Terra firme forests in the Brazilian Amazon	Up to 30 m tall / from December to April

Ameixa or jacaiacá (*Antrocaryon amazonicum* [Ducke] B.L. Burtt & A.W. Hill)



The ameixeira or ameixa tree is 25–37 m tall and up to 80 cm in diameter, normally with large buttress roots. The fruit is yellow or orange, globose but slightly flattened, smooth, 6 cm in diameter. The skin is thin and the sweet pulp surrounds the hard pit. It is found infrequently in terra firme forests in Acre, Pará and Roraima. It fruits in October and November, or in March. Ameixa is highly valued where it occurs; the pulp is used to make juices.

Araçá (*Eugenia* spp.) and azeitona da mata



In Acre, besides the araçá-boi *(Eugenia stipitata*) – a tree native to Peru but widely cultivated in Amazonia – there are wild relatives that also have edible fruits, including the following:

Species of *Eugenia*	Fruit	Occurrence	Tree size/fruiting season
Azeitona brava *E. egensis* DC.	Black and red, globose, about 1 cm diameter	Terra firme and várzea, in South and Central America, Amazonia, and northern Paraguay; widely distributed in Acre	Shrub or small tree, 3–6 m tall / November
Araçá *E. feijoi* O. Berg	Floats; orange and globose; 2.5 cm in diameter; rind similar to tangerine; pulp soft and sweet	Flooded areas (várzea and river margins), but also in bamboo thickets	Shrub or small tree, 3–4 m tall / November to March

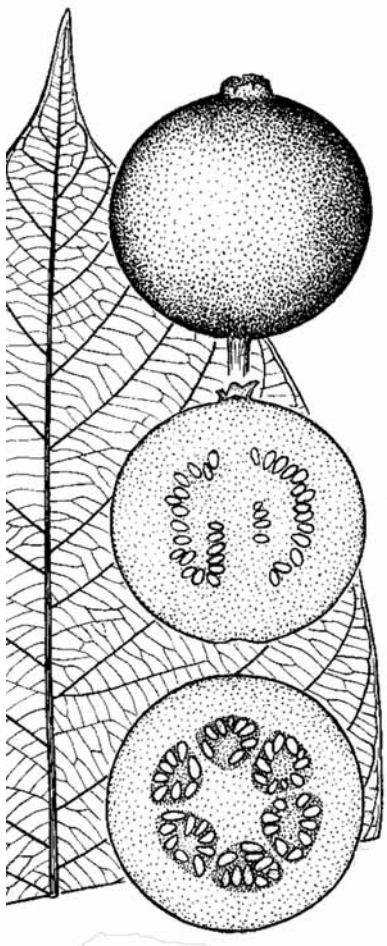
Apuruí and puruí or puruí grande (*Alibertia* spp.)

Piero Delprete

Alibertia (now including *Borojoa*) is a genus with about 21 species that occur in humid forests in Central and South America. Most of the species produce edible fruits that are consumed fresh or in some cases used to make juices and ice creams. The fruits, which vary in size from 5 to 15 cm in diameter, have a fleshy pulp. The genus is represented by shrubs and trees 4 to 25 m tall.

There are various other species of *Alibertia* in Acre, but the two that produce the most popular fruits are *Alibertia sorbilis* and *Alibertia claviflora*. These species are not available in the market, but they are well loved by locals, who know the locations of apuruí trees and when they fruit. Because these species grow in the shade of the canopy in seasonally flooded forests, an area to which few Amazonian crops are adapted, they could be domesticated with minimal impact on the natural vegetation.

Species of *Alibertia*	Fruit	Occurrence	Tree size/fruiting season
A. sorbilis J. Huber ex Ducke	Globose, 12–15 cm in diameter	Understorey of seasonally flooded forests	4–7 m/July to November
A. claviflora K. Schum.	Globose, 5–7 cm in diameter, with a fleshy mesocarp 1–2 cm thick	Understorey of seasonally flooded forests; mostly southwestern Amazonia	5–12 m/March to June



Biribá, biribá brava and ata brava (*Rollinia* spp.)

Most kinds of biribá fruits have large, soft 'scales', as in the true ata (*Annona* spp.), while others are smooth and irregularly lobed when the seeds are mature. In some, the scales are sharply pointed but never very hard. Of the seven known species of biribá, three are found only in Acre and small parts of adjacent Peru or Bolivia[2].

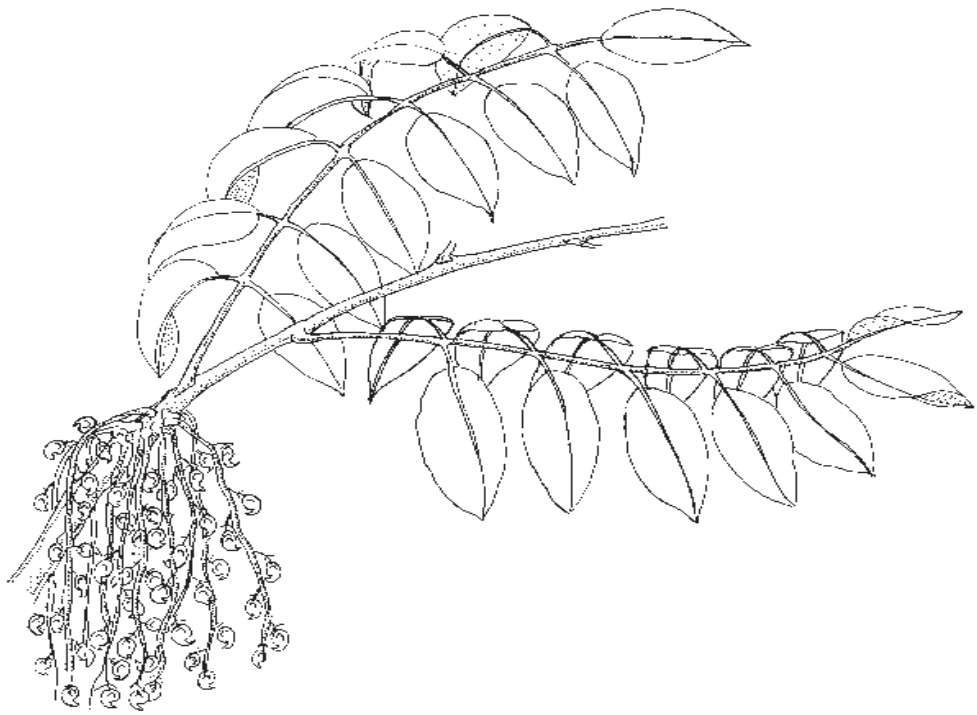
Species of *Rollinia*	Fruit	Occurrence	Tree size/fruiting season
Ata brava *R. calcarata* R.E. Fries	Globose	Rare, found in terra firme forests but also in low-lying areas, apparently restricted to Acre	About 25 m tall / end of the year
Biribá brava, ata brava, ata preta *R. mucosa* (Jacq.) Baill.	Yellow; egg-shaped, 2–20 cm long and 2.5–15 cm in diameter; covered with brown hairs; scales smooth or with curved 'spines' near the tip	Terra firme forest on rolling terrain, bamboo forest, and sometimes várzea forest. Well distributed throughout tropical America	Up to 20 m tall / much of the year
R. peruviana Diels	Green to yellow, globose but slightly flattened, 1.5–2 cm long and 2–2.5 cm in diameter; when immature densely covered with brown hairs, scales with a curved tip 1–3 mm long	Primary or secondary terra firme forest; restricted to western Amazonia	Up to 15 m tall / October to February

Breu (*Protium* spp.)

The Brazilian Amazon is home to five genera in the Burseraceae family—*Crepidospermum, Dacryodes, Protium, Tetragastris* and *Trattinnickia*—with some 100 species, a few of which produce fragrant resins used as medicine and insect repellent, for illumination and to caulk boats. In the indigenous reserve of Tembé, in Pará, the average abundance of mature breu trees that produce such resins is 1 tree/ha, but can be up to 10 trees/ha. The resin is produced in special conducting tissues under the bark and is exuded in response to various kinds of injuries. In some species of breu, insect attacks provoke release of resin.

Dacryodes has some 36 species in the American tropics, at least 21 occurring in Amazonia. The fruits of most are olive-shaped, some reach the size of olives, and like olives they have an oil-rich pulp around the stone. At least two Amazonian species are known to be managed by indigenous groups.

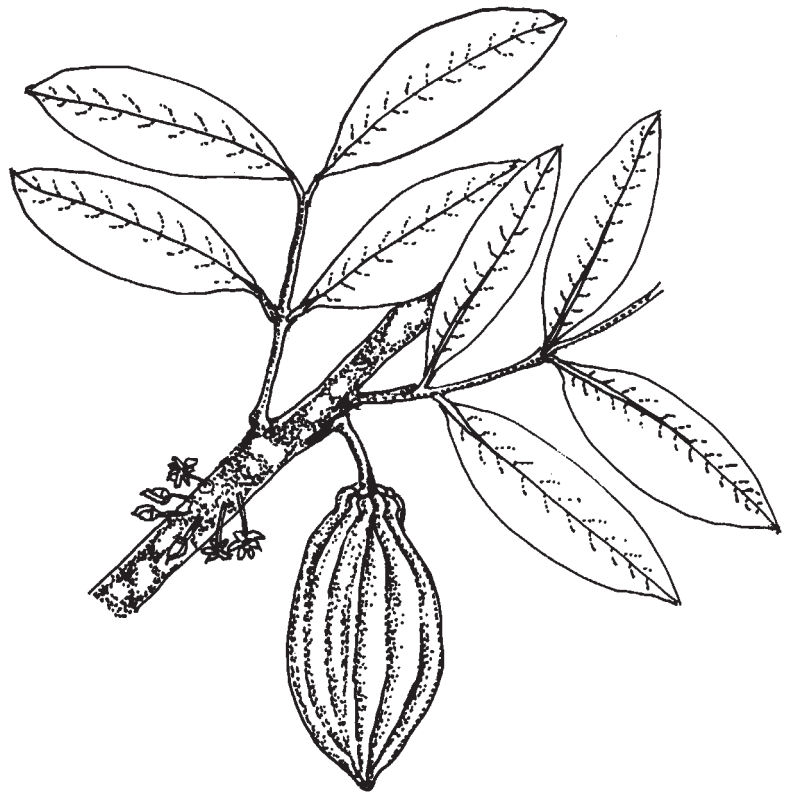
The fruits of *Protium, Tetragastris* and *Crepidospermum* are generally red, opening at maturity to expose a stone with a sweet white covering that attracts animals like pacas, peccaries and tortoises, which disperse some seeds throughout the forest. Many hunters build platforms and wait near breu trees to hunt game animals, and forest people snack on the white pulp when the stones fall.



Cacau, cacauí, cacaurana and cupuí (*Theobroma* spp. [cacau jacaré: *Herrania mariae* (Mart.) Decne. ex Goudot])

Besides the universally known cacao and the well-known cupuaçu, there are at least five additional species of this same group in the Brazilian Amazon that deserve attention. The fruits of all these trees grow either on the trunk or on the principal branches; inside the fruit are five columns of seeds along a central axis, each is surrounded by a sweet, succulent pulp. The roasted seeds of some of these species produce chocolate, while those of *Theobroma bicolor* are roasted or grilled and salted to make 'nuts'.

It is a genus with approximately 20 species of understorey trees[3]. The pulp of the fruits is used to make juices, sweets, frozen ice treats, ice creams, jams and other products.



Species	Fruit	Occurrence	Tree size/ fruiting season
Cacao *Theobroma cacao* L.	Yellow or multi-coloured (yellow, red, purple), egg-shaped or elongate, variable in size, with 10 grooves. Contains 40–60 seeds, each 2–4 cm by 1.2–2 cm, that can be roasted to make chocolate. The seed pulp is used to make a delicious drink	Widely cultivated in tropical America, but also occurring spontaneously in the understorey of terra firme forests in parts of Amazonia	10–12 m tall/ various times of the year, depending on the region
Cacao jacaré *Herrania (Theobroma) mariae* (Mart.) Decne. ex Goudot, *H. nitida* (Poepp.) R. E. Schultes	Green or yellow, egg-shaped to slightly elongate, 10–12 cm by 5–7 cm diameter, with 10 longitudinal ridges and (in *H. nitida*) fibrous ribs between the ridges; when the fruit is ripe, the rind is covered in irritating hairs; contains 30–40 seeds	Small understorey tree in terra firme forests, never abundant, but widely distributed throughout Amazonia	Shrub or slender tree not taller than 10 m, normally with few branches / sporadic
Cacau de macaco, cacaurana, cabeça de urubu *T. obovatum* Klotzsch ex Bernoulli	Brownish yellow, inverse egg-shaped, slightly elongate, the apex round, 5–7 cm by 3–4 cm diameter; the rind is bumpy	Restricted to terra firme forests in western Amazonia	Up to 15 m tall / between October and June
Cacaurana *T. microcarpum* Mart.	Egg-shaped and elongate, greenish yellow, up to 12 cm long	Rare in terra firme forests of western Amazonia, including Colombia (caquetá), also along the Tapajós river; cultivated in Trinidad and Tobago	Up to 18 m tall / various times of the year
Cacauí *T. speciosum* Willd. ex Spreng.	Yellow, slightly elongate-globose, about 10 cm by 7–8 cm diameter containing 20–26 seeds; the rind is smooth, slightly velvety and hard; some make chocolate from the seeds	Normally in terra firme forests, sometimes found in secondary forests but never abundant; widely distributed in Amazonia with the exception of the northeast of the region	7–15 m tall / September to November in the majority of the region, November to March in Pará
Cupuaçu *T. grandiflorum* (Willd. ex Spreng.) K. Schum.	Green but covered with brown hairs, oblong or elongate-oblong, 12–25 cm long by 10–12 cm diameter; weighing up to 1.5 kg and containing 20–50 seeds; the rind is smooth; among various other products, the pulp can be mixed with Brazil nuts and coconut to make the 'cupuaçu salami' of Pará	Native to southern pará and western maranhão, but widely cultivated throughout the Brazilian Amazon and in Colombia, Costa Rica, Ecuador and Venezuela	4–10 m tall, reaching 18 m / first semester of the year

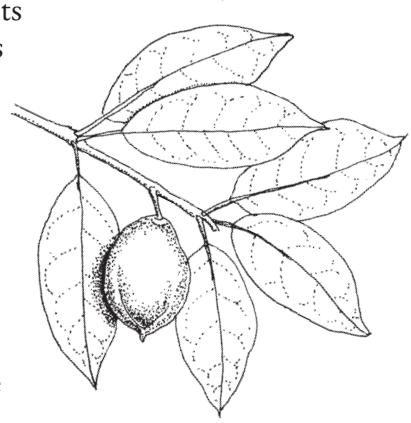
Cajá, cajarana, cajá de jaboti and taperibá/taperebá (*Spondias* spp.)

The genus *Spondias* is represented by at least ten species of fruit trees in tropical America, half of them found in Amazonia. All produce great quantities of fleshy, orange or yellow fruits. The skin of the fruit is relatively thin, and the pulp (same colour as the skin) is acidic, sweet, aromatic and flavourful. Fallen fruits can be collected and eaten right beneath the tree, but most people take them home to remove the skin and separate the pulp with a sieve. In small communities, people usually consume them as juices. In the cities, ice cream and frozen pulp are made for sale. A few riverine communities in Acre make a spicy pepper sauce with the fruits of cajá de jaboti. In the forest, the native species serve as 'waiting trees' for hunters because the fallen fruits attract various animals like peccaries, tapirs and tortoises.

species	Fruit	Occurrence	Tree size/fruiting season
Cajarana, cajá de jaboti *S. testudinis* J.D. Mitch. & Daly	Greenish-brown, oblong, 5–6.5 cm by 2.5–3 cm diameter; rough with raised spots	Restricted to Acre; Huánuco and Ucayali in Peru; and Pando in Bolivia	Up to 38 m tall and 65 cm in diameter / March to April
Cajá *S. mombin* L.	Yellow or orange, usually egg-shaped, 2–4 cm by 1.8–2.7 cm diameter	Widely distributed in tropical America and cultivated in the rest of the tropics	Up to at least 28 m tall and 56 cm in diameter; the trunk can have thick nodules or ridges when it grows in the sun / November to May
Taperibá, taperebá, cajá *S. globosa* J.D. Mitch. & Daly	Yellow; globose, 3.5–4 cm in diameter; less sweet than mombin	Temporarily flooded areas in western Amazonia and Venezuela	Canopy tree up to 40 m tall and 105 cm in diameter / March to June
Cajarana *S. dulcis* Parkinson	Yellow or orange, oblong, 5–10 cm by 3–8 cm in diameter, stone spiny	Tree native to Asia but cultivated throughout the humid tropics	Cultivated, reaching 25 m tall / August and September
Cajá-açu *S. "mombin x testudinis"*	Like the cajá de jaboti but larger (the largest fruit of the group)	Tree apparently restricted to Acre, in terra firme forest	Likely a hybrid of cajá with cajá de jaboti / February

Castanha de porco, castanhola, castanhinha (*Caryodendron amazonicum* Ducke)

The castanha de porco, also called castanhola and castaninha, is cultivated on a modest scale in Venezuela for the sale of its oil-rich edible seeds, which are normally roasted. It fruits from October to November and in April, when it serves as a hunting site for game such as peccaries.



It is a medium- to large-sized tree 15–40 m tall. It grows in terra firme forest, often in rolling terrain. It is primarily a western Amazonian species, but it can also be found along the Jari River in Pará.

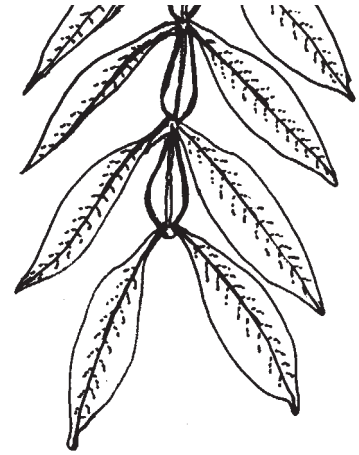
The essentially globose fruit is approximately 4 cm in diameter; it has three lobes and opens in three parts. The seeds are about 3 cm long.

Cocão (*Attalea tessmannii* Burret)

The cocão is a single-stemmed palm that occurs, however, in dense clusters of individuals. Oil extracted from the cocão seed is used in the preparation of various foods. Rubber-tappers burn the woody endocarp or stone of the fruit to smoke rubber. This species merits special attention because it is native and seems to be abundant where it occurs, and at least one of its products, the oil, is not immediately perishable, making it a good market product.

Each plant is robust, reaching a height of 8–19 m. The fruits are brown, elongate egg-shaped, and 12–13 cm long by about 7 cm diameter. The outside of the fruit is hard and fibrous, while within a fine layer of starch covers a woody pit or stone containing 2–3 oil-rich seeds. It occurs in the understorey or in the canopy in terra firme forest. The cocão is native to western and southwestern Amazonia, occurring in Peru and in Acre in the upper Juruá River basin.

Envira caju [*Onychopetalum periquino* (Rusby) D.M. Johnson & N.A. Murray]



The sweet pulp of the envira caju tree is highly prized by traditional communities, which know the species well. We still lack detailed knowledge of certain key characteristics of the fruit in order to evaluate its market potential in the region. For example, the fruits are astringent until they are completely ripe; moreover, the local abundance of the trees, and the quantity and consistency of production per tree, are unknown. The envira caju has a red, globose fruit about 4 cm in diameter. The tree is 8–28 m tall, and it is found frequently in terra firme forests, often on hilly terrain. It is apparently restricted to Acre and the Department of Madre de Dios in Peru. In Acre, it occurs only from Tarauacá to the east. Envira caju fruits in October and November.

Ingá (*Inga* spp.)

Ingá is one of the most important tree groups in Amazonia. In addition to its diversity (approximately 130 species in the region), it possesses characteristics that increase its potential as a resource for agroforestry systems, recuperation of degraded areas, and fruit commercialization. The genus is abundant in various environments and various ingás occur in secondary forests or in várzea. Many of the trees are small, fast-growing, and highly productive. As legumes (the bean family), they contribute to soil fertility, which in the tropics is normally poor. Both Acre and Pará have more than 50 species of ingá each.

Depending on the species, ingá fruits can measure from 5 cm to 1 m long. Though they do not open spontaneously, they are easy to open by hand. The seeds of most species are surrounded by a sweet, white, fluffy pulp, and the fruits of some of these species are sold in the markets of Belém, Manaus, Iquitos (Peru) and other Amazonian cities, but the majority are collected and consumed in the forest; few species are cultivated.

The following table summarizes the natural geographic distribution for a few ingás, as well as the environments in which they are found[4].

Species of *Inga*	Distribution	Habitat
I. alba (Sw.) Willd.	Southern Mexico, Central America, northern South America	Terra firme
I. cayennensis Sagot ex Benth.	Northern South America south to Peru, also northeastern Brazil	Terra firme
I. capitata Desv.	Costa Rica; northern South America south to Bolivia; Atlantic Forest of Brazil	Terra firme and várzea
I. chartacea Poepp.	Southwestern Amazonia and southern Pará	Terra firme
I. cinnamomea Spruce ex Benth.	Widespread in Amazonia	Várzea; cultivated
I. edulis Mart.	Northern South America east of the Andes; Atlantic Forest of Brazil	Clearings in terra firme
I. grandis T.D. Penn.	Restricted to southwestern Amazonia	Terra firme
I. ingoides (Rich.) Willd.	Northern South America, Bolivia, Central Brazil, Atlantic Forest of Brazil, northeastern Brazil, Lesser Antilles	Terra firme and várzea
I. laurina (Sw.) Willd.	Northern Mexico south to northern Argentina; Caribbean	Often in dry forests
I. macrophylla Humb. & Bonpl. ex Willd.	Amazonia and Pacific coast of northwestern South America	Secondary and disturbed forests; cultivated
I. nobilis Willd. var. *nobilis*	Amazonia, Guyana, French Guiana, central and southern parts of Venezuela, Central Brazil	Várzea
I. stipularis DC.	Amazonia, Guyana and French Guiana	Terra firme and river margins
I. velutina Willd.	Amazonia	Terra firme and várzea

Sapota or sapota do Solimões (*Matisia cordata* Bonpl.) and sapota macho (*M. bicolor*) Ducke

Sapota and sapota macho are large trees up to 40 m tall in terra firme forests. The sapota fruit is slightly egg-shaped or sometimes globose, smooth, 7–15 cm long by 5–15 cm in diameter. The *sapota macho* fruit is smaller, round, wrinkled, and up to 7 cm in diameter. The fruits of both species are yellowish brown or orange, with firm leathery skin (thinner in *M. bicolor*). The orange pulp that surrounds the hard pit or stone resembles that of a mango and is fibrous and sweet.

Species of *Matisia*	Fruit	Distribution
Sapota *M. cordata* Bonpl.	Cultivated trees are smaller but can produce 700–1 000 fruits / year; fruit matures between February and May and is sold in the markets of Iquitos, Peru	Native to western and possibly central Amazonia, but also widely cultivated there, in Belém, and on both sides of the Andes in Colombia and Ecuador
Sapota macho *M. bicolor* Ducke	Not cultivated, but it can be frequent where it occurs; fruits October–November	Restricted distribution, recorded only in the south-western corner of Amazonia (Acre and south-eastern Peru) and in the Xingu River basin

[1] Pennington, T. D. 1990
[2] Maas, P. J. M., Westra, L.Y. Th. and collaborators 1992.
[3] Cuatrecasas. J. 1964
[4] Pennington, T.D. 1997