INDIGENOUS KNOWLEDGE AND SOCIO-ECONOMIC VALUES OF THREE KOLA SPECIES (*COLA NITIDA, COLA ACUMINATA* AND *GARCINIA KOLA*) USED IN SOUTHERN BENIN

Dah-Nouvlessounon Durand., Msc.
University of Abomey-Calavi,
Laboratory of Biology and Molecular typing in Microbiology, Benin
Adoukonou-Sagbadja Hubert., PhD.
University of Abomey-Calavi,
Laboratory of Genetic Resources and Molecular Breeding, Benin
Diarrassouba Nafan., PhD.
Université Péléforo Gon Coulibaly of Korhogo UFR of Biology sciences,
Côte d'Ivoire
Adjanohoun Adolphe., PhD.
National institut of agricultural research of Benin, Benin.
Baba-Moussa Farid., PhD.
University of Abomey-Calavi,
Laboratory of Microbiology and Food Technology, Benin.
Sezan Alphonse., PhD.
University of Abomey-Calavi,
Laboratory of Biomembrane and cellular signalling, Benin.
Baba-Moussa Lamine., PhD.
University of Abomey-Calavi,
Laboratory of Biology and Molecular typing in Microbiology, Benin

Abstract

This research paper aims to study the ethnobotanical knowledge and evaluate the socio-economic potentials of the three different kola species (*Cola nitida, Cola acuminata* and *Garcinia kola*) used in southern Benin. Some semi structured and semi quantitative surveys were made with 461 people from 62 villages and 13 main-markets. The study revealed that, those interviewed were conversant with the three kola species, though with varying level of knowledge. This knowledge depends on the cultural ties of each ethnic group to the specie. Some morphotypes were traditionally recognized in *C. nitida* and *C. acuminata* through their nuts' colors. Other information

related to the use as well as to the socio-cultural importance of kola trees were also registered. The analysis of the market revealed a substantial variation of the purchase and sale average prices. *C. acuminata* had the highest economic value with a selling price of 64.78±16.16 Euro/ 25 kg of nuts (producer). It is followed by *C. nitida* (49.54±10.77 Euro/ 25 kg of nuts) and *G. kola* (24.01±4.85 Euro/ 25 kg of nuts). This study revealed the social and cultural importance, the medicinal benefits and the economic potentials of kola genetic resources in the southern part of Benin. The valorization of these species will help to keep them and at the same time increase the income of the local people.

Keywords: Cola spp., *Garcinia kola*, local knowledge, socio-economic values, Benin

Introduction

Tropical forests contain vast reserves of useful plant biodiversity, that for millennia, men used for their daily needs. The genetic resources of these plants are composed of species that play fundamental roles in the satisfaction of many basic needs of local communities. Often unknown to a large people, they contribute however significantly to the economy and food security in the country (Achigan-Dako et al., 2011). Over 100 forest genetic resources of major importance have been reported in international market and kola nuts are one of the products (Carr, Chen, & Tate, 2000). Furthermore, the trading of kola nut is more profitable than trading other non-timber forest products because of its high amenability to storage, both fresh and dried (Adebayo & Oladele, 2012). Indeed, the market based conservation approach strives to provide economic incentives in order to conserve the resource base (Kainer, Schmink, Leite, & da Silva Fadell, 2003). There is a close connection between fighting against poverty and environmental management. The safeguarding of the natural resources can become a guarantee of income, this can be achieved by encouraging the rational use of the ecosystems and also supporting its evolutionary process. Today, the majority of these species are faced with extinction due to the unsustainable exploitation that accompanies the growth of human population (Gebauer, El-Siddig, & Ebert, 2002) and lack of attention from governments and scientists.

Various studies on the traditional uses and folk knowledge of species in many regions of the world have shown that the survival and the development of mankind depend on the ability to explore and exploit the environment (Abdurrahman, Fajemiroye, Oladele, & 2006; Anisuzzaman, Rahman, & Islam, 2007; Chunlin, Sumei, Bo, Yana, & Benxi, 2009; Haile, Ensermu, Tanarat, & Ermias, 2008; Saeed, Arssad, Ahmad, & Ishaque, 2004). Rural development that links the improvement of living conditions

and the conservation of natural resources, has been more successful when based on local knowledge and common resources used by the involved communities (Idu, Osawaru, & Orhue, 2005) .

Among the kola trees, *Cola nitida* (Vent.) Schott & Endl. and *Cola acuminata* (P. Beauv.) Schott & Endl. belong to the *Sterculiaceae* family how it incorporates into *Malvaceae* in broad sense and *Garcinia kola* Heckel of the *Clusiaceae* family (Akoegninou, van der Burg, van der Maesen, 2006; www.theplantlist.org).

In Benin, very few studies have been conducted on the kola species, except our recent study which dealt with the pharmacological properties of *C. nitida* (Dah-Nouvlessounon et al., 2015)**.** Therefore, many questions remain unresolved: (i) what is the state of kola genetic resources in Benin? (ii) which traditional knowledge is related to its management by the local people? (iii) what influence does ethnic groups' knowledge have on the use, conservation and regeneration of these trees ? and (iv) what are the influence and the economic impact of these trees in rural areas? In this context, our study aims to document ethnobotanical knowledge related to the management and use of the genetic resources of the three kola species (*C. nitida*, *C. acuminata*, *G. kola*) and assess their socio-economic potentials in southern Benin. The study provides an indepth knowledge of kola genetic resources in Benin and positively contribute to their valorization.

Methods

Study Area

The present study was conducted in southern Benin, precisely in Ouémé and Plateau administrative departments (Figure 1). The study area belongs to the Guinean zone between 6°25'-7°30'N and 2°33'-2°58'E where the rainfall is bimodal (April to June and September to November) with a mean annual rainfall of 1200 mm. The mean temperature varies between 25 °C and 29 °C and the relative humidity between 69% and 97%. The vegetation in the study area has been strongly affected by various agricultural activities and now forms a mosaic of cultivated land and small relic forest patches (Assogbadjo, Sinsin, & Van Damme, 2005). Specifically the department of Ouémé is characterized by reddish ferruginous, sandy-clay, alluvial and co-alluvial soils with essentially anthropized vegetation which formed thicket, some relic forests, a grassland and raffia marshy formation and some mangroves. The department of Plateau is characterized by tropical ferruginous, clay and deeply soils. The climate is the Sudano-Guinean type. The vegetation is a shrubby savannah with dominance of *Daniellia oliveri*. It also contains some forest relics (INSAE, 2004) .

Exploratory Survey

After a documentary study, preliminary information on the geographical range of the three kola species was obtained; a prospective trip was conducted in the study areas with the objective of arranging interviews with resource persons and some community leaders. It also aimed to evaluate and adjust the pre-established questionnaires, familiarize with the stakeholders that are involved in the chain value of kola species and finally to identify target groups that had been investigated during the ethnobotanical survey. The methodology used in this prospective study was based on ethno-ecological approach (study of the relations of a society with its natural environment) described by Biloso, (2008). After this exploratory study, 62 villages and 13 markets (rural, urban and peri-urban) were selected to conduct ethnobotanical and socioeconomic surveys.

Figure 1: The geographic map showing the study area and villages surveyed (Topographic IGN, 1992)

Ethnobotanical Survey

The field work (ethnobotanical study) was conducted from January to March 2013 in the selected villages from five ethnic groups (Goun, Tori, Ouémè, Nago and Yoruba). The villages and ethnic groups selection was made using some criteria such as the accessibility of the surveyed village, the presence of kola trees in the village, the degree of use knowledge, the socio-cultural particularity, and the open-minded collaboration of the population to share their knowledge. Some important villages were revisited from February to March 2014 for complementary information. The sampling of the respondents was made according to the methodology described by (Assogbadjo et al., 2012). The size of the sample was determined using the formula of binomial distribution described by (Dagnelie, 1998):

$$n = \frac{U_{1-\alpha/2}^2 \, x \, p(1-p)}{d^2} \qquad (1)$$

with n the sample size; p the proportion of respondents who answered yes; d the margin error of the estimation; $U_{1-\alpha/2}$ is the value of normal random variable at probability value of 1-α/2. For a probability value of 0.975 (or $\alpha = 0.05$), $U_{1-\alpha/2} \approx 1.96$

The ethnobotanical surveys were conducted according to the methodologies described by (Adoukonou-Sagbadja, Dansi, Vodouhe, & Akpagana, 2006) and included free, semi-structured and semi-quantitative surveys after consent of respondents. The free and semi-structured ethnobotanical survey was done as open interviews with respondents using a pre-established question card. The semi-quantitative ethnobotanical survey was conducted by consulting cult leaders, herbalists and traditional therapists resident in the study area. Free surveys were conducted individually and in groups while semi-structured surveys were conducted only in groups. In either type of survey, occasional discussions were also carried out for getting further information. Plant specimens (when possible) were collected and their complete organ pictures were taken for botanical identification at the Beninese National Herbarium (Abomey-Calavi Campus). All plant scientific names, author and family names were checked by visiting www.theplantlist.org and Mansfeld´s Encyclopedia of Agricultural and Horticultural Crops.

Socio-Economic Survey

This survey was conducted using the same methodology as above (Adoukonou-Sagbadja, et al., 2006) with the sellers of kola nuts as respondents. The interviews were directly conducted in local markets following the availability of respondents. The diverse information collected is related to the market (buying and selling) prices, the quantities sold in a given time (per day), the conservation methods of kola nuts, etc.

Data Analysis.

Data from surveys conducted in the field were coded and computed into a database using Excel 2007 worksheet. This database was further analyzed using SPSS (Statistical Package for the Social Sciences) software version 16.0 for the determination of descriptive statistics in terms of percentage and average. Besides, the Factorial Analysis of Correspondence was further performed with the software package Minitab 14. The consensus factor (Fic) was used to assess the degree of homogeneity of the information (Trotter and Logan 1986). This is calculated using the formula:

$$Fic = \frac{\mathrm{Nur-Nt}}{\mathrm{Nur-1}} \qquad (2)$$

with Nur : number of use citations in each disease category; Nt: number of species used for the treatment.

Results

Socio-demographic characteristics

Information was collected from 461 respondents belonging to five ethnic groups distributed over the whole study area. Socio-demographic characteristics of the respondents are presented in Table 1. On average, 64.8% of respondents were men against 35.14% of women. The majority (66.8%) of the informants belonged to the age bracket from 30-60 years that were largely (49%) animists. With regard to educational level, about 35.7% of the respondents are illiterates against 64.3% who have done studies among which 53.3% have completed elementary study, 9.3% have they completed secondary education and finally 1.7% reached the university level.

Table 1: Socio-demographic characteristics of the respondents

Characteristics	Modality	**Respondents** (%)		
		Ouémé	Plateau	Mean
Sex	Female	23.8	46.4	35.1
	Male	76.1	53.5	64.8
Age	< 30 years old	9.9	25.7	17.8
	Between 30 and 60 years old	72.9	60.7	66.8
	≥ 60 years old	17.2	13.6	15.4
Education level	Illiterate	35.7	35.6	35.7
	Elementary	51.4	55.1	53.3
	Secondary	10.3	8.2	9.9
	University	2.4	1.1	1.7
Religious affiliation	Islamic	1.6	28.1	14.8
	Christian	37.8	30.9	34.4
	Animist	57.1	40.9	49.0
	Atheist	3.5	0	1.7
Ethnic group	Goun	19.9	5.5	21.5
	Tori	61.4	2.1	31.7
	Ouémè	30.9	4.3	17.6
	Nago	2.9	26.5	14.7
	Yoruba	10.7	18.3	14.5

No surveyed locality was mono-ethnic. Indeed, the collecting method of survey data has led to a classification of substantially mono-ethnic identities despite the presence among the surveyed individuals of multiple ethnic identities. From the data, it appears that Tori ethnic group is the most represented in the study area (31.8%) while the Yoruba and Nago had a lower representation with 14.5% and 14.7% of respondents respectively.

Inventory of kola species found in the study area

In general, six kola species were recorded in the study area. They are *C. nitida, C. acuminata, G. kola, Cola gigantea*, *Cola anomala* and *Cola milénii*. Most of the respondents had a good knowledge of *C. nitida, C. acuminata* and *G. kola* but very few (4.9%) recognized the other three species.

The three species *C. nitida, C. acuminata* and *G. kola* are cultivated their fruits are edible and commonly used by local people. In contrast, *C. gigantea, C. anomala* and *C. milenii* are wild edible species not cultivated by the population. *C. anomala* nuts are morphologically close to those of *C. nitida*. It was known to few people in our study area (38.1% of respondents) with only 12.5% of them reporting to have used it at a given time for food and medicinal purposes. Finally, in the study area, a prioritization of the three crop species (*C. nitida, C. acuminata, G. kola*) can be observed between the five ethnic groups because they are appreciated and are used for various purposes by the local population.

Indigenous knowledge of kola species grown in the study area

In the study area, *C. nitida, C. acuminata, G. kola* are well known to respondents. Various local names are used by the surveyed five ethnic groups to identify each species (Table 2).

Table 2: Commonly used vernacular names of the kola species in the different ethnic groups surveyed in southern Benin

Species	Local names (ethnic groups)
Cola nitida	Gbahoundja (Goun, Ouémè, Tori), Glo (Tori) Obi (Nago), Obi gbanjâ (Yoruba)
Cola acuminata	Avi (Goun, Tori, Ouémè) Obi abata (Nago, Yoruba)
Garcinia kola	Ahohohoué (Goun, Tori,Ouémè) Kòla (Yoruba), Orogbo (Nago)

However, the respondents did not use the same criteria to recognize these trees. The recognition descriptors used by the respondents depended on the plant and were related to the morpho-botanical traits. In general, the facility in plant recognition depends on the links of each ethnic group with the studied plant, its particular environment and the stages of tree

development. Among the three species, the totality of the respondents indicated that *G. kola* is easily distinguished from *C. nitida* and *C. acuminata* even before flowering by the color and shape of its leaves (97.1%), the trunk of the tree and also the look of its size (34.3%). In contrast, *C. nitida* and *C. acuminata* show some resemblance and therefore some people were not able to distinguish them easily. However, 78.9% of respondents may distinguish them before flowering against 21.1% of the respondents who can only distinguished them after the first fruit setting. With regard to the descriptors used by those who made a clear differentiation, the shape and color of the leaves were the most important (98.2% of respondents). In addition to these descriptors, some respondents used the tree's trunk aspect. Moreover, of all the ethnic groups surveyed, the *Tori* group developed a very high knowledge of these plants; this justifies their cultural proximity and secular attachment to these kola trees.

Regarding the fruits, the majority of respondents made a clear differentiation between *G. kola* and the other two species (*C. nitida* and *C. acuminata*). In contrast, 32.4% of respondents had difficulty differentiating between *C. nitida* and *C. acuminata*. The Fig. 2A shows the morphology of the three species' fruits.

Similarly, concerning the nuts, all respondents were able to make a clear differentiation between *G. kola* nuts and those of *C. nitida* and *C. acuminata* species (Fig. 2B). Moreover, they were not able to differentiate between *C. nitida* nuts and those of *C. acuminata*. Indeed, 96.7% of respondents were able to easily differentiate the two kola nuts. For those who differentiated them, the criterion used was the number of the nut's cotyledons: two for *C. nitida* and at least three for *C. acuminata*. Indeed, 100% of respondents stated that *C. acuminata* has a number of nut cotyledons between 3 and 5; only 8.3% of them indicated that *C. acuminata* nuts could be composed of six cotyledons.

Furthermore, it is important to note here that, in contrast to *G. kola*, some varieties or morphotypes were recognized in *C. nitida* (Fig. 2G) and *C. acuminata* (Fig. 2H) . These varieties were defined through, the color of the nuts. Indeed the totality of respondents reported a red variety for both species against 48.1% and 26.2% of respondents who reported a pale-red variety for *C. nitida* and *C. acuminata* respectively. Besides, 98.1% of respondents reported a white variety for *C. nitida* against 18.6% for *C. acuminata*.

A- Shape of *C. nitida* fruit

B- Shape of *C. acuminata* fruit

C- Shape of *G. kola* fruit

D- *C. nitida* nuts aspect

E- *C. acuminata* nuts aspect

F- *G. kola* nuts aspect

G- *C. nitida* variety and cotyledon number

H- *C. acuminata* variety and cotyledon number

Figure 2: Recognition of fruits, nuts and variety differentiation in cultivated kola species

During our investigations, 54.4% of the respondents indicated that most of the trees are found in farms (field, home-garden, fallow land) while others are still in their natural habitat (forest). Besides, all respondents reported that the three species have a sexual mode of reproduction (by seed). 38.2% of respondents reported that the kola trees were to be endangered in the different areas surveyed with a significant reduction in trees' natural population. The three species were reported to have neither the same

occurrence nor the same period of fruit production in the year. In general, *C. nitida* and *C. acuminata* have the same period of fruit production; they produce mainly in June and from October to December. This significantly differs from *G. kola* which produces all the year with essentially three peaks of production: the first in August, the second in November and the third in April.

Socio-cultural importance

In the areas surveyed, the studied kola trees have varied socio-cultural importance. Based on interviews and field observations, 83.3% of the respondents did not like the three species in the same degree and some of them made a judgment according to the economic power of the species or their use value.

Economically, *C. acuminata* was more appreciated (83.1%) followed by *C. nitida* (53.5%) and *G. kola* (49.9%). In terms of use, *C. nitida* ranked first (83.1%) followed by *G. kola* (73.2%) and *C. acuminata* (62.3%). The first rank of *C. nitida* is explained by the fact that among the three species, *C. nitida* meets the spiritual aspirations of thron, so it is much more requested for "Thron" cults, a traditional deity (Vodoun) from Ghana that are currently found in many ethnic groups in Benin and with the number of believers currently growing in the study area.

In all the ethnic groups surveyed, majority of the respondents within the age bracket of 30 to 80 years had the habit of chewing kola nuts, with the notion that *C. nitida* nut is a good substitute for alcohol or other stimulant, and its consumption calm hunger. In contrast, *C. acuminata* nut is not chewed like *C. nitida*, but it is much used for rituals and religious purposes. For *G. kola*, the nut was reported to be chewed for specific reasons including the medicinal purpose and the maintenance of voice. It is not chewed like others because of its very bitter taste. Furthermore, the nuts of the three kola tree were used in social relations. For example, some ethnic groups like Tori, 10.3% of respondents claimed that the nuts of *C. nitida* are kept at home to receive foreigners. In other ethnic groups, the nuts of the three kola trees were shared to mark the birth of a special friendship or relationship. For most (98%) of respondents, the nuts of the three kola trees are necessary for certain events such as a new born baptism, the dowry for marriage or first recognition (before the marriage process begins, there is an initial ceremony called first recognition of the girl's parents. During this ceremony, the boy's family sends gifts to the future in-law in which the major ingredient is kola nut.) The preference of the nut was reported to depend on the special tradition of each family as it is enshrined in the tradition and custom of their ethnic group.

Figure 3 shows the results of the Factorial Analysis of Correspondence in the preference of each ethnic group for the use of kola nuts in traditional rites. The data shows that the first two lines express 100 % of the baseline information. The axis 1 (93.5%) shows a correlation between four ethnic groups namely Goun, Tori, Oueme and Yoruba with *C. nitida* and *G. kola* while axis 2 connects the Nago ethnic group with *C. acuminata*. The graphic analysis shows that axis 1 opposes Goun, Oueme and Yoruba ethnic groups to Tori group on the one hand and of *C. nitida* and *G. kola* on the other hand. It appeared that the individuals belonging to Tori group express a preference to *G. kola* while Goun, Ouémè and Yoruba use more *C. nitida*. On the axis 2, we remark an opposition between Nago ethnic group and *C. acuminata*. Whereas there is a convergence between Goun, Tori ethnic groups and *C. acuminata*. We can thus say that in addition to *G. kola*, Tori group prefer the use of *C. acuminata* while in addition to *C. nitida*, Goun ethnic group prefer *C. acuminata*. Moreover we noticed according to axis 2 that Yoruba, Nago and Oueme use more *C. nitida* and *G. kola*.

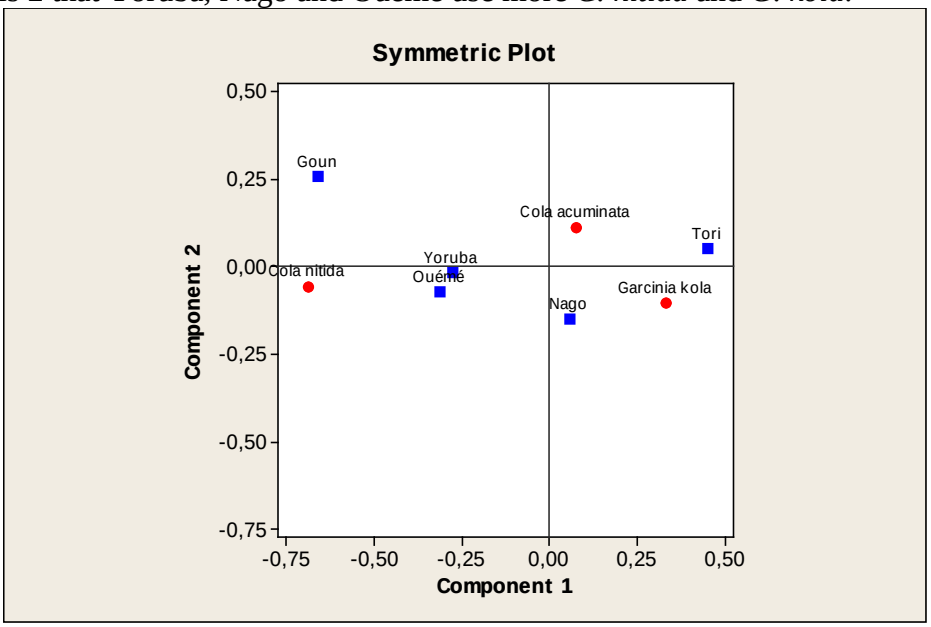


Figure 3: Factorial analysis showing correlations between ethnic groups and kola species

In the study area, 86% of respondents of the five ethnic groups have interdicts for each kola tree. General prohibitions that have been raised for all ethnic groups were on one hand, the defense to make these trees firewood as long as the plant is in production. On the other hand, it is strictly prohibited to a young person whose age is between 7 and 30 years old to plant a kola tree at risk of dying before the beginning of its fruit production. Other

prohibitions reported were specific to each tree according to ethnic groups in the study area.

Finally, all the respondents reported that the three plants are protected by the people especially those who have ownership of these trees. They were protected because of their increasing scarcity and represent a heritage (5.4%) and wealth (61.8%). Indeed, in some ethnic groups, the *G. kola* tree was reported to be put in pledge to borrow money or receivewine. Similarly, 74.8% of the respondents said that since times of old till present, kola trees incarnate the divinity, so they have high spiritual significance. Indeed, without their products (especially nuts), many traditional ceremonies cannot take place. They are trees with very high cultural impact in the study area. Because of their rarity and their cultural status, these trees are cut only for specific reasons: when space is requested (63.5%), when the wood is needed (3.9%), when the tree does not produce any more (23.4%), when the size of the tree becomes unmanageable (14.9%). Likewise several reasons of disappearance of the kola trees reported were: excessive exploitation (7.1%), urbanization (55.3%), interdicts (10.6%), long duration of development (2.4%), food crops (2.2%), harmful insects (6.3%) and lack of heightening, awareness (6.9%). Despite their socio cultural importance, these trees' management mode does not enable a good regeneration. At 64.4% these trees are a domestication status semi-cultivated.

Uses of kola products

In the study area, the three kola trees were used for different purposes. They constituted a source of income, food, medicinal in pharmacopoeia and wood for the populations. Of the five usage categories (alimentary, pharmacopeia, traditional cult, industrial wood and commercial), the three kola trees have high trading value while only *G. kola* have use as industrial wood (43.4%). Beyond the nuts, the leaves, barks, roots and wood were exploited by local people. In traditional cult, *C. acuminata* had the high value (96.2%) followed by *C. nitida* (89.9%) and *G. kola* (81.6%). In human consumption, despite its known stimulatory effect, 28.4% of respondents reported that excessive consumption of *C. nitida* can create health damages among chest pain or heart and eyesight problems. Moreover, it has been reported that *G. kola* nuts were also used to produce beverages, while the substance extracted from *C. nitida* nut was used to traditionally tint clothes.

In traditional medicine, different diseases were treated with the products of these three species. During our investigations, 21 diseases were identified and reported in Table 3.

Table 3: Various diseases treated by the three species

Diseases category	Diseases treated	Species and organs used						ICF
		C. nitida	Organs used	*C. acuminata*	Organs used	*G. kola*	Organs used	
Digestive system disorders	Diarrhea	×	Ba			×	Nu, Le	0,81
	Stomach ache	×	Ba, Le, Ro, Nu	×	Nu, Le, Ro, Ba	×	Nu, Ro, Le, Ba	
	Sore throat					×	Nu	
	Dysentery	×	Ba			×	Nu	
	Cough					×	Nu	
	Nausea					×	Nu	
	Vomiting			×	Nu	×	Nu	
	Ulcer			×	Nu, Le			
Obstetrical diseases	Female sterility	×	Le, Nu	×	Le			0,99
	Early menopause	×	Le, Nu	×	Le			
	Painfull period	×	Ec, Nu,	×	Le			
	Complexity delivery	×	Le, Nu			×	Nu	
Blood diseases	Diabetes	×	Ro			×	Nu, Ro	0,92
	Blood-pressure	×	Nu, Ba			×	Nu,Le, Ba	
Others	Charm	×	Le, Nu	×	Le			
	Urinary infection	×	Ba	×	Nu, Ro			
	Headache					×	Le,Ba, Ro	
	Malaria					×	Le, Ro	
	Tiredness					×	Nu, Ro	
	Male sterility			×	Le			
	Hernia	×	Ba					

Nu: Nuts; Le: Leaves; Ba: Bark; Ro: Root ; ICF; Informant Consensus factor

The most common disease treated by all three species was the stomach ache. The Factorial Analysis of Correspondence of organs used according to species in the treatment of this disease shows that the first two axes express 88% of baselines information (Figure 4). It reveals various correlations between *C. nitida*, *C. acuminata* and leaves, roots and bark on axis 1. Though the leaves and nuts are more correlated to axis 1, they also show high contribution to the axis 2. In contrast to *C. nitida* and *C. acuminata*, the axis 2 reveals connection between *G. kola* roots and nuts. It

appears that for the treatment of stomachache, nuts of *G. kola* are more used against bark of *C. nitida* and leaves of *C. acuminata*.

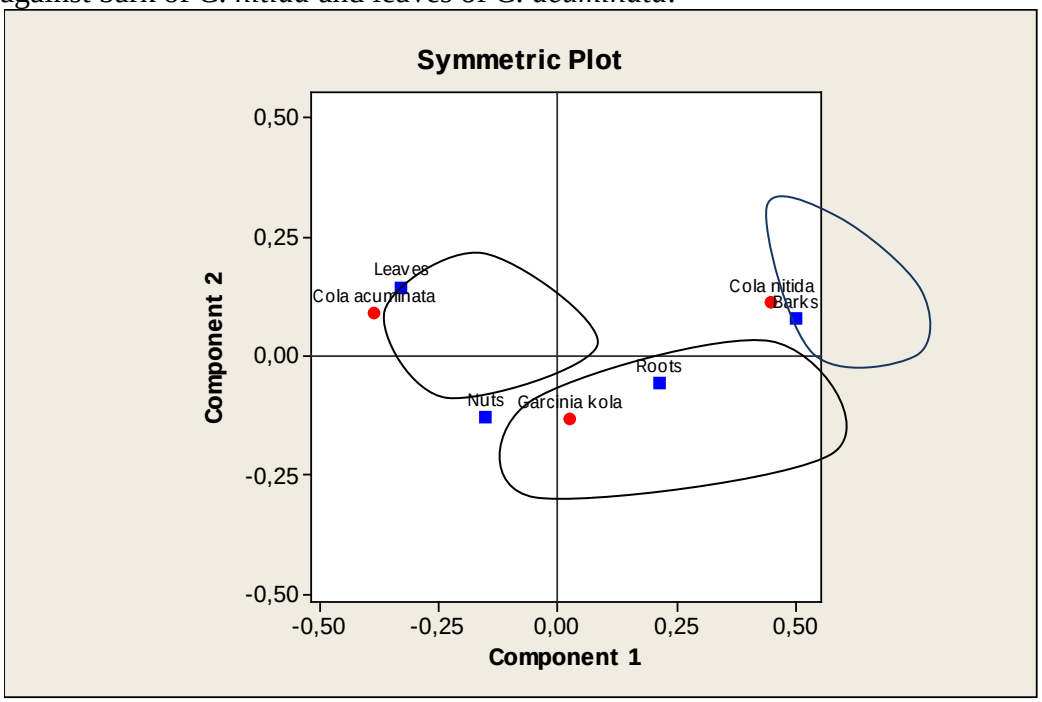


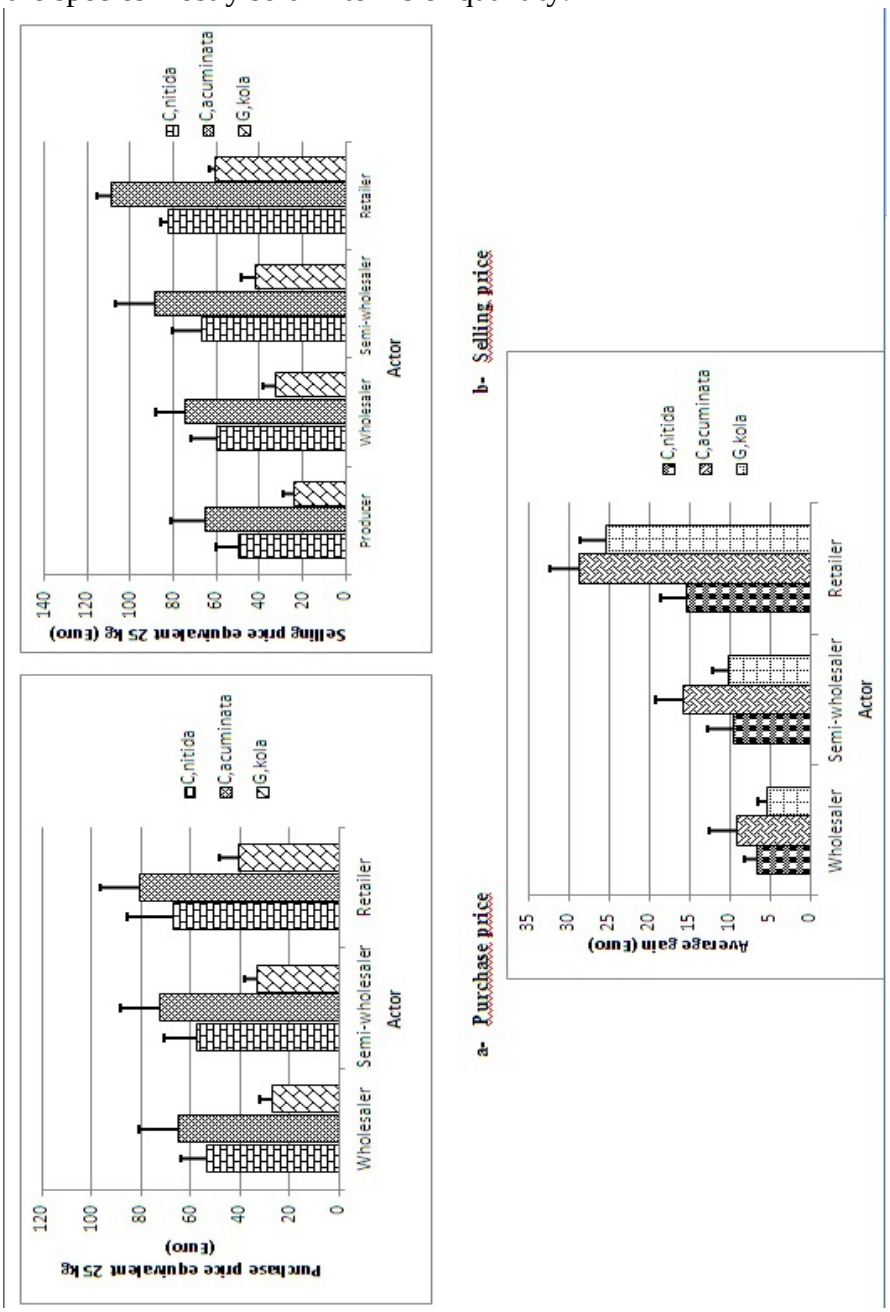
Figure 4: Projection of the species organs used in the treatment of the stomachache on AFC axis.

Economic value of kola trees products

In the study area, the marketed kola products were wood and nuts. Among the wood and nuts, only the nut was subjected to intensive trading for all the three kola species. The local production was low and the 4/5 of the marketed nuts in the study area were imported from other countries in the sub region. The largest supplier reported by the sellers was Nigeria (68.1%) followed by Togo (13.5%) and Ghana (8.4%). For better management of their products, the surveyed actors used various techniques in kola nuts' conservation.

Roughly 87.5% of respondents indicated that the current availability of kola nuts compared to previous years was significantly down. The average purchase and selling prices of each kola nut registered during the study period as well as the gains varied significantly according to the level of implication of the actors (Figure 5). In general, the gains range from 5.3 to 64.8 Euro equivalent of 25 kg according to the nuts and the actors involved in the sector. Producers are the primary beneficiaries of kola products in the study area and can make profit from 24.1 ± 4.8 Euro for *G. kola*, at 64.9 ± 16.7 Euro for *C. acuminata* per equivalent of 25 kg. For other actors (wholesalers, semi-wholesalers and retailers) involved in the sale, retailer

earned the biggest benefits with 15.24 ± 1.82 Euro for *C. nitida*, 28.9 ± 3.8 Euro for *C. acuminata* and 25.2 ± 3.3 Euro for *G. kola* per equivalent of 25 kg of nuts. *C. acuminata* had the highest economic power. Finally, though it is the least profitable species for some actors involved in the sale, *C. nitida* was the species mostly sold in terms of quantity.



Discussion

Socio-cultural and economic importance of kola (*Cola nitida, Cola acuminata* and *Garcinia kola*) in southern Benin

In Benin, particularly in the study area, kola trees present remarkable socio-cultural and economic importance. Among all the products from these plants, only the nuts are consumed and are of socio-cultural importance. This importance of kola nuts is a general fact in South Saharan Africa (Purseglove, 1968). (Kiple & Ornelas, 2000) as well as (Iyere, 2011) in Nigeria reported that even after the emergence of Western civilization the kola nuts have a remarkable socio-cultural importance.

In the use of nuts, *C. nitida* and *G. kola* are most frequently used. This remark is related to the abundance of their availability in comparison with *C. acuminata*. It could also be explained by the people's preference for these two kola nuts because of their stimulating effect. This remark corroborates the observation of (Purseglove, 1968) which stated that, in the habits of Sub-Saharan African populations, chewing kola seeds is a similar behavior to drinking of tea, coffee, alcohol or smoking cigarettes in the Western country. Moreover (Leakey, Tchoundjeu, Schreckenberg, Shackleton, & Shackleton, 2005) reported that these nuts were chewed to stimulate the flow of saliva. In all the ethnic groups surveyed, in contrast to *C. nitida* and *G. kola*, *C. acuminata* has very high ceremonial value in convents of traditional divinities. The same was reported by (Kanoma et al., 2014) in Nigeria, in relation to five edible species of kola. Similarly, (Rätsch, 2005) stated that among the kola species, *C. acuminata* is a specie used in sacrificial ceremonies. Also, (Opeke, 1992) reported that kola nut is used during ceremonies related to marriage, child naming, enthroning of chiefs, funeral and sacrifices made to diverse gods in African mythology.

In social relations, the nuts of three species are used whatever by all ethnic groups. They are kept at home in some ethnic groups to receive foreigners. This attitude which is a sign of peace and acceptance of the visitor were reported by (Iyere, 2011) within a population living in the eastern part of Nigeria. Similarly, the nuts of these species are essential for traditional engagement ceremonies or marriage dowry. The same observation was also made in some tribes in Ghana by (Town, 1967) and in Nigeria by (Adenuga, Mapayi, Olasupo, Olaniyi, & Oyedokun, 2012). Finally, there is an ethnic preference in the nuts use of each species. *C. acuminata* is essential for all ethnic groups in the social relations, while the use of *C. nitida* and *G. kola* is more specific to the preference of the ethnic groups.

In addition to the nuts of the three kola species, other organs are used in traditional medicine by the people to treat various diseases. Similarly, (N'Guessan, Kadja, Zirihi, Traoré, & Aké-Assi, 2009) in Ivory Coast,

(Cheryl, 2007) in Colombia and (Oladele & Adewunmi, 2008) in Nigeria reported in their studies the traditional use of these species in the treatment of various diseases. Several studies (Akpantah, Oremosu, Noronha, Ekanem, & Okanlawon, 2005; Lacmata et al., 2012; Sonibare, Soladoye, Esan, & Sonibare, 2009) in this direction showed that the three species possess various and interesting biological properties. All these results confirm the traditional practices in the use of these kola trees in the study area.

The study also allowed us to appreciate the economic importance of these species in the local communities' lives. The results showed a significant contribution of kola nut in the income-improvement of people in rural areas, especially those of the producers and retailers who, in large part, are those who make more profit in the sale of kola products (nuts) in the study area. The same observation was made by (Adedokun et al., 2012). Some authors (Asogwa, Otuonye, Oluyole, Ndubuaku, & Uwagboe, 2011; Ojo & Ehinmowo, 2010; Oluyole, Adebiyi, & Fagbami, 2009) they also reported the economic importance of kola nuts in the people's lives in Nigeria. Among the three species studied, *C. acuminata* has the highest market value, corroborating the observation of (Oladokun, 1982). This economic potential of kola trees should be considered in the promotion and valorization of these species in Benin.

Kola genetic resources and their traditional management in Benin

In the study area, the surveyed population showed a clear knowledge of the kola trees by the ethnic groups that are culturally attached to these species, they had more in depth knowledge than other ethnic groups. These observations were made by (Fandohan, Assogbadjo, Glèlè Kakaï, & Sinsin, 2011) on the tamarind tree. Taking into account the resemblance between these trees, especially *C. nitida* and *C. acuminata*, traditional descriptors for kola trees recognition before fructification are specific to each kola species. The common descriptor for these three kola species is the shape and color of the leaves. It also appears that the traditional descriptors used for trees identification are identical to those used by botanists. Those above reported that *C. acuminata* has oblanceolate, closely elliptical leaves with acumen long, while *C. nitida* has widely oblong leaves with short acumen (Akoegninou, et al., 2006). Except the leaves, other descriptors related to the flower with greenish yellow sepals (*C. acuminata*) and creamy white (*C. nitida*) are used by botanists. Similarly, the shape and color of fruit pericarp enable to differentiate them by local people. Generally, nuts differentiation is based on the cotyledon number (Irvine, 1956; Keay, 1958). *C. nitida* nuts have two cotyledons while those of *C. acuminata* have a number varying from three to six. These observations are in agreement with those of (Adenuga, et al., 2012) in Nigeria. Beside, varieties are distinguished

through the nuts color. These results corroborate also those of (Atanda, Olutayo, Mokwunye, Oyebanji, & Adegunwa, 2011).

In contrast to what is reported in other countries such as Nigeria, Ghana, Cameroon, Ivory Coast, Brazil and Island (Eijnatten, 1973; Oludemokun, 1982) the three kola trees are not formally grown in Benin, mainly in the study area. Thus, no field plantation was encountered during our investigation. However, the kola trees can be found in the fields, home gardens and pastures. The mode of cultivation of these trees reported by the public is generally a protoculture. This method of cultivation of kola trees in the study area is essentially due to the defense to plant a kola tree, explaining the absence of young people in the culture of kola trees in the study area. This management of kola trees in the study area makes a heavy threat on the long-term survival of these plants due to the current endemic status of populations of kola tree existing in the localities surveyed. The results also showed that in 63.5% of the cases, the trees are cut when spaces are needed. Beside, the fundamental reason for the disappearance of these trees is urbanization which accounts for 55.3%. Systematic awareness conducted with the support of the local authorities and the cultivation of kola trees could favor the safeguard and the conservation of these important species.

Acknowledgement

Thanks to UEMOA for the financial support through the project LBTMM-PAES-UEMOA-2012. We thank the community leaders (heads of districts, heads of convents, heads of sacred forests and the traditherapists), the survey guides, resource persons and all others encountered during the survey for their openness and collaboration and to have shared their knowledge with us.

Conclusion

Overall, the study allowed the documentation of the local population's knowledge of the species of kola trees (*C. nitida*, *C. acuminata* and *G. kola*) used in southern Benin and assess their socio-cultural and economic importance. It clearly appeared that the populations have good knowledge on the three kola species. However, among all the ethnic groups, Tori had better knowledge of these plants. The differentiation criteria of trees, fruits and nuts of each one based on morphological traits and other parameters were documented. Several organs of these plants are used in traditional medicine to treat various diseases. Among the products of kola trees, the nuts hold's a remarkable socio-cultural importance. Also, except wood from *G. kola*, only the nuts of the three kola species have high market value and are important sources of income. These plants play a vital role in sustaining

livelihoods of certain local communities. But the traditional management of kola tree genetic resources in Benin does not favor their regeneration and propagation. Indeed, the valorization of these plants through their domestication and cultivation will obviously participate to the management of their regeneration and propagation. Moreover markets for kola nuts are available at national and international levels, the improvement of management methods and strategies of valorization of these trees would increase advantageously the economic level of the people involved.

References:

Abdurrahman, A., Fajemiroye, O., & Oladele, F. (2006). Ethnobotanical study of economic trees: uses of trees as timbers and fuel woods in Ilorin Emirate of Kwara state Nigeria. *Ethnobotanical leaflets, 10*, 113-120.

Achigan-Dako, E., N'Danikou, S., Assogba-Komlan, F., Ambrose-Oji, B., Ahanchede, A., & Pasquini, M. (2011). Diversity, geographical, and consumption patterns of traditional vegetables in sociolinguistic communities in Benin: implications for domestication and utilization. *Economic Botany, 65*, 129-145.

Adebayo, S., & Oladele, O. (2012). Medicinal Values of Kolanut in Nigeria: Implication for Extension Service Delivery. *Life Science Journal 9*(2), 887-891.

Adedokun, M., Soaga, J., Olawumi, A., Oyebanji, O., Oluwalana, S., & Imaledo, E. (2012). Socio-economic Contribution, Marketing and Utilization of Edible Kolanut (*Cola acuminata* and *Cola nitida*) to Rural Women Livelihood in Abeokuta, Nigeria. *International Journal of Molecular Ecology and Conservation, 2*(6), 32-38.

Adenuga, O., Mapayi, E., Olasupo, F., Olaniyi, O., & Oyedokun, A. (2012). Nigeria's Cola Genetic Resources: The Need for Renewed Exploration. *Asian Journal of Agricultural Sciences, 4*(3), 177-182.

Adoukonou-Sagbadja, H., Dansi, A., Vodouhe, R., & Akpagana, K. (2006). Indigenous knowledge and traditional conservation of fonio millet (*Digitaria exilis, Digitaria iburua*) in Togo. *Biodiversity and Conservation, 15*, 2379-2395. doi: DOI 10.1007/s10531-004-2938-3

Akoegninou, A., van der Burg, W., van der Maesen, L., & ., B. P. (2006). Flore analytique du Bénin. In A. Adjakidje, J. Essou, S. B & Y. H (Series Eds.), A. Akoegninou, W. van der Burg & L. van der Maesen (Eds.),

Akpantah, A., Oremosu, A., Noronha, A., Ekanem, T., & Okanlawon, A. (2005). Effects of *Garcinia kola* seed extract on ovulation, oestrous cycle and foetal development in cyclic female sprague - dawley rats. . *Nigerian Journal Physiological Sciences, 20*(1-2), 58-62.

Anisuzzaman, M., Rahman, A., & Islam, A. (2007). An ethnobotanical study of Madhurpur, Tangail. *Journal of Applied Sciences Research, 3*, 519-530.

Asogwa, E., Otuonye, A., Oluyole, K., Ndubuaku, T., & Uwagboe, E. (2011). Kolanut Production, Processing and Marketing in the South Eastern States of Nigeria. *African Journal of Plants Sciences 5*(10), 547-551.

Assogbadjo, A., Glèlè Kakaï, R., Vodouhê, F., Djagoun, C., Codjia, J., & Sinsin, B. (2012). Biodiversity and socioeconomic factors supporting farmers' choice of wild edible trees in the agroforestry systems of Benin (West Africa). *FOREST POLICY ECONOMICS, 14*, 41-49.

Assogbadjo, A., Sinsin, B., & Van Damme, P. (2005). Caractères morphologiques et production des capsules de baobab (*Adansonia digitata* L.) au Benin. *Fruits 60*(5), 327-340.

Atanda, O., Olutayo, A., Mokwunye, F., Oyebanji, A., & Adegunwa, M. (2011). The quality of Nigerian kola nuts. *African Journal of Food Sciences, 5*(17), 904-909.

Biloso, M. (2008). Valorisation des produits forestiers non ligneux des plateaux de Batéké en périphérie de Kinshasa (RD Congo). . *Thèse de Doctorat, Université Libre de Bruxelles, Faculté des sciences, service d'écologie du Paysage et Système de Production Végétale*.

Carr, M., Chen, M., & Tate, J. (2000). Globalization and home-based workers,. *Feminist Economics, 6* (3), 123-142.

Cheryl, L. (2007). Comparison of plants used for skin and stomach problems in Trinidad and Tobago with Asian ethnomedicine. *Journal of Ethnobiology and Ethnomedecine, 3*(3). doi: 10.1186/1746-4269-3-3

Chunlin, L., Sumei, L., Bo, L., Yana, S., & Benxi, L. (2009). Medicinal plants used by the Yi ethnic group: a case study in central Yunnan. *Journal of Ethnobiology and Ethnomedecine, 5*, 1-11.

Dagnelie, P. (1998). *Statistiques théoriques et appliquées.* Bruxelles: De Boeck et Larcier.

Dah-Nouvlessounon, D., Adoukonou-Sagbadja, H., Diarrassouba, N., Sina, H., Adjanohoun, A., Inoussa, M., Akakpo D., Gbenou D., Kotchoni S., Dicko M., & Baba-Moussa, L. (2015). Phytochemical analysis and biological activities of Cola nitida bark. *Biochemistry Research International, 2015*, 1-12.

Eijnatten, C. (1973). Kola: A review of the literature. *Tropical Abstracts, 28*(8), 451-550.

Fandohan, B., Assogbadjo, A., Glèlè Kakaï, R., & Sinsin, B. (2011). Geographical distribution, tree density and fruit production of Tamarindus indica L. (Fabaceae) across three ecological regions in Benin. *Fruits 66*, 53-62.

Gebauer, J., El-Siddig, K., & Ebert, G. (2002). Baobab (Adansonia digitata L.). *A Review on a Multipurpose Tree with Promising Future in the Sudan. Inst für Gartenbauwissenschaft 67*(4), 155-160.

Haile, Y., Ensermu, K., Tanarat, B., & Ermias, L. (2008). Plants used in traditional management of human ailments at Bale Mountains National park, Southeastern Ethiopia. . *Journal of Medicinal Plants Research, 2*, 132-153.

Idu, M., Osawaru, M., & Orhue, E. (2005). Medicinal plants in some local markets in Benin City. *Niger Ethnobotany, 17*, 118-122.

INSAE. (2004). RGPH2 Cahier des villages et quartiers de ville Département de l'OUEME, Bénin 22p.

Irvine, F. (1956). Plants of the Gold Coast H. Milford (Ed.)

Iyere, I. (2011). The Socio - Religious Significance of Obi (Kola Nut) among the Igala People of Kogi State. *Cross-Cultural Communication, 7*(2), 199-208.

Kainer, K., Schmink, M., Leite, A., & da Silva Fadell, M. (2003). Experiment in forest based development in Western Amazonia, . *Society and National Resources: An International Journal, 16*(10), 869-886.

Kanoma, A., Muhammad, I., Abdullahi, S., Shehu, K., Maishanu, H., & Isah, A. (2014). Qualitative and Quantitative Phytochemical Screening of Cola Nuts (*Cola nitida* And C*ola acuminata*). *J Biol Agr Health, 4*(5), 89-97.

Keay, R. (1958). *Trees of Nigeria*. New York:: Clarendon Press

Kiple, K., & Ornelas, K. (2000). *Cola nuts. In The Cambridge World History of Food*. New York, NY.: Cambridge University Press.

Lacmata, S., Kuete, V., Dzoyem, J., Tankeo, S., Teke, G., Kuiate, J., & Pages, J. (2012). Antibacterial Activities of Selected Cameroonian Plants and Their Synergistic Effects with Antibiotics against Bacteria Expressing MDR Phenotypes. *Evidence-Based Complementary and Alternative Medecine, 2012*, 1-11.

Leakey, R., Tchoundjeu, Z., Schreckenberg, K., Shackleton, S., & Shackleton, C. (2005). Agroforestry Tree Products (AFTPs): Targeting Poverty Reduction and Enhanced Livelihoods. *International Journal of Agricultural Sustainability, 16*, 5-16.

N'Guessan, K., Kadja, B., Zirihi, G., Traoré, D., & Aké-Assi, L. (2009). Screening phytochimique de quelques plantes médicinales ivoiriennes utilisées en pays Krobou (Agboville, Côte-d'Ivoire). *Sciences & Nature 6*(1), 1-15.

Ojo, S., & Ehinmowo, O. (2010). Economic Analysis of Kola-nut Production in Nigeria. *J Soc Sci, 22*(1), 1-5.

Oladele, A., & Adewunmi, C. (2008). Medicinal plants used in the management of malaria among the traditional medicine practitioners (tmp's)

in south western Nigeria. *African Journal of Infectious Diseases, 2*(1), 51-59.
Oladokun, M. (1982). *Morpho-physiological aspect of germination, rooting and seedling growth in kola.* . thesis PhD Unuverisy of Ibadan Nigeria.
Oludemokun, A. (1982). Processing, storage and utilization of kolanuts, *Cola nitida* and *Cola acuminata*. *Tropical Sciences, 24*(2), 111-117.
Oluyole, K., Adebiyi, S., & Fagbami, O. (2009). Economic analysis of kolanut production in osun state, Nigeria. *Int. J. Sustain. Crop Prod., 4*(3), 12-15.
Opeke, L. (1992). *Tropical Tree Crops*. Ilorin, Nigeria: Woye & Sons (Nig.) Ltd.
Purseglove, J. (1968). *Tropical crops: Dicotyledons.* (Vol. 2). London: Longmans Green & Co Ltd:.
Rätsch, C. (2005). *The Encyclopedia of Psychoactive Plants. Ethnopharmacology and Its Applications*. USA: Park Street Press.
Saeed, M., Arssad, M., Ahmad, E., & Ishaque, M. (2004). Ethnophytotherapies for the treatment of various diseases by the local people of selected areas of N. W. F. P. *Pakistan Journal of Biological Sciences, 7*, 104-1108.
Sonibare, M., Soladoye, M., Esan, O., & Sonibare, O. (2009). Phytochemical and antimicrobial studies of four species of Cola schott & endl. (sterculiaceae). . *African Journal of Traditional Complémentay and Alternative Medicine, 6*(4), 518-525.
Town, P. (1967). *Studies on fruitfulness in Cola nitida.* M. Phil Thesis, University of Reading U.K.
www.theplantlist.org. consult 26 March 2015