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Review
COROJO PALM, A NATURAL RESOURCE FOR SUSTAINABLE OIL PRODUCTION

Revisión bibliográfica
La Palma Corojo, un recurso natural para la producción sostenible de aceite

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ABSTRACT. The worldwide demand for the use of vegetable oils is increasing, due to their extensive use, ranging from satisfy growing nutritional needs of the population, until the industrial production of soaps and cosmetics and the use in the recent years as lubricants and biodiesel as renewable source of energy. The actual tendency in many countries to oil production is the use of new sources, such as the palms. In Cuba there are many oil producing species of oleaginous palms including those know as the "corojo palm" including the remarkable *Acrocomia aculeata* (Jacq.) Lodd. ex Mart, which is native and grows spontaneously in most of the provinces, mainly in the central and eastern region of the country, being located according to the international bibliography as the second among the group of oil producing species with an estimated 4200 L ha^{-1}. In the present work, different aspects about palms are discussed and specifically about this specie and the researches that have been done in different countries of Latin America and particularly in Cuba, where it only has been exploited in an extractivist method for self-consumption by the population of different territories where it grows naturally.

RESUMEN. La demanda del uso de aceites vegetales a nivel global es cada día mayor, debido a su amplia utilización, que va desde satisfacer las crecientes necesidades nutricionales de la población, hasta la producción industrial de jabones y cosméticos y el uso en los últimos años como lubricantes y biodiesel como fuente de energía renovable. La tendencia actual de muchos países para la de producción de aceites es a partir de nuevas fuentes, como son las palmas. En Cuba existen varias especies de palmas oleaginosas, entre ellas las conocidas como "palma corojo" entre las que sobresale *Acrocomia aculeata* (Jacq.) Lodd. ex Mart, la cual es autóctona y crece de forma espontánea en la mayor parte de las provincias, principalmente en la región central y oriental del país, estando ubicada, según la bibliografía internacional, como la segunda especie del orbe en producción de aceite, con un estimado de 4200 L ha^{-1}. En el presente trabajo se abordan diferentes aspectos sobre las palmas y muy especialmente sobre esta especie y los trabajos que se han llevado a cabo de forma general en diferentes países de América y de forma particular en Cuba, donde la misma solo ha sido explotada de forma extractivista para autoconsumo por las poblaciones de diferentes territorios donde habita de forma natural.

Key words: nonwood forest products, oil palms, oil products, plant propagation, biofuels

Palabras clave: productos forestales menores, palmas oleaginosas, productos oleaginosos, propagación de plantas, biocombustibles

INTRODUCTION

The palms are plants that have been closely linked from immemorial times to the life of men in the tropics in particular and humanity in general, providing the most vital products for subsistence. Its use has permitted the manufacture of food, drugs, blanket and timber for housing, fabrics for making fishing gear, ropes and work tools, oil for lighting; as well as many other products that have led to the development in places where natural conditions are extremely fragile and palms play an important role in the ecological and economic balance (1-3).

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During the decade of the 80s of the twentieth century emerged in the world is growing interest in oil plants, partly due to the demand for vegetable oils for human consumption and later as a renewable alternative energy source (4). After this, the global demand for vegetable oils has grown considerably and the increase expected to further due to population growth. Also due to the high demand for renewable fuels and raw materials for the production of chemicals; that the production will increase by 33,2 million tons, according to statistical data for commercial campaigns of vegetable oil in the world, between 2010 and 2020. Reaching a total of 179,5 million tons in 2020, of which 147 million will be destined for human consumption, and 26,8 million will be used as biofuel, and it is expected that prices will increase from $ 1022,9 in up to $ 1086,5 per ton in 2020 (5).

Many tropical countries where oil palm, mainly in Latin America, Asia and Africa grow have been dedicated to the production of oil from different species, among which is the African palm (*Elaeis guineensis* Jacq) in first place and corozo palm , Mbokaja or corojo (*Acrocomia aculeata* (Jacq.) Lodd. ex Mart.) in second one. Regarding it appears that in Venezuela are encouraging the development of technologies to increase domestic production of oils and fats, and 80 % are imported, still important to use the existence of a wide variety of oil palms, which are unknown and constitute a valuable source for the production of oil (6, 7).

In the case of Cuba, which has more than 11 million people (8), with a fixed consumption of edible oil of more than 2 million 750 thousand liters per month represents more than 33 million liters of oil a year; without count consumption produced by different trading companies. Acquisitions in the store network in convertible currency, used by hotels, and facilities for food production and services, which represents an expenditure of millions of dollars annually, so it would be appropriate to encourage the development of new technologies that allow domestic production of this area, which is mostly imported.

Among the Cuban native species, the “Corojo Palm” (*Acrocomia aculeata* (Jacq.) Lodd. Ex Mart) is used as a potential source of oil production: a natural resource that is not exploited, and that has been slowly disappearing from our fields (8, 9). Various authors cited it (6, 7) as the second of the world in oil production with an estimated 4200 L ha^{-1}due its high quality oil, comparable to Olive one, which can be intended for food use, as a raw material in the production of soap and cosmetics, or as a strategic product in the production of biofuels.

This plant also has other uses as food production of flour from the pulp (if not converted into oil) with high content in Vitamin A (9). For making sweets, cakes, ice cream, and soft drinks; in preparing portions from leaves equine high performance due to its nutritional and energy content and the product cake endosperm after pressed to extract oil used in making rations (meat animals and milk), due to its high nutritional content. In energy production as charcoal, the exocarp is used and in making crafts and working tools such as ropes, fishing gear and others its with high strength and durability leaf fibers are used. It also has a large ornamental and landscape use. Being among its virtues as a plant having a great power of adaptation to low quality soils and resistant to prolonged periods of drought, as well as being a perennial, and life expectancy is 70 to 80 years (1-4, 9 ,11).

It is the objective of this work, to know the state of the art in terms of results and progress made by some countries on the issue of multiplication, production, harvesting and extraction of palm oil and its derivatives. Everything is to serve as a basis the development of projects leading to the implementation of appropriate technologies for the production of palm oil in Cuba.

CHARACTERISTICS FAMILY *Arecaceae*

The family *Arecaceae* C. H. Schultz. (*Palmae*) are terrestrial, arboreal or shrubby plants, erect or scandent (*Desmoncus*), acaulescent or caulescent, with solitary or caespitose, unarmed or spiny stipes. The alternate leaves with whole leaves, or flabellate pinnate, spirally arranged, hermaphroditic, monoecious or dioecious plants. Axillary, interfoliar inflorescences (born between the leaves) or infrafoliar (born undersides of leaves) held by two curled prophylls, spikes, racemes or panicles, short or elongated stems, bearing numerous bracts. Bisexual or unisexual flowers, with bracts commonly; differentiated perianth, two to three sepals, and two petals to three. Three to six indefinite stamens completely separated. Staminodes and pistiloids often are present in unisexual flowers; apocarpic or syncarpic gineceo, carpel one to four (in the apocarpic species) or three (in the syncarpic species), top with one or three cores, an egg in each locule, axillary placentation apical-axillary or basal-axillary ovary, styles from one to three or unobvious; erect or recurved stigmas. Drupaceous, glabrous, unarmed, spiny or scaly fruits, sometimes (*Iriartea*, *Socratea*) more or less dehiscent; one seed to numerous (12). The species of the family in tropical areas of the world are mainly distributed; some even manage to subtropical regions of the new and old world. This makes the family *arecaceae* this ranked as one of the great families of almost exclusively tropical distribution (12-14). *Arecaceae* consists of 189 genera and 2700 species known (1, 12-14). Pollination of flowers is in many cases by the wind, are also important pollinators families beetles, *Nitidulidae* and *Curculionidae* and other insects such as bees and flies (12). The palms have been used by human societies since immemorial times, and for their fruits and edible palm hearts (gasipaes Bactris, Cocos nucifera, precatoria Euterpe, Geonoma edulis, Iriartea deltoid, Phoenix dactylifera), and to source materials for housing construction or for craftsmanship in general (*astrocaryum alatum*, *martiana Asterogyne*, *Attalea butyracea*, *Geonoma firn*, *Raphia taedigera*, *Socratea exorrhiza*) (1-3, 12, 13).

PRODUCING PALMS OIL AND ITS DERIVATIVES

There are about 1300 species of Neotropical palms (13, 14), the following genera the greatest potential in oil production: *Elaeisi* (Dendé and Caiane) E. *Oleifera* (Babassu the Orbiguya-Atalea and piassava complex), *Mauritia* (Buriti - M. flexuosa) and *Acrocomia* (Macauba, Mbocaya) (15-20).

ESTABLISHMENT OF GENDER *Acrocomia*

The genus was described by Mauritiusen in 1824, as *Acrocomia sclerocarpa* today (*A. aculeata*), as typical species in its taxonomy as with many kinds of palms, calling these authors (21), an urgent critical review. The acrocomia gender groups 29 species (22); However, another researcher says that gender Acrocomia is neo tropical species and groups 26 and extend from northern Argentina and Paraguay to Mexico and the West Indies, Cuba and Jamaica (23).

BOTANICAL DESCRIPTION AND CHARACTERISTICS OF *A. aculeata*

It should be noted that the word "aculeata" that identifies this species, refers to hard spines, rigid and stingers (14). Some researchers have agreed that the characteristics of *Acrocomia aculeata* are as follows; it is a single palm trunk, medium, thorny and monoecious (Figures 1 and 2), erect up to 15-20 m tall trunk, often less and 30-50 cm in diameter, very abundant in leaf scars and densely armed with thorns. The root system with frequency much is greater than the cup diameter.

Figure 1. *A aculeata*., Field of natural managed sprout in Mato Grosso do Sul, Brazil

Figure 2. *A. aculeata.* National Botanical Garden., Havana, Cuba

The reduplicatedly pinnate leaves, ones about 20-40 in the cup of gray-green color. They are of 3-5 m long and more or less curved. The pod is about 40 cm in length, with brown hair and armed with black thorns. Petiole up to 60 cm long and armed with black thorns, prickly also rachis; the leaflets, in number of about 100-120 on each side of the spine, about 30-70 cm long and 3-5 cm wide, and arranged in several unarmed pianos, which gives the leaf a feathery and the interfoliar inflorescence up to about 150 cm long, peduncle about 60 cm long and densely armed with long black spines. The first bract (Prophyll) about 50 cm long, more or less hidden, hairy and bristling; the second bract up to 130 cm, navicular, woody, beaked, brown and woolly and thorns hairs, the inner surface of yellow-creamy color and strong smell of earth, the male of about 7 mm long, the female about 10 mm long. The rounded fruit, 3-6 cm in diameter, rarely up to 9 cm and color between green and brown off; soft, thin and pretty hard but brittle epicarp; mesocarp of 3-7 mm thick, green or color, cream, orange (12-14).

In the typical species the base of the petioles remain attached to the trunk for many years and the fruits have a hard shell and cream. The known mocayayba, the trunk is thin and smooth, the fruits have yellow skin and yellow and sweet pulp. In addition, it is said that the pioneer plants are tolerant to fire (7, 14, 20, 24-27).

Usually bloom towards the end of the dry season; fructifies usually between December and May, although others place the fruiting season in the months of July to November so apparently variations have to do with the geographic region (7, 24, 26, 27).

NAMES HAVE RECEIVED THE PLANT

In different countries and regions *Acrocomia* gender has many names and characteristics depending on the area from which comes the plant. *Acrocomia* word means in Greek words: Akros, tip or end and Kome, foliage or hair, so when we join the two words say something like “Completed in hair” (7, 14).

From a country report on the use of Non-Timber Forest Products in Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama, only we found reports of the use of *Acrocomia* in Belize and Panama, receiving in Belize name: corozo or cohune and the scientific name is (*Attalea cohune*) and in Panama the name of pacora, *Acrocomia aculeata* (28).

Acrocomia aculeata (Jacq) Lodd ex Mart palm has common names also called vernacular names. For example:,macara oil, butter tree, Parguay palm, palm macaw (in English), macauba, Macaiba, macaja, uba, grou grou, noz do paraguai, Mbocaya, bocaiuva, coco-slimy, cold coconut (Brazil); coyol, palm wine (Central America); corozo (Venezuela); Carijo, gru gou, catey (Dominican Republic), also; mbocaia, cayiete, ocori, nutsedge (Paraguay and Argentina); totai, Cayara (Bolivia); palmiste EPINEUX (Martinique); orotaich, Mbocaya (Amerindians) Macaúba, Macaúva, coco-de-cold, Bocaiuva, espinho coconut, coconut slobbering, Macaíba, macaúba, Macajuba, macaibeira, mucaja, mucaia, mucajuba and gum tabaiano (24, 26-29).

A. aculeata Palm has the following synonyms, in Martinique and Dominica; *A. lasiospatha* Mart in the Guianas; *A. totai* Mart in Paraguay and Argentina. *Mexican A. Karw*. ex Mart. (24), *Acrocomia Antiguan* L. H. Bailey; *A. antiquiensis* Posada-Ar; *A Belizensis*. L. H. Bailey; *A. Chonta* Covas & Ragon; *A. Eriocantha* Barb. Rodr; *A. fusiformis* (Sw) Sweet; *A. glaucophilla* Drude; *A. grenadana* L. H. Bailey; *A Hospes*. L. H. Bailey; *A. ierensis* L. H. Bailey; *A. microcarpa* Barb, Rodr; *A. mocayayba* Barb, Rodr; *A. odorata* Barb, Rodr; *A. pilosa* Leon; *A. sclerocarpa* Mart; *A. subinermas*. Lion.; *A. totai* Mart. (26).

HABITAT AND DISTRIBUTION

A. aculeata and other (probably no different) closely related species are found from Mexico to Argentina, except Ecuador and grow in poor soils, but does best in fertile areas. It is very common in open, degraded savannah areas. Young plants are fire resistant and can tolerate four to six months of drought and do not tolerate waterlogging conditions soil (waterlogged). It does not grow in the high forest, but is becoming more abundant in cleared areas of the humid tropics of the Amazon once. Usually it is associated with a rainfall of between 1000 and 2500 mm, and it is able to withstand occasional frosts. It usually occurs scattered in densities up to 20 trees per hectare, in large areas, but may appear locally in dense thickets of 100 or more trees. It has been observed that it looks for areas of suitable climate in the foothills of the mountains of the coast and in the highlands of the tropics and best known occurrences are located in Central America, the Caribbean and South America (24, 25, 27).

In Paraguay covers a total area of 4,546 million hectares, much of the southern understanding and east of the Paraguay River in the Central departments, Cordillera, Paraguaré, Caazapá, Caaguazú and Concepcion (29) and Brazil inhabits from Parana to Sao Paulo and Mato Grosso do Sul, mainly on hill sides (26). *Acrocomia aculeata* palm is present in other countries as Colombia, Venezuela, Guyana and Bolivia (13, 23).

The geographical area covered by the palm of "hair on top" covers virtually the entire tropical region of the globe, occasionally it is found in subtropical areas (29).

RESEARCH WORKS PERFORMED IN *A. aculeata* AND THEIR USES IN COUNTRIES OF LATIN AMERICA

Brazil began in 1982 within the Cooperative System of Agricultural Research of the Ministry of Agriculture. Later an active program glimpsing the domestication of Mbocaya and Macauba species and in 1983 the expert consultation on palm little-known tropical America, organized by FAO, selected gender *Acrocomia*. Especially, *Acrocomia aculeata* and *Acrocomia totai,* as one of the priority groups for domestication, mainly, because of the great importance as a source of oil production. In 1984, the National Center for Genetic Resources (CENARGEN), in collaboration with institutions of Bolivia, Colombia, Paraguay and the United States, introduced an ambitious project to USAID; sighting set the parameters for sampling the main genetic resources of economically important species of the genus (4).

In work carried out in Brazil in order to determine whether the Macauba and Mbocaya are central to produce palm oil sources, compared the potential of these two species with the main sources of palm oil and until then they were used of commercial form. They were the Dendé (*Elaeis guineensis* Jacq), with over 80 years of cultivation and more than 50 years of breeding and production yields 3-5 t ha^{-1} oil and Coconut (*Cocos nucifera* L.) the palm tree that had the second best performance, with an average production of more than 2 t ha1 oil (21).

These productive averages and surveys made were compared in Minas Gerais and taking into account two population densities, with 150 palms per hectare, which showed a productivity of 9600 kg ha^{-1} fruit, with oil production 2486 t ha^{-1} and the other with 200 palms per hectare, which showed a productivity of 25000 kg ha-1 of fruit with a production of 6475 t ha-1 oil. Therefore, new species to be competitive are showed to have a high yield potential (21).

FRUIT CHARACTERIZATION

The fruit pulp is edible naturally, or used for the extraction of fats, making jellies and sweet coconut. Almond gives a clear quality olive oil similar to oil, which is used in home medicine, cooking, to make soap and fuel for lamps.

The integument of the seed is quite hard and rough, in making craft ornaments, such as rings, buttons it is used, chains, etc. The pulp and kernels have industrial potential in removing grease and oils used to make soaps, and leaves can be produced textile fibers (27, 30).

COMPOSITION FRUIT AND NUTRITIONAL VALUE

The literature shows a wide variation in the composition of the fruit, caused in particular by the time between them maturation and laboratory analysis (9); can be observed in Table I, the composition of coconut and in Table II, the physicochemical properties of the various fractions of coconut.

The presence of lipolytic enzymes in the pulp or mesocarp, causes a marked elevation of free acidity of pulp oil, limiting its use for food or industrial consumption, but does not affect its energy use (9).

Although the composition of the fruits of *A. aculeata* varies considerably (24), a characteristic fruit weighs 40 g, of which 26 are formed by dry matter. This is composed of 20 % exocarp, 34 % of mesocarp, 39 % endocarp and 7 % of seed (Figure 3), which in turn contains 5 to 10 %, from 56 to 70 % and from 55 to 58 % oil, respectively.

Table I. Coconut macaúba composition

Parts	Percentage of fruit	Percent dry base oil	Percentage of total fruit oil
Husk	30,5	10,9	3,3
Pulp	27,5	69,6	19,2
Endocarp	34,7	-	-
Almond	7,3	46,6	3,4
Total	100	-	25,9

Taken from Wandek, F.A., 1985 (9)

Table II. Physical chemical characteristics of the various fractions of the coconut "Macaúba" in the region of Jaboticatubas. Minas Gerais

Characteristics	Shell	Pulp	Almond
Humidity %	8,8	13,5	3,8
Oil %	10,8	69,6	46,6
Free acidity %	82,7	49,3	2,4
Iodine content %	67,8	72,8	28,2
Saponification index	195,6	196,4	231,14
Composition in fatty acids	Oil of shell %	Oil of pulp %	Oil of almond %
Caprylic 8	-	-	4,9
capric 10	-	-	42
Lauric 12	-	-	58,6
Myristic 14	-	-	8,0
Palmitic 16	20,8	17,5	4,7
Palmitoleico 16:1	3,8	2,3	-
Stearic 18	2,4	2,7	4,2
Oleic 18:1	62,5	65,9	12,8
Linoleic 18:2	10,5	11,6	2,6

Taken from Wandek, F.A., 2012 (9)

Figure 3. Fruit of *A. aculeata*, showing the different parts of what is composed

The total oil ranges between 16 and 23 % of fresh fruit weight, and between 25 and 34 % dry weight, with about one-sixth from the nugget. The dry matter of the pulp has a 3, 4 % protein, and often there is a small amount of sugar and carotene. Consequently, the results as a good source of calories are considered and some varieties can provide reasonable amounts of vitamin^{A} (9).

Brazilian researchers detected a high percentage of carotenoid (9,590 UL 100 g), precursor of Vitamin A in mature fruits of *A. aculeata* (31).

FRUIT PRODUCTION

Weeds hurt much fruit production and determined that isolated and without care, copies reach about 15-20 kg of fruit per plant per year; however, with proper agronomic management, it is possible to obtain up to 70 kg per plant annually (32).

The Mbocaya or Totai palm (*Acrocomia*) distributed in more than 218 000 hectares of volunteers in the central region of Paraguay populations, it is the most common and most economically important palm of that country. The densities found ranged between 50 and 150 individuals per hectare. So apparently there is a direct correlation between density and intensity of land use for agriculture and an extractive potential of between 100 000 and 200 000 tons of coconut is estimated, representing between 25,000 to 50,000 tons of oil per year; from data compiled between 1940 and 1953 exploited only 2 % of this potential (15).

However, actual production until 1995 the fruits of coconut was in the order of 200 000 tons per year, in that year CAINCO had an installed capacity to produce up to 19350 tons of oil per year using 322,500 tons of coconut capacity ; however, industry worked only 30 % but with a tendency to decrease[A].

A survey done of the species called Macauba in the state of Minas Gerais, Brazil (21), showed a very similar to that found situation in Paraguay, with a total covered area of about 20,000 hectares with a productive potential of 200 000 tons of fruit, representing about 50,000 tons of oil per year. So far, in a traditional and limited way in Paraguay and Brazil, Acrocomia is used. However, the *Acrocomia* potential is revalued and some development and research activities to optimize its use as a crop are conducted (15).

Knowledge and practical experience of crops and industrialization of Acrocomia, including propagation material selected, crop management, semi-mechanized harvesting and use of industrial by-products are now available. Therefore, the conditions for establishing Acrocomia as a new highly competitive oil crop are given and an important component in a future sustainable economy for almost all Latin American countries (15).

PEST, DISEASE AND PROTECTION OF SOIL

In the current state of knowledge, *Acrocomia* is not particularly susceptible to typical diseases of oil palm, as white rot *Ganoderma* or red palm weevil (*Rhynchophorus ferrugineus* Olivier). It belongs to the family of palms (*Arecaceae*), such as oil palm, but to a different genre. Finally, like a tree, *Acrocomia* provides very good protection to the ground and a significant potential for tackling climate change through reforestation and agroforestry systems[A].

SEEDS AND MULTIPLICATION METHODS

A. aculeata seeds germinate well after six months of dormancy, and then grow slowly during the early years (Figure 4). They begin to bear fruit between the fourth and sixth year, depending on soil fertility, having a height of about four meters. So far, it has not revealed any pest or disease in wild plants (24).

A kilogram of fruit contains 25-35 units, which are considered difficult germination can take up to years this process. The seedlings removed from the base of the mother plant with root ball, they resist very well the transplant in the rainy season (26).

The plant is grown from seeds, one kilogram of fruit contains 25-35 seeds; for germination, seeds are placed after collection in individual containers, substrate containing organic fertilizer and sandy soil, keeping them in shady environments, occurring germination of 3-5 months, with a moderate rate of germination. The development of the positions as plants in the field is slow (27).

The species *A. aculeata* in Brazil can be found preferentially in valleys and around cloud forests, semidesiduos (tropical forests sub deciduous) and its spread is facilitated by

Figure 4. Plants naturally germinated extracted from the soil for transplant

[A] McDonald, M. J. *Revisión de la Situación Actual de Mbokaja (Acrocomia totai) en Paraguay* [en línea]. Inst. geAm Gestion Ambiental, 2007, Asuncion, Paraguay, p. 78, [Consultado: 1 de agosto de 2014], Disponible en: <http://www.geam.org.py/v3/uploads/2011/11/Mbokaja_Informe_Final1.pdf>.

the high fruit production and consumption of these by the people and by several species of animals also consume and spread the seeds (30, 33).

Work carried out in Curitiba, Brazil, in the adaptation of plantlets *Acrocomia aculeata* (Jacq.) LODD. EX MART, grown from zygotic embryos (34) using Arbuscular mycorrhizal fungi (AMF) and an analogue of brassinosteroid, Biobras-16, significant differences among treatments and control treatment, the index number of roots were found, watching more in plants inoculated with AMF[B].

Other work in the Federal University of Parana, Brazil, between 2008 and 2010 in the adaptation of vitro plants of *A. aculeata* (Jacq.) LODD. EX MART, from zygotic embryos, showed that the use of bioproducts: AMF, strain *Glomus Cubense* Y. Rodr. & Dalpé and the application of brassinosteroid analogue: Biobras -16, at the transplantation time, from *in vitro* tube to small polyethylene bags, yielded significant results on the treatments used so far and which were used as witness, which is an important production and adaptation of vitro plants step.

Thereby achieving higher rates of growth and development, such as height, leaf number, root length, dry weight and fresh weight of both the aerial part and the underground part and leaf area (35) (Figures 5, 6 and 7).

Figure 5. Transplant of adapted vitro plants to bags to a substrate

Figures 6 and 7. Transplanting of vitroplants to bags for their acclimatization in plastic boxes with lid, used as wet chamber

Also the technology has been worked comprehensively by professors and Brazilian researchers from Federal University of Vicosa, Minas Gerais, which have implemented a methodology to induce germination of seeds, (Figures 8 and 9), which is a patent . Using that method, the pre-germinated in "tubetes" (plastic pots made especially for growing plants, mainly forest), passing them after some development to plastic bags, which are placed in seed nurseries and then transplanted to the field, also establishing the fertilization to take place, for Brazil soils (36).

[B] Borcioni, E. *Subsídios à implementação de sistemas de cultivo de Acrocomia Aculeata (Jacq.) Lodd. Ex Mart (Arecaceae)* [en línea]. Doutor em Ciências, Universidade Federal do Paraná, 2012, Curitiba, Brasil, 111 p., [Consultado: 1 de agosto de 2014], Disponible en:<http://acervodigital.ufpr.br/bitstream/handle/1884/27305/TESE%20FINAL_%20ELIS%20BORCIONI.pdf?sequence=1&isAllowed=y>.

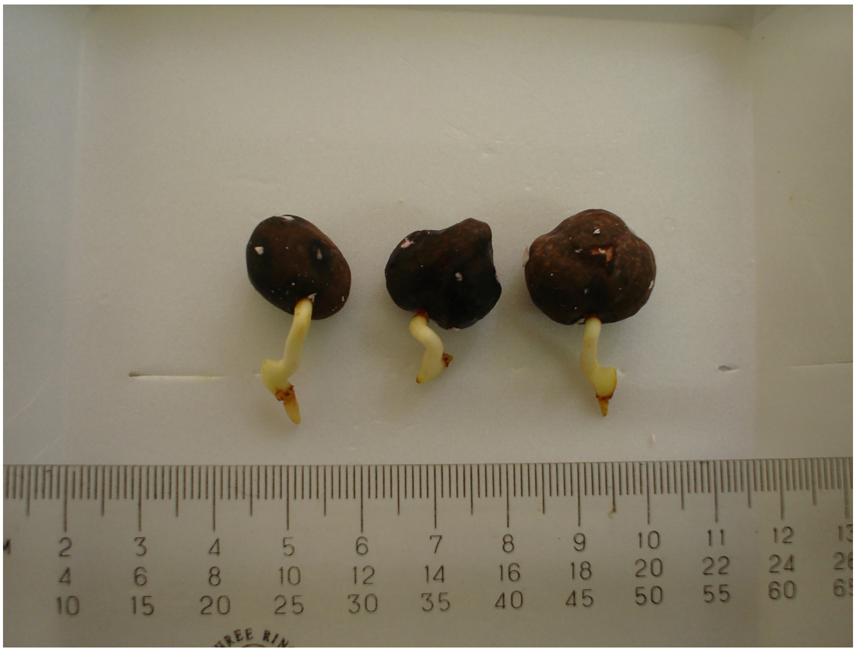


Figure 8. Pregerminated *A. aculeata* seeds

Figure 9. Seeds pregerminated, planted in plastic tubes

PRODUCTS TAKEN OF PALMS AND ITS ECONOMIC IMPORTANCE

The exploitation of *A. aculeata*, was probably carried out before the discovery of America by the Spaniards, and it could say that its use began with the first appearance of indigenous people in the eastern region of Paraguay River and north of the Paraná river[A] .

Palms (*A. aculeata*) may also provide palmettos (soft and white or cream-colored tissue found in the meristematic plant area, covered by leaf pods), of which also states that can be used to produce a similar to sago starch and palm wine. Some tribes use the fruit pulp, and other starch and sugar trunk, to prepare fermented beverages (Figures 10 and 11). The taste is slightly sweet pulp and has a pleasant smell, but the mucilaginous and oily texture of the fruit is attractive only for those who are very used to consuming (24).

Mesocarp oil rancid rapidly because of little falling mature tree. The fruits ripen unevenly. Usually, by mostly indigenous inhabitants by primitive cooking methods and pressed the oil is extracted by. So, for making soap it is used. Often, the pulp and seed are extracted together. Each year are processed in Brazil about 2 000 tons of dried fruit, and many more in Paraguay. Often the fruit serves as food for livestock, which uses only the pulp, while pigs are able to reach the nugget. For this reason, in remote farms, as a useful source of animal feed this species is considered. For post and beam construction the logs are used, leaves for fodder and fiber to make baskets and hats (24).

The fruit of *A. aculeata* has been and still is in certain areas, an important component of the diet of some tribes. Unattractive as fruit, but its high oil content and potential returns are of great interest (24).

Figure 10. *A. aculeata* flour produced from the mesocarp of the fruit

Figure 11. Liquor made from adult plants of *A. aculeata*

Currently, programs aimed at improving the current collection and extraction techniques ongoing several researches. This is to better exploit the pulp oil, equivalent to about six times the kernel oil; but apart from the problems of collecting mature fruits and avoid rapid deterioration, the task of separating the pulp from the exocarp and endocarp, and oil and fiber mucilage, it is difficult when the pulp is not dry. Techniques that are currently under review as, rapid bleaching, pulping machines using specially designed for the purpose, the enzymatic decomposition of mucilage and extraction with solvents have been suggested (24).

The "Mbokaja" (*A. aculeata*) has a high socio-economic value, since small farmers harvested the fruits of wild populations and coconut oilers sold to the country. Although it profits industrially for decades, few research aimed at improving crops and implementation of large-scale ordered. However, in recent years with increasing demand for oils, including those intended for the production of biodiesel, it has emerged as a promising plant, since according to studies ranks second in the world in terms of production oil per hectare, second only other palm, African palm *Elaeis guineensis* Jacq. (30).

The *Acrocomia* has great potential, because the extraction of oil from the mesocarp and endosperm fully usable products such as cakes for animal feed and the pericarp and endocarp for generating heat by direct combustion in furnaces and boilers are generated (30).

The *Acrocomia aculeata* consumed in Belize and Panama (28), as follows: Belize, the fruits are used and people to consume as palmetto remove the apical meristem. In Panama, the sap of the stem with a fermented beverage is produced is extracted; crushed fruits are used for cooking and extract oils.

Corozo oil seeds are widely used throughout the country, although its importance has declined due to the introduction of oils from other plants. The produced wine from the stem of this palm is marketed.

The Indians of eastern Colombia and Venezuela, who live on the edge of the savannah, used as a food source various palm trees, eating the fruits both raw and cooked consumed directly or fermented to make drinks, another possibility is to extract from them oil or starchy flour. Palm trees falls to develop "toddy" also bleed characteristic palm liquor) and in this area, apparently the art of bleeding the living tree is not practiced (31).

Compared with other seeds of palm fruits, the value of fat in the corozo flour (*A. aculeata*) is slightly greater than the maximum value for oil palm seed *Elaeis guineensis* Jacq. (40-52 %) and lower babassu seeds (*Altea speciosa* Mart. Ex Spreng) or (*Orbignya phalerata* Mart. Ex Spreng) (67-69 %) and coconut (*Cocos nucifera* L.) (63-70 %), indicated seeds are materials conventionally used in the oil industry (37).

With respect to other oil materials useful, the fat content of the corozo flour harina exceeds cotton (22 %), soybeans (*Glycine max* L. (18 %)), sesame (*Sesamum orientale* L (48 %).), and sunflower (*Helianthus annuus* L. (40 %)). Therefore, the seed is an oleaginous cohune resource possible use as raw material for the oil industry (24).

Seed (*Acrocomia aculeata* Jacq.) is a highly resistant to lipid oxidation raw material oleaginous recommended for obtaining oil. As the product of interest, which has physicochemical characteristics and in composition of specific fatty acids of lauric oils, and lipolysis; being recommended for use in the manufacture of cosmetic, pharmaceutical and food products as a substitute or supplement to conventional use oils such as coconut oil and palm kernel oil. Oil extraction of corozo seed brings as defatted flour product, which has protein and fiber content suggesting their use in the formulation of animal feed and possibly also for human consumption (24).

Vegetable oils are an importance category in exports from Paraguay and other countries, within the oil extracted from the *A. aculeata.* It is probably one of the most popular due to its quality, and its high lauric acid, make an excellent raw material in the production of cosmetics products, detergents, soaps, and other edible oils[A].

Palm *A. aculeata* (Jack) Lood. ex Mart, is one of the promising species in Brazil for the production of oil, which can also be dedicated to the production of Biodiesel (37). The wood is highly durable and it is used in rural construction, leaves supply of textile fibers for making nets and gear and fishing lines.

From pulp of fruit, edible fat is extracted, considered standard of good land; it has good landscape potential (26).

One of the species found in the list of plants that have the public trees in the city of Resistencia, Chaco in Argentina, is the palm: *A. aculeata*[C], known in Argentina with names (*A. totai, Mbocaya, Coquito*), supports the cold well up to about -4 °C and very high temperatures. Slow to germinate, (12-18 months) due to its endocarp thick but fast enough to grow.

The Coyul (*Mexican Acrocomia* Karw. Ex Mart.), is a species that extends from the Mexican Pacific to Central and South America. Its fruit is appreciated since pre-Hispanic times, in San Blas, Nayarit, Mexico there is an ecosystem where populations are exploited Coyul wild and cultivated traditionally, where it has economic, ecological and cultural importance, this species being an important production source of edible oils, livestock feed, crafts are produced(38).

[C] Grassia, J. *Palmeras en la Ciudad de Resistencia* [en línea]. 2010, [Consultado: 2 de agosto de 2014], Disponible en: <http://palmasenresistencia.blogspot.com/2010/12/introduccion.html>.

REMOVING THE ALMOND FRUIT OF COROZO PALM

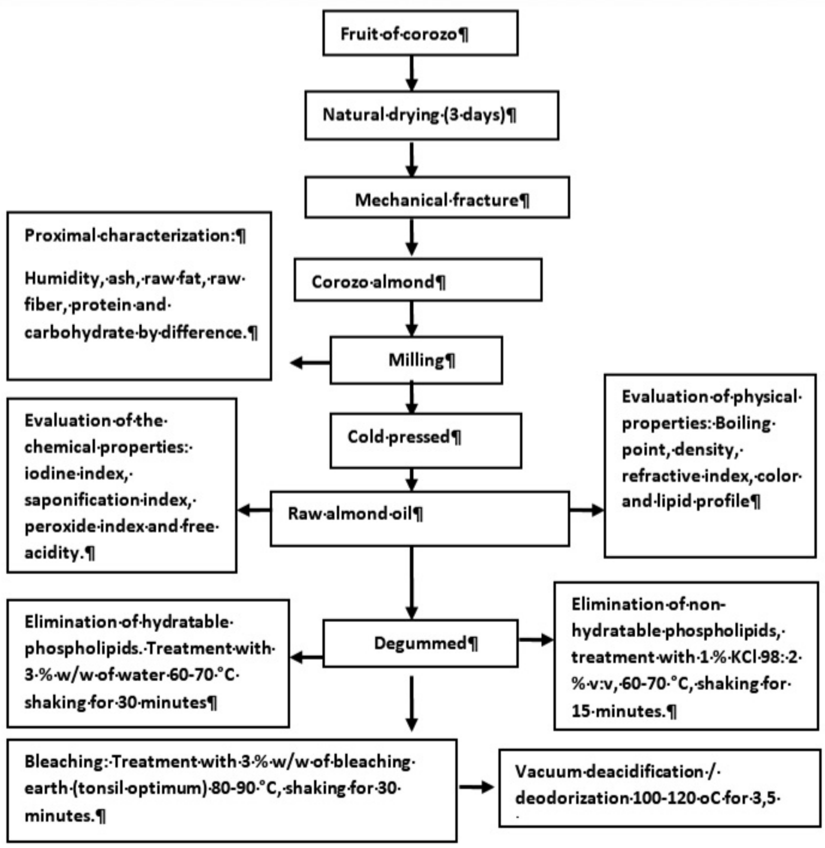
Once the raw material for analysis, it is subjected to ambient drying for five days, at controlled temperature and humidity conditions, 25 °C and 60 % respectively. This treatment is done in order to achieve more easily remove the epicarp and mesocarp of the fruit, and therefore quickly and almond extract properly. Epicarp with a hammer fractures, separating the same from the rest of the fruit. The remaining parts of the fruit made up the mesocarp, endocarp and almond, is subjected to a second mechanical extraction to facilitate manual removal of almonds, which are stored in clean containers in refrigerated environment (6).

EXTRACTION FOR COLD PRESSED AND PHYSICOCHEMICAL CHARACTERIZATION OF ALMOND FRUIT CRUDE OIL OF COROZO PALM

From the kernel of the corozo fruit is performed the oil extraction by cold pressing technique. The pressures used for the tests are, 2,000, 4,000, 6,000, 8,000 and 10,000 psi, for a time of 5, 15 and 30 minutes, 2 tests per treatment, at pressure and room temperature. All tests are conducted with a sample of ground almonds about 20 grams and a particle size of 0,75 mm. The physicochemical characterization of the almond crude oil of corozo palm is performed following the methodology described in COVENIN (Standards Venezuelan oil extraction) performing the corresponding tests in triplicate. Best results from the first pressing laboratory scale when the pressure is 10,000 psi and 30 minutes with removal of 21,75 % oil are obtained. Moreover, after refining, no significant changes are seen in the properties of refined oil relative to the oil, except color which the level of yellow is reduced by 80 %, red 94 % and blue 100 % (6) (Figure 12).

OIL PALMS AS RENEWABLE ENERGY SOURCE IN THE MANUFACTURE OF BIOFUELS

Short-cycle crops such as maize (*Zea mays*, L), sugarcane (*Saccharum oficinarum* L.), cassava (*Manyhot sculenta* L.) and pineapple (*Ananas comosus* L.) are promising sources of alcohol. In Brazil with more than a million driven from alcohol vehicles, it is the first commercial exploitation of this option (19), but as most industry and heavy transport rely on fuel oils, then, other possibilities must be explored using oil palm.



Taken from Hernández, C., 2005 (6)

Figure 12. Industrial extraction system of corozo oil

Macaúba oil is not possible to use directly as a substitute diesel (9), due to its temperature with the process of crystallization (cloud point) starts. The tests conducted showed that it is possible to use in ternary mixture (Intol xxDf7) with percentages of 20 % vegetable oil, 7 % ethanol and anhydrous 73 % of Diesel. The mixture reduces the viscosity and cloud point, allowing its use in engines with less energy consumption than pure diesel (39).

In Brazil, in the biodiesel-diesel blends, the 2 % (40) was allowed, between 2005 and 2007, with a potential market of 800 million liters per year. Between 2008 and 2012 it was mandatory to use up to 2 % and up to 5 % allowed, with a guaranteed market of a billion liters per year. Between late 2003 and until 2008, it was mandatory to 3 % and from 2013 it is mandatory the use of a 5 % biodiesel, with a guaranteed market of 2,4 billion liters per year.

In the Biodiesel composition, oils extracted from various species of oil plants are used. Including soybean (*Glycine max* L.), castor bean (*Ricinus communis* L.), oil palm (*Elaeis guineensis*), palm macaúba (*A. aculeata*), groundnut (*Arachis ipogea* L.), sunflower (*Helianthus annuus* L.) and pinion jarotropha or botija (*jarotropha curcas* L.); using for the extraction chemical-mechanical methods, and after a cracking-esterification and transesterification process, by biodiesel industry, it is sent to distribution - consumption points (40).

Today, more than 60 % biofuel from soybean oil is produced, which has a higher value in the market being one of the prominent species for biofuel production, the *A aculeata*., which is given in the land spontaneously and, if carried to plantations, can produce up to 4000 or more liters of biodiesel per hectare (40).

The percentage of oil per hectare produced by each of these species is shown in Table III.

Table III. Percentage of oil and kg ha^{-1} produced

Oleaginous	Oil percentage	kg ha^{-1} of oil
African palm	22	5000
Jarotropha	38	1500
Ricino	43	750
Sunflower	40	650
Soja	18	450
Macauba (Corojo)	20	4000 or more
Crambe	35	630

Taken from da Silva (40)

PURIFICATION OF CRUDE OIL REMOVED FROM THE ALMOND FRUIT OF COROZO PALM

Oil purification is performed by physical refining, which consists of a degumming, followed by a bleaching process and finally deodorization and deacidification. The aim is degumming phosphatides or phospholipids remove oil with minimal loss of neutral one (6).

The degumming process in two stages, to remove, hydratable and non-hydratable phosphatides is performed. Bleaching is to decompose the peroxides, remove oxidizing compounds and any trace of gums, soaps, and discolor, and finally proceeds to process deacidification/deodorization, to reduce free fatty acids and an oil with little or no flavor and pale in color (6).

THE PALM IN INTEGRATED PRODUCTION

They are diverse and applicable to different production models, the current alternatives to palm resort that could offer solutions to the small and medium land and exploitation of large areas, involving key elements for tropical production systems, integration, optimization production cycles with minimal losses, efficient use of energy and high biomass productivity (1-3).

Just enough to devote some attention to the use and management of some palms current unexploited under cash crops, to identify multiple production systems (41).

It is an aspect of great importance in the incorporation of many palms to different production alternatives; it is the possibility of association, from the management of production strata.

It should also consider association annual subsistence crops such as maize (*Zea mays* L.), bean (*Phaseolus vulgaris* L.), rice (*Oryza sativa* L.) rainfed and vegetables. The impossibility of inclusion pasture is because livestock can eat the fruit (29).

Number of native palms, reach in adulthood a height that does not generate greater kind of competition with the lower stratum; therefore, it is feasible to obtain important benefits upper layer in a production arrangement with palms. The hingher the degree of integration, the greater the efficiency of energy introduced into the production system, since they will be increasingly lower losses within the same (42).

BACKGROUND OF OIL PALM TREES IN CUBA AND ITS USE

As non-timber forest products (NWFP) palms in Cuba are considered, although the Coco (*Cocos nucifera* L.) is considered as a fruit and Corojo (*Acrocomia* spp.) is also considered a fruit species and both are considered oleaginous plants (10, 11).

In Cuba in the mid-90s of the twentieth century, Non Wood Forest Products (NWFP) begun to revalue, acquiring first a certain level of interest. The volume in the Cuban forest of these products in written form is recognized, the level of knowledge and the possibilities or potential for development. The report says much about the palms, mainly from the Royal Palm (*Roystonea regia* (Kuntz) oF Cook.) and other species primarily engaged in the production of guano. However, there some allusion to "Corojo Palm ", although it is mentioned in the document the existence of three species of *Acrocomia*, being shown in Table IV, genders and number species of existing palms in Cuba (43).

OIL PRODUCTION FROM PALMS IN CUBA

They are well known in Cuba three species of which industrially, experimental-research or craft, or so self-sustainable consumption by residents of some regions of the country, oil for human consumption and production of soap is removed and other sub products. They are the Coco (*Cocos nucifera* L.); The Royal Palm: *Roystonea regia* (Kuntz) O.F. Cook and Corojo, *Acrocomia* ssp., because in the country there are several species, to be discussed later (43-47).

Table IV. Genres and species of Cuban Palms

Gender	Number of species	Observations
Roystonea	4	
Chrysalidocarpus	1	"lutescens" (naturalized)
Gaussia	2	
Cocos	1	"nucifera" (naturalized)
Calyptronoma	4	
Acrocomia	3	
Bactris	1	
Copernicia	23	
Acoelorraphe	1	
Colpothrinax	1	
Sabal	2	
Coccothrinax	36	
Thrinax	5	
Prestoea	1	
Total	85 (*)	

(*) Of these 78 endemic, 5 indigenous and 2 naturalized. Taken from Mesa (43)

COCONUT (*Cocos nucifera* L.)

It is well known in Cuba the extraction of coconut oil (*C. nucifera*), which is used mainly in the eastern provinces, largest producers of coconut in the country. Mainly in Baracoa municipality, industrial and artisanal production of sweets from the mass of the fruit it is used in. Oil extraction as a product of the industrial process, occurring him this different uses such as in the preparation of various foods, and their use as raw material in the soap industry and perfumery is also performed[D].

During the decade of the 60s, in Cuba in experimental forms, a project was held[D], for the extraction and use of royal palm oil, (*Roystonea regia*) (Kuntz) O.F. Cook. The project was evaluated technically and economically for agricultural and industrial oil extraction process, from plants growing naturally in the fields; palm fruit crop, harvest in the provinces of Matanzas, Las Villas, Camagüey and Orient and industrial processing work in Jinaguayabo, Las Villas province, in it the following aspects were evaluated:

- Palm fruit supply of raw material (Table V).
- Benefit phase (Table VI).
- Industrial processing phase

[D] Equipos de Investigaciones Agrícolas. *Efectividad económica del aprovechamiento del palmiche como oleaginosa*. Informe Económico, no. 4, Inst. Universidad de La Habana, abril de 1969, La Habana, Cuba, p. 41, Documento inédito disponible en el Centro de documentación del Ministerio de la Agricultura.

Table V. Collection of palmiche as raw material, year 1967

Provinces	Metric tonnes collected	% representing the total
Matanzas	393	7
Las Villas	3645	69
Camagüey	764	14
Oriente	515	10
Total	5317	100

Table VI. Phase of benefit of the palmiche

Existing previous system: cleaner	Updated system: mechanical benefit
The palmiche is passed through the cleaner to remove foreign matter and subsequently dried up to 10% moisture	Machines made in Cuba for the mechanical pulping of the grain, which represent a modification to the order of operations of the previous system
Production capacity 10 Tm. In three shifts of eight hours receiving the grain with 20% moisture	It increases the capacity of benefit to eliminate the pulp, losing the greater degree of humidity because only the almond remains
In this section the work was insufficient so they had to work 1 more turn and the dryer column was delayed more than twice to dry the grain that arrived with 40-45 % moisture	The grain dryer column can work to the required capacity even with humidities of 40-45 %. A volume of clean almond is obtained to extract 6 MT of oil daily
The palmiche must be processed quickly because excess moisture causes fermentation and raises the acidity index of the oil, decreasing its quality and a reduction in the refining process	

INDUSTRIAL PROCESSING PHASE OF *R. regia* OIL EXTRACTION

Plant which theoretically had a capacity of 6 MT extraction of oil actually drew only 2,4 TM, which have lower efficiency of 40 %[D].

The high percentage of palm oil acidification causes that that this oil is not used to mabe soap and causes double the coefficient of palm kernel oil by the coconut[D].

The cost of a metric ton of palm kernel oil is in Convertible Foreign Currency: $ 55,44 USD. These costs are due to the solvent used: 29,89 %; transport: 25,03 % and collection of palm fruit: 16,52 %[C].

In Table VII the use of palm kernel oil has shown in the soap industry and tannery with the consequent substitution of imports more expensive raw materials such as castor, coconut and sunflower oil[D].

Upon completion of the research work of palm oil extraction project, the following conclusions were exposed.

The use of palm kernel in import substitution was effective economically. Its exploitation as the oil in the development of this line of production on a larger scale was not proposed by the following considerations:

- It is not recommended for the use of Public Health Ministry (MINSAP) palm kernel oil for human consumption, for behaving this as animal fats, harming human health.
- Palm kernel meal is an element of low value in feeding pigs according to analyzes made in the National Poultry Combined and can be used only as a filler in feed formulation.
- Obtaining palm kernel oil involves the use of millions of palms that do not constitute an organized cultivation, but a wild planting with varying degrees of concentration and accessibility, so that resources for harvest are substantial and they are not used with efficiency.
- Development progress of agricultural plans placed at a disadvantage as palm collection areas are currently unproductive land, but in many cases suitable for cultivation and retention of palms in the same prevent mechanization. The characteristic of being an unorganized culture undermines the economic comparison between areas devoted to other crops or produce palm kernel oil.

Table VII. Effectiveness obtained in the soap and oil industries by replacing imported oils with palm oil

Type of industry in which it is used	Replaced product	External price of the replaced product	Palm oil	
			Cost	Effectiveness %
Soap	Coconut oil	$326,00 USD	$55,44 USD	215,12 a 253,93
Tannery	Castor oil	$343,85 USD	$55,44 USD	288,41
	Sunflower oil	$320,00 USD	$55,44 USD	264,56

For these reasons, in complying with the technical plan of the extraction plant in 1969, there is an import substitution of US $ 300,000.00 per year

- Topping palm fruit represents one of the most important limiting factors in the industrial exploitation of it, it needs trained personnel, and productivity is low.
- There is dependence between the volumes collected palm fruit and swine feed mass in the various provinces, if there is no other food for them.

OTHER ASPECTS INVESTIGATED ON PALM FRUIT PROCESSING FOR OIL EXTRACTION

During the 80s of the twentieth century, it worked and a patent on the method was obtained to facilitate the crushing of the *R. regia* fruits through decreasing their mechanical stability by irradiation of fruits and shelled with rays a dose of 3 to 7 megarads. One of the limitations of palm and coconut oil from the nutritional point of view is related to the relative low unsaturated fatty acids of these oils. However, the oil obtained from the fruits of the royal palm is of excellent quality for its high content of fatty acids such as lauric and oleic latter in a percent higher than in the case of African palm and coconut oil.

The extraction of oil from the royal palm fruits has been so far, very difficult using conventional methods of extracting oils from different raw materials. This has been mainly due to the great hardness of said fruit, which is reflected by high mechanical treatments conventional or improved resistance milled.

To facilitate the crushing of different materials they have been employed other methods such as cooling and applying pulsed electromagnetic waves. The use of ultra sound method, and this combined with pressure, are not advantageous for its high-energy costs and the need to work on its solution. The difficulties encountered during the crushing of the royal palm fruits have motivated the search for solutions that enable the use of this valuable raw material, which is not used yet, although its potential is known as a source of flour for feed and vegetable oil excellent quality (46).

COROJO PALM (*Acrocomia sp.*), IN CUBA

According to a report of the 90s, in Cuba there are three species of Acrocomia, Table IV; however, existing species, or the use of these were given (43) were not mentioned therein.

In the list of plants available to the “Genebank” within the Palmácea family, four species of palms known as “palm oil” is listed, they are:

- *Acrocomia armentalis*, Bailey; originally from Cuba
- *Acrocomia subinervis*, Leon; originally from Cuba
- *Acrocomia hairy*, Leon; originally from Cuba
- *Acrocomia aculeata* Lodd; originally from Jamaica, which is called “Corojo of Jamaica”

In addition, it indicates the existence of a species (*Acrocomia ssp.*) which ensures that has pitted fruit, that is, with soft endocarp, which is being studied for its spread (44).

A famous researcher and Cuban taxonomist mentions two species of palm in Cuba as “ Corojo Palm “ are: *Gastrococos crispa* (Morales) Moore, endemic to Central Cuba - Eastern Cuba and *Acrocomia aculeata* Lodd, known as corojo of Jamaica (Jacq.) , which in addition to Cuba, it grows in plains and low hills in Puerto Rico, St. Thomas, Jamaica, Haiti, St. Kitts, Antigua, Guadeloupe, Dominica, Martinique and Trinidad, which is considered an Antillean species (45 47).

Another author, states that the Gender *Acrocomia* has two native species in Cuba representatives, who are *Acrocomia aculeata* (Jacq.) Lodd. ex Mart. and *Acrocomia Pilosa* Leon. Y cites: the corojo, *Gastrococus crispa*, known for the proverbial hardness of walnut, is known by its fruit, whose seed oil is extracted and it is also consumed naturally. Same use is also found in the east of the country to another species also commonly called corojo: *Acrocomia pilosa* (48).

In work carried out in the Sierra de Cubitas, Camagüey, it was found that there are three species of palm called "Corojo" with significant populations of *Acrocomia aculeata* and *Gastrococos crispa* and less abundant populations of *Gastrococos flexuosa*.

However, it was observed that the natural spread is significant having *Gastrococos flexuosa* in the plains of Guáimaro municipality, adjacent to Las Tunas province. *Gastrococos crispa* has abundant populations on the heights of Maraguán, Najasa and anthropic savannas of municipalities as Florida, Vertientes, Minas, Sierra de Cubitas and Santa Cruz del Sur, with high natural regeneration and rapid vegetative growth, and continues that in the wild They are distributed within a framework of minimum 6,0 x 4,5 planting maximum of 12,0 m x 12,6 m, forming small colonial associations or groups capable competitively to reach the reproductive cycle without depressive effects of some individuals on others[E].

During the period 1991-1999, these species in the Sierra de Cubitas, were studied as main objective of a Territorial Research and Development Project and in turn, intensively exploited by residents of the area in the "special period", used oil for human consumption, and cake for animal feed[E].

Acrocomia aculeata (Jacq.) Lodd. ex Mart species, is disseminated in Cuba in the areas of Camagüey and Oriente; however, in recent years the plants have been declining, which makes it necessary that a plan for multiplication and repopulate areas of their natural habitat (10, 11) is implemented.

Work performed by specialists of the Botanical Garden of Cuba, expressed the *Acrocomia aculeata* develops secondary formations herbaceous vegetation communities (leaves); which they are flat areas with a dominant substrate herbaceous with shrubs, trees and emerging palms and semi natural grasslands on extreme soils that do not allow the development of woody elements and regeneration of natural vegetation, both *Acrocomia aculeata* (Jacq) being reported lodd ex Mart, as *Acrocomia crispa* (Kunth) Baker ex Becc., as classified by the number of individuals per surface, within the category of "least concern plants".

They also express synonymy of the name *Acrocomia aculeata* (Jacq) Lodd ex Mart. as *Acrocomia hairy* Leon., and Acrocomia crispa (Krunth) Baker ex Becc., as *Acrocomia subinervis* Leon (48) (Figures 13, 14 and 15).

The corojo, with scientific name *Acrocomia armentalis* (Morales) Bailey, is ranked in Guisa, Granma province, Cuba, as an ornamental plant and fodder (49).

Figure 13. *A. pilosa*, now *A. aculeata*

Figure 14. *A. aculeata*, now *A. aculeata*

Figure 15. *A. crispa*, now *Gastrococos crispa*

[E] Carrera, P.E. *Los «corojos», palmas aceiteras cubanas sub utilizadas*, 13 p., [Documento inédito en formato pdf].

Figures 13, 14 and 15: Herbarium leaves which were classified palms of the genus *Acrocomia* by Brother Leo in the decade of the 30s of the twentieth century, which were reclassified in 1990 of the twentieth century, location: Herbarium of the Institute Ecology and Systematics, Havana, Cuba.

CONCLUSIONS

- ♦ *Acrocomia* gender palms, and especially *aculeata* species, have come to occupy since the 80s of the twentieth century the second in the world in oil production performance, after the African palm *Elaeis guineensis* Jacq.
- ♦ In the last twenty years the production and marketing of palm oil has increased in the international market, both for food use and for use in the chemical industry and more recently in the production of biodiesel.
- ♦ In Cuba there are at least two species of the genus *Acrocomia* palms, one *A. aculeata*, and the other *A. crispa*, with which it can work, drawing upon the results and experiences of several Latin American countries in multiplication technologies, cultivation, harvesting, extraction and refining of oil, to carry out institutional projects it can implement a production technology that response to the widespread demand for oil for food, industrial and as a renewable source of energy in the form of biofuel use.

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