

THE BIOTECHNOLOGY OF CHESTNUT BRAZIL (*Bertholletia excelsa* Humb & Bonpl.) - LECYTHIDACEAE IN FORESTS AMAZONIAN

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RESUMEN: (La Biotecnología de las Castaño-de-Brasil (*Bertholletia excelsa* Humb y Bonpl. Lecythidaceae en los bosques de la Amazônica). La biotecnología revela el conocimiento de las personas mediante el uso de la nuez de Brasil y destaca la importancia económica, ambiental y cultural de la especie. El estudio tuvo como objetivo rescatar el conocimiento empírico y las actividades de extracción y elaboración de productos obtenidos de los castaños en los bosques amazónicos. Los procedimientos metodológicos consistieron en la observación directa, entrevistas semi - estructuradas, visita guiada, registro fotográfico. Los datos fueron recogidos en 2013 de la extracción a la tramitación de la mejora de la castaña. La población vive en armonía con la diversidad forestal, clasificar y nombrar el castaño como etnocategorías de usos. Datos socioeconómicos muestran que la mayoría es de sexo masculino y la edad osciló entre 22 y 79 años. En cuanto a la educación 60% tienen educación primaria incompleta y 40% no tiene escolaridad. Los informantes designan al castaño de acuerdo a sus características morfológicas y botánicas etnoclasificación informes empíricos que producen tres tipos: rosa, ráfaga y mirim. La diferencia está en el color de la madera, del tamaño de la fruta y semillas y número de semillas. Se concluye que emite el conocimiento sobre el uso y manejo de la castaña involucra el patrimonio y las tradiciones culturales, creencias y religiosidad, que se transmiten de generación en generación y evitar la erosión cultural local.

Palabras clave: Productos de las semillas; Etnocategorías de usos; Extracción; El conocimiento local.

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ABSTRACT: The ethnobotany reveals people's knowledge through the use of the Brazil nut highlighting the economic, environmental and cultural importance of the species. The study aimed to rescue the empirical knowledge about the collection and management ethnocategories of uses of chestnut trees in Amazonian forests. The methodological procedures consisted of direct observation, semi - structured interviews, guided tour, photographic record. Data were collected in 2013 from the extraction to the processing of improvement chestnut. The population lives in harmony with the forest diversity, classify and name the chestnut as a ethnocategories of uses. Socioeconomic data show that the majority is male and the age ranged from 22 to 79 years old. Regarding education 60 % have incomplete primary education and 40 % have no schooling. Informants appoint the chestnut according to their morphological and botanical characteristics yielding empirical ethnoclassification reporting three types: pink, mirim, gust. The difference is in the color of the wood, the size of the fruit and seeds and number of seeds. It is concluded that the knowledge issued on the use and management with chestnut involve heritages and cultural traditions, beliefs and religiosity, which are passed from generation to generation and avoiding local cultural erosion.

Key words: Beneficiation; uses ethnocategories; extraction; local knowledge.

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INTRODUCTION

The Amazon is home to a third of rainforests in the world and account for nearly 30% of the world's biological diversity. Have immense potential genetic covering 64.9% of the Brazilian territory, being the largest rainforest on the planet while library as a basis for biodiversity and environmental services for the stabilization of the global climate, according MMA (2006).

The Amazon rainforest reserve grandiose figures as their biological diversity, being very rich and wide, having three basic ecosystems: lowland forests, woodlands and forests igapó upland. Moran (1990) consider a simplistic classification system for ecological complexity of these systems, adds to this thought a more meaningful understanding of the historical action of the native man on the Amazonian ecology, ecosystems unfolding in different types of lowland and upland environments, considering this essential knowledge reorientation of conservation, developmental and territorial policies. For Posey (1986a) the natives of Brazil had one but integrated empirical notion of all compartments of a shallow flood plain, even the marshy areas of floodplain dominated by grasses, featuring its forested ascending ramp up spending the lower terrace or at the base of strands of forests of "mainland".

Over decades of research and etnobiólogos anthropologists have found a deep knowledge of the local agencies and ecological processes of these groups worldwide. This knowledge about the environment in which they live and live human populations is critically important about the use and management of plant resources, with a view to obtaining food, medicine and raw materials for various purposes. This local knowledge is rooted in specific cultural and environmental contexts, so it is necessary to understand some of the internal logic of the group to enjoy it and evaluate it properly, according Amorozo *et al.* (1996).

The ethnobotany aims to search for knowledge and the rescue of traditional knowledge or local botanical knowledge, particularly related to the use of the resources of flora. Ethnobotanical studies indicate that the structure of plant communities and landscapes are managed by people in their daily lives. In this context, ethnobotanical research can play roles of great importance to gather information about all the possible uses of plants in their various etnocategorias and thus contributing to the development of new forms of uses of plant resources by humans, according Pasa (2011).

Ethnobotanical studies in the maintenance of the standing forest is an alternative to reducing deforestation and pressure of the agricultural frontier enabling economic development to generate income for the local population from the sustainable use of non-timber products. In addition, sustainable forest management practices that seek to optimize the use of natural resources without compromising their regeneration, ecological stability and use by future generations is also true.

For Muller (1981) the chestnut is a tree that grows in the Amazon lowlands of tall forest, often in hard to reach places, with natural dispersion ranging from the Upper Orinoco to the Alto Beni, which are included Venezuela, Colombia, Peru, Bolivia and Guyana.

The present study aims to rescue the local knowledge about the collection and management of conservation *Bertholletia excelsa* Humb. & Bonpl as well as the processing of almonds in their etnocategorias different uses by local populations in the Brazilian Amazon forests.

MATERIALS AND METHODS

AREA OF STUDY

Municipalities located north of Mato Grosso are considered an agricultural state border and have a steady stream of immigrants, mainly from the south. According Mato Grosso (2001) the occupation of the lands of these municipalities are concentrated in the vicinity of urban areas and highways from structured settlement projects implemented in the 70s in the within the Amazonian Occupation of Land Policy.

The Amazon region is inserted in geomorphological terms Interplanáltica depression in the

Southern Amazon, characterized as wide undercut surface, dissected in dominantly convex shapes with different orders of magnitude dissection and degree of deepening of drainage valleys separated by background. The climate according to Köppen is kind Am (tropical rainy climate), with rainfall that expresses the character of transition between two areas to tropical humid Amazon and the Brazilian Central Plateau. The average annual rainfall exceeds 2,000 mm, with well-defined seasonal rainfall regime, where the dry season is from May to September with rainfall less than 60 mm in the driest month, while the wet season lasts from October to April, which concentrates more than 80 % of the total rainfall. The average temperature is 25 ° C, with low amplitude variation, and months of highest matching value with the spring summer (rainy season), and the lowest value during the winter period when masses of polar air attenuated step into the region the relative humidity is quite high and is limited to the isohigras 80-85 % , second IBGE (2005).

Data were collected in several Amazon regions throughout the year 2013, but in CECAB (Cooperative Extraction Chestnut-of-Brazil) was the place where we got the data on the processing of chestnut and where it remained longer in location. The cooperative has fifty-two -five active members and retirees in the municipality of Alta Floresta, distant 700 km from Cuiaba, capital of Mato Grosso.

METHODOLOGY

The methodological procedures used consisted of direct observation, semistructured interviews of application type, according Viertler (2002), guided tour through the woods, photographic records and logbook. Data were collected from the stage of extraction of the fruits in the woods until the improvement in Chestnut CECAB (Cooperative Extraction Chestnut Brazil) in the city of Alta Floresta in the state of Mato Grosso. The collection period took place in several phases throughout the year 2013. The first expedition was in the woods watching and interviewing collectors during the extraction and following the other steps until the improvement of chestnut. The species was collected and identified by experts of the Central Herbarium of the Federal University of Mato Grosso (UFMT), where it is deposited.

In total 47 people were interviewed between collectors, drivers and employees working in the Cooperative and forming an association of collectors and processors of the Brazil nut in the town of Alta Floresta in northern Mato Grosso and distant 720 km from Cuiabá, in addition extractive other cities such as Manaus in the Amazon region, Tefe, Cotriguaçu, Santa Carmen, Itauba, Claudia, Sinop, among others cities.

RESULTS AND DISCUSSION

The Chestnut Brazil (*Bertholletia excelsa* Humb. & Bonpl.) is a native tree species in the Amazon region, which has been exploited both for its wood and by its seeds. This is a species with high economic value, both for nutritional and seeds rich in selenium as for its timber. The largest mining production took place in the 70s by opening roads in the Amazon region and later with the expansion of the agricultural frontier parallel government policies of territorial occupation.

The *Bertholletia* gender is derived from the name of the chemist Berthollet (1748-1822), and the species was described by Humboldt and Bonpland in 1807, who proposed the *excelsa* name because the species very leafy stand out above the canopy, second Braga (2007). The nut is the only extant species in the gender *Bertholletia* and although there is considerable variation in size, shape and number of seeds per fruit and records of divergence with respect to its classification no justification for recognizing more than one species for Mori & Prance (1990). The *Bertholletia excelsa* Humb & Bonpl. is systematically classified in Division Angiosperm Class Eudicotiledonea, Myrtiflorae Order, Family Lecythidaceae second Souza (1963).

The results show that the majority of respondents coming from the southern region (80%) and the rest from other states such as Pará, Maranhão, Rondônia and Minas Gerais. The sample was 47 people directly involved with the collection and processing of chestnut with 40% female and 60%

male. Among respondents 40% had no schooling, and literate as to have incomplete primary education. There were no reports of progress or completion of high school and college. Their ages ranged from 22 to 79 years old.

Data obtained from the interviews suggest that all women perform activities related to the processing working in the Cooperative. As for the male informants are divided between the tasks of collecting the urchins in the forest and heavier work in the Cooperative. The income is distributed among the associate members equally and independent of activity that exerts way because everyone works eight hours a day and with a formal contract. The higher the production and export of product benefited higher income to be distributed among the members. The Brazil-nut is a large tree species, reaching 50 meters in height (dominant canopy, straight and cylindrical bole, bark and slited hard and grayish-brown for Mori & Prance (1990). (Figure 1).



FIGURE 1. Arboreal *Bertholletia excelsa* Humb. & Bonpl. Santa Carmen, MT. Collection of authors. 2013.

As the testimony of informants CECAB (Cooperative extraction of the Brazil nut) in Alta Floresta beginning of flowering and fruiting may vary, but generally the chestnut flowers from October to December and fruits from January to March.

The maturation occurs between 12 and 15 months, thus not being an annual production. During flowering and fruit development of the new, the old chestnut canned fruits and almost mature according Moritz (1984). Is common to find fruit at different stages of development in the same individual Hedgehogs fall after ripening being ready to be harvested in the rainy season, Maués (2002).

The fruit is called a hedgehog or incomplete pixídio. It has approximately 15 to 25 seeds that are about 4 to 7 cm long and joined by the central column cord ovarian covered by a husk or shell ligniforme harboring a single almond inside, second Moritz (1984). (Figure 2).



FIGURE 2. Fruit of the chestnut tree or hedgehog. Santa Carmen, MT. Collection of authors. 2013.

According to the informants the action of dispersion is made by people agouti (*Agouti paca*), by capuchin-monkeys (*Cebus apella*), cairaras-monkeys (*Cebus albifrons*), macaws (*Ara* sp.) Woodpeckers (*Campephilis* sp.), paca (*Agouti paca*) or other small rodents as Acouchies (*Mioprocta* sp.) and quatiurus (*Sciurus* sp.) among others. In this context, ethnobiological research can play roles of great importance, such information about all the possible uses of plants and animals, contributing to the development of new forms of exploitation of ecosystems that are opposed to the current destructive ways, second Pasa (2011).

Second Clemente (1993) the distances of seed dispersal of the Brazil nut are very limited due to the large distances between the nut. Some researchers believe that the occurrence of chestnut trees in concentrated areas is due to seed dispersal by agoutis that are not susceptible to dispersal over long distances by these animals. Peres & Baider (1997), Cimerys et al. (2005) observed zoochoric dispersal distances up to 50 m away.

The Mato Grosso Amazon has a strong vocation for non-timber extraction and approximately 12,500 people live in this practice, which represents 0.55 % of the state population. Local people living marketing Chestnut ensure the family income and this marketing is responsible for 10 % of total revenues coming from the extractive activity in the Amazon second Ibama (2009).

In the north of Mato Grosso, deponents reported that collect on average between 180-220 urchins of each tree, but a lot depends on the type of nut. They attach to the pink type greater fruit yield relative to burst and mirim, local etnoclassificação. The popular names are related to their uses as food, ritual, craft, timber, general household and mainly medicinal. The processes of categorization of plants within societies are culturally influenced by cognitive categories and organized into logical patterns (taxonomic structures) according Levi–Strauss (1962).

According to Albuquerque (2005), the biological world is classified on the basis of perceived characteristics, whether intrinsic (as extractive substances) or extrinsic (such as morphology). To Van Rijsoort et al. (2003) total seed production per tree is a product of the number of urchins per tree, number of seeds per hedgehog, and mass per seed. Trees produce on average 260 hedgehogs, with 17 seeds per hedgehog, the mass of 7.2 g/seed.

According Viana et al. (1998) and Zuidema (2003) there are several factors that determine the number of fruits produced by a chestnut tree : the tree diameter, position the canopy and the form of the liana infestation, nutritional factors related to soil, climatic factors, the temporal variation, genetic factors, plant-animal interactions (pollinators and predators).

In Alta Floresta ethnobotanical the process begins with collecting chestnuts hedgehogs, which is the first stage, which occurs through the opening of trails in the forest by collectors. On average three to four men travel the path by selecting Peak and will have individual trees where the fruit will be collected. Pikes are a set of trails the forest joining the chestnut trees and every pike can provide 5-250 chestnut, according Coelho et al. (2005).

Collection activity of hedgehogs in the woods is a task exclusively male, as already hold the job for years. Collectors reported that collects, on average, two-thirds of the total number of hedgehogs fallen to the ground. This practice reveals the care they give to the process of regeneration of the species in the region to cease certain amount of fruit for natural dispersal, where the agouti and other rodents. Thus, it is apparent local management attributed the preservation of fruits for the maintenance of the species in the region as well as practice of environmental sustainability of the product of chestnut trees by the human population of the region, through the processing of nuts for consumption and export, mainly to Bolivia.

The nut production comprises some seasonality, as some trees that produced large amount in one year can produce almost any hedgehog in the following year. The reproductive cycle of the Brazil nut is about fifteen months. The average yield per tree in the area is 22.76 Kg areas, according to collectors. Each collector spends an average of two hours on each tree by selecting the hedgehogs that will be transported and collect, on average, about 250-500 kg of fruit per day the chestnut.

For one week can collect approximately between 1800 kg to 2500 kg of seed. The working day lasts, on average, eight hours, which is included in the travel time of the Cooperative to the collection area and the time spent for lunch. The route can be done twice or more a day, depending on the choice of the collector lunch in the woods or not or the need to return to the place of crowding to catch the seeds

that failed to load on the first trip. The average time spent in breaking the hedgehogs is 2 hours. Each collector can collect per day between 60 Kg and 100 Kg According to information collectors selection of seeds still get the forest through the process of breaking hedgehogs throughout the collection , for visual separation, is a pre-classification, which are removed the seeds which have defects , mold or different colors. The selection can also extend to the Cooperative (Figure 3).



FIGURE 3. Selection and breakage of hedgehogs. Alta Floresta e Santa Carmem. MT. Collection of authors. 2013.

The second stage consists in washing the seeds in a pressure cooker, which are boiled for two hours for softening brown to favor the breaking and almond extract. This process will facilitate the extraction of almond, which is largely protected by the hardness of the nut shell. (Figure 4).



FIGURE 4. Seeds Boil. Collection of authors. 2013.

The third stage also ethnobotanical nature occurs by breaking the seeds with the aid of a rustic and simple machine. The seed is placed in a vertical position and then is pressed by a wooden lever, which will promote its opening wings and thus facilitating the extraction of almond in full. Commercially it is very important that the extraction of a whole almond is because when this happens the effect is visible, it provides great advantages for all stages from storage to consumption (Figure 5).



FIGURE 5. Extraction of almonds. Alta Floresta, MT. Collection of authors 2013.

The fourth stage is the storage of the product for marketing purposes. Initially all selected through criteria such as size, weight, shape, color and morphology of chestnuts will be stored at first in plastic bags and then in aluminum bags, which favors mainly the incident light effect directly on stored product. Almonds remain longer in aluminum bags, which are propitious to maintain the good condition and after being transported and marketed to various regions of Brazil and / or other countries like Bolivia (Figure 6).



FIGURE 6. Storage of almonds. CECAB, Alta Floresta, MT. Collection of authors. 2013.

The fifth step is to develop various ways of by-products derived from the almond for consumption and marketing. The Brazil- nut is sold in seed form in shell and shelled, edible oil and industrial. There are also products like fine soaps, olive oil, milk, flour, bran, pie, butter, etc. The biggest source of production is the extraction within Pas (protected areas), SDRs (Sustainable Development Reserves) and RESEXs (extractive reserves) and the IT (Indian Lands) region comprising the cities of northern Mato Grosso as Alta Floresta, Sinop, Santa Carmen, Itauba, Claudia, Nortelândia, Cotriguaçu and Amazon as Manaus and Tefé, among others. (Figure 7 and 8). It takes advantage of the tree: the wood for construction and shipbuilding, the bark for medicinal purposes, your burlap fiber, used in caulking boats, the fruit / hedgehog is harnessed for making crafts. The bark as fuel for furnaces and boilers or organic matter like compost or landfill. Urchins and shells were used as well as smokers and rubber garments in indigenous rituals.

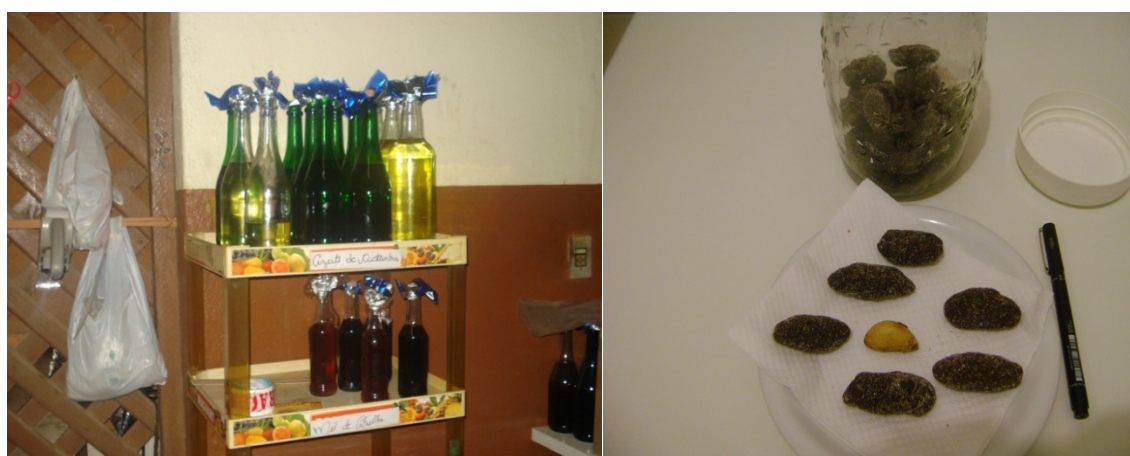


FIGURE 7. Beneficiation of fine oils and candied almonds. Itaúba, MT e Tefé, AM. Collection of authors. 2013.



FIGURE 8. Byproducts of the Brazil nut (body gel, shampoo, conditioner and e cream for hand and feet). Collection of authors. 2013.

In the case of ethnobotany to the Brazil nut beyond the economic value of their fruit tree is a very popular for its varied applications, having many uses in folk medicine. The hedgehog can be used in the preparation of tea as a natural remedy, especially for anemia, hepatitis and intestinal problems. The species is high in protein and calories, and got milk of almonds is similar in nutritional value to cow's milk, as it contains minerals and amino acids complete second Cymerys *et al.* (2005).

Of its bark is extracted a kind of tinder, regarded as top quality, employed in the work of caulking and even such coarse garments for some indigenous peoples. Bark is also taken a type of mat used by nut collectors as bed rest for the collection sites, the hedgehog is used as fuel some people believe that burning this drives away the "pests", according Souza (1963).

For the Kayapo people in the fruiting period of the Brazil nut, every family has a bounded area for collection featuring the common use of resources so that everyone can benefit. Chestnut collection in this case illustrates the ingenuity of those who can strengthen the main social functions of a traditional activity despite changes imposed in the course of their relationship with the globalized world of the non-indigenous. The experience of gathering to the same procedures to regulate the management perpetuates a chestnut territoriality for the Kayapó, with the support of indigenous territoriality social life, directly linked to the beliefs and knowledge system by setting a sociocultural and environmental resource site, Pascale (2009).

To Scoles (2010) the relationship between human populations and the nut is quite complex and interconnected. For this author, it seems obvious that the intense seed removal should bring down the rates of recruitment of species, in turn, the activity of collectors favors the regeneration of the species. In this sense, the chestnuts are involuntary seed dispersers during their gathering activities, through the opening of trails and fruit production, transportation, washing and storage of chestnuts.

The collection of nuts in some regions of the Amazon is a saga where families are organized with their luggage equipped with pots, nets, sugar, flour, paneiros (small baskets with handles), coffee, among others, placed in small canoes, that can be pushed in hard-to locomotion. The families full days paddling in streams or rivers up until you reach a convenient location near the Brazil nut tree to be explored. Generally building a rustic housing composed of a small palm leaf thatched roof called paperi is made to house the urchins contact with the ground. With slats paxiuba (*Socratea exorrhiza* L.) built one stand to remove them from the reach of predators.

The milk is taken as brown dish, but can be used to manufacture soap, used in place of the rubber and other oils for the treatment of skin blemishes, while green and its result can be prepared with sweet rice crumbs, and has strong laxative action, widely used for constipation. The oil chestnut is considered emollient and some people used to lavage, Souza (1963).

Local extractive identify the quality of walnut wood by color, with the chestnut rose with a pinkish brown appearance, the Mirim with light beige look and Gust with dark brown pinkish aspect. For the categories of household timber according Ramos *et.al.* (2010) was the only identified the construction category, which has by definition the use of elements that are part of a structure for purposes of territorial delimitation, housing or shelter for animals or objects. Uses are also cited for hedgehogs in the manufacture of coal and seed husks for fertilizer.

The extractive mentioning Mirim walnut wood as a wood that no one likes to sawing the lower hardness and durability. The wood of chestnut rose is used for building houses, the best sawing. And the wood of chestnut Gust is used to make rulers paddock, being a bit tougher when the sawn wood of chestnut rose, but with greater durability. According to statements the gusts chestnut is found most frequently in the area and the difference between the grades is not related to age of the individuals.

The only study found about popular ranking of the Brazil nut was to Braga (2007) in the state of Acre, who noted that people living in the extractive clearly distinguish two types: red and white chestnut tree still exists, a third type mentioned, rose chestnut, but this was not considered as consistent as the others, as only some extractive mentioned its existence. According to the author quoted above refers to the etnoclassificação of two types, both tree morphology (shape of the trunk and canopy, color and quality of wood) and the output (number of fruits, fruit size and seed and shape of the operculum). The red chestnut was identified with the thickest trunk, cup in the form of umbrella, red wood, which they say is the only nut used in construction, with larger fruit and seed size as well as higher quantity of oil in the seeds. For white chestnut has thinner trunk taper base being observed at the canopy, the canopy is smaller and is formed from a split by well known feature extraction, "eating up" or "hook party girl".

The wood in chestnut, is not suitable for use in the construction industry, because they said it is a "embuchada" wood and decomposes easily. Still in Acre, a variety of nut retained by rubber tappers in the region of Xapuri, whose seed is four times heavier than normal, second Ming (1997).

CONCLUSIONS

Hundreds of residents of the northern regions of Mato Grosso and the Amazon get some income with the Brazil nut, through various forms of etnocategorias of uses. The species is considered a symbol of the Amazon and its collection and marketing contribute to the protection of millions of acres of forests contributing to the socioeconomic development of local populations. Besides the ecological importance in maintaining floristic structure, scenic beauty and functionality of life in the forests, also stands out cultural and environmental importance characterized by ancestral relationships with the products of chestnut trees in the Brazilian Amazon.

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