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Research Article

TRADITIONAL USES, PHYTOCHEMISTRY AND IN VITRO EVALUATION OF TOXICITY OF *RICINODENDRON HEUDELOTII* (BAILL PIERRE EX HECKEL) LEAVES IN BENIN

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ABSTRACT

The study is carried out in Benin in the municipalities of Kétou and Pobè, involving 156 individuals. Ethnobotanical, phytochemical and toxicological studies have been carried out on *Ricinodendron heudelotii* to evaluate endogenous knowledge on the use of the species in the Nago, Holli and Mahi ethnic groups, to identify the chemical groups characteristic of leave extracts and to evaluate *in vitro* their toxicity.

The target groups know the species with an unequal distribution of knowledge for both ethnic groups and for age and sex categories. The Nago use much more *Ricinodendron heudelotii* for its artisanal properties, the Mahi for its food properties and the Holli for its medicinal properties.

Phytochemistry reveals the great families of chemical groups (alkaloids, flavonoids, etc.) whose number and nature vary according to the provenance. The water-ethanolic extracts of the leaves have a half lethal concentration (LC_{50}) higher than 0.1 mg / mL, and are therefore non-toxic on human cells.

INTRODUCTION

The Plants, by transforming carbon dioxide and water into sugars and dioxygen through photosynthesis, are responsible for feeding and living organisms on Earth. They also provide many medicines, fuels building materials and paper-based products. Their conservation is therefore essential to ensure the continuity of the ecosystem services rendered. But a step that precedes conservation is to know them in order to document the services they render to humanity. Thus, many woody plants, *Prosopis africana* (Houetchegnon *et al.*, 2015), *Milicia excelsa* (Ouinsavi et al., 2006) and *Parkia biglobosa* (Koura *et al.*, 2011) have been valorised thanks to their ecological, ethnobotanical and economic characteristics. Until now, many african oilseeds are still under exploited and their potential ignored. However, the valuation of these unconventional oilseeds could contribute significantly to poverty reduction. Among the many forest species, most of the annual crops, which have not yet been documented at all in Benin, are *Ricinodendron heudelotii* (Baill, Ex. Heckel). It is a diploid forest species belonging to (Pieraerts, 1917, Tshiamala-Tshibangu & Ndjigba, 1999, Vivien and Faure, 1985) and endemic to tropical humid tropics (Plenderleith, 1997). It is found in tropical Africa, from Guinea to Angola, to East Africa (Vivien and Faure, 1996) and Madagascar (Heim, Guarrigue and Husson, 1919). *Ricinodendron heudelotii* is most prized for its high-grade seeds oil, 49.25% to 63.18% (Fondoun *et al.*, 1999, Kapseu and Tchiegang, 1995, Mbofung*et al.*, 1994, Pieraerts, 1917). Its aromatic almonds are used in Côte d'Ivoire and Cameroon to thicken sauces (Ake-Assi 1991, Fondoun *et al.*, 1999) and are used in many african dishes as spices (Leakey, 1999, Mosso *et al.*, 1997). Tshiamala-Tshibangu and Ndjigba, 1999). Its highly edible oil used in the manufacture of soaps and pharmaceutical preparations (Okafor and Lamb, 1992, Mapongmetsem and Tchiegang 1996, Latham, 1999) is

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widely marketed locally, regionally and internationally (Sunderland and Obama, 2000) an export cost estimated in 1996 to 778793400 FCFA (Perez, 1999). This socio-economic importance makes this species, which has become very useful for indigenous peoples and farmers, naturally tolerated in agroforestry in Cameroon (Adeola, 1995). In addition, leaves rich in calcium, magnesium and phosphorus (Uzoekwe et al., 2016) produce very fertile litter under the tree, Oyefesobi (1983). Its roots sink deep into the soil and promote better erosion control (soil physical stability), while avoiding competition with the roots of adjacent plants located in the upper layer (Latham, 1999).

The tree, suitable for agriculture or alley cultivation (Okafor and Fernandes 1987; Okafor and Lamb 1992) is associated in Cameroon with cocoa or banana crops that benefit from its shade (Djeugap, 2013). Many medicinal virtues are cited for *R. heudelotii* (abscesses, boils, fever and fungal infections are treated by leaves, Mapongmetsem and Tchiégang, 1996, Laird and Betafor, 1997). Its low-carbohydrate oil is used to feed diabetics (Matig et al., 2006) and to fight cardiovascular disease and atherosclerosis due to its low cholesterol and triglyceride levels (Yeboah et al., 2011). The leaves crushed and applied daily to the skin fight against varicella (Tamo et al., 2016) in Cameroon.

Despite this diversity of uses, Benin has not provided scientific data on the status of the species. This work aims at the characterization of the species on the ethnobotanical, phytochemical and toxicological aspects. The objective is to evaluate the endogenous knowledge of the uses of the organs of the plant, to identify the main chemical groups of the ethanolic and aqueous extracts and their level of toxicity.

MATERIALS AND METHODS

Area of the study

The study was performed in Plateau department located in southeastern Benin in the Guineo-Congolese zone, which is the wettest area in Benin. The annual rainfall varies from 900 mm in the West to 1300 mm in the East, the temperature varies between 24 ° C and 37 ° C; the climate, subequatorial with a bimodal rainfall regime presents four seasons including two rainy seasons and two dry seasons with dominant soil, ferralitic and deep (Adomou, 2005). The ethnobotanical survey was carried out in the municipalities of Ketou and Pobè (Figure 1). For the phytochemical and toxicological analysis, the leaves come from Ketou and the forest reserve of Itchèdè-Toffo in the territory of the area of Pobè and that of Adja-Ouèrè. According to the third census of the population and the habitat (RGPH3, 2002), the department is composed mainly of the majority ethnic groups like the Yoruba and related (67, 7%) and Fon and related (28, 9%). The area of the two zones, Pobè and Kétou is 2,583Km2 with a population of 281,029 inhabitants (RGPH 4, 2013). At the cultural level, the two communes bordering Nigeria, where most of the West African Yoruba community resides, have in common several dances and Yoruba religious ceremonies (Orisha cult), such as the Guelede masks cultural world of UNESCO), the Eguns etc ... (en.wikipedia.org, consulted on 15 July 2017 at 10h 04mn).

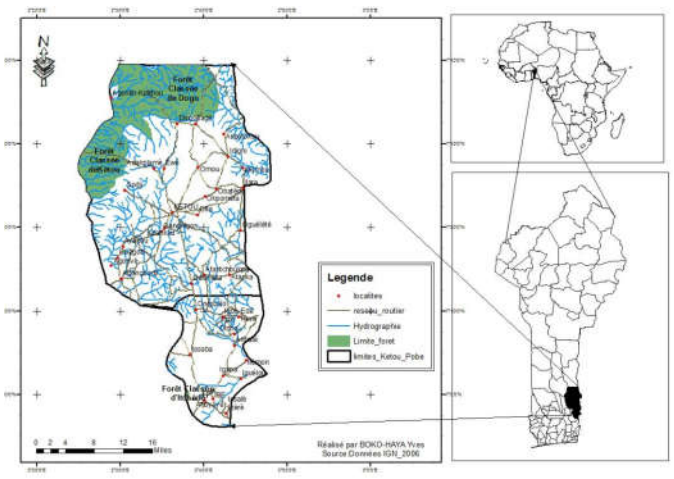

Figure 1 Study area

Sampling method

The area of Pobe was chosen on the basis of the literature (Flore du Benin, 2006), which mentioned the presence here of *Ricinodendron heudelotii* but also in Bassila. In the Bassila commune, our preliminary surveys revealed the absence of this species in the habitat quoted in the flora. However, in Pobè, the species is present with very limited numbers in some forest reserves. The field of study was extended to Ketou by a snowball sampling which proved very positive. In each of these communes, the localities where the species is present were retained, namely four villages or neighborhoods of towns in Kétou (Adaka, Illagbe, Idena and Ofia); the classified forest of Itchèdè-Toffo, the protected area of the Agricultural Research Center on Perennial Plants (CRAPP) and the locality of Akouho, bordering the Ictchèdè-Toffo forest in Pobè. For sampling localities and respondents, a preliminary survey interviewed 75 individuals of both sexes randomly and at the end of which 49% of the interviewees declared that they were using the plant. The size of the survey sample was determined using the Dagnelie formula: $N = u^2_{1-\alpha/2}\, p(1-p)/d^2$ with $u^2_{1-\alpha/2} = (1.96)^2 \approx 4$ (for a normal distribution with α= 0.05) so $N = \frac{4p(1-p)}{d^2}$ where N is the sample size, p is the percentage of individuals with knowledge of the species (p = 0.49), and d the margin of error on the parameters considered is 0.08.Thus, the size of the sample N, calculated with all the parameters elicited, gave156.

Collecting and analysis method of ethnobotanical data

The identification of the respondents was based on the forestry guides and the association of traditional healers in Pobè and on the network of sculptors and the association of traditional healers and some farmers in Kétou. 78 individuals were surveyed in each of these two communes. The ethnobotanical survey itself took place from August to October 2016 on the basis of a semi-structured questions list, elaborated and sent individually to the respondents after having presented them with a sample of the species and this, with the service of one local translator. The data collected concern the endogenous knowledge of the various socio-cultural groups in the study

area on the uses they make of the organs of *Ricinodendron heudelotii*.

The raw data collected from the field was entered into the EXCEL spreadsheet and processed to facilitate statistical analysis. For the age group and sex, in each ethnic group, individuals were grouped into six groups: male youth (JM), female youth (JF), male adults (AM), female adults (AF), old male (VM) and the old female (VF). Young people are those whose age is less than 30 years, adults are between 30 and 60 years of age, and older adults are older than 60 years (Assogbadjo et al., 2008).

For the quantitative analysis, different index (Table 1) were calculated in order to measure the level of knowledge of the respondents on *Ricinodendron heudelotii*. These measures are based on the respondent diversity index (ID) and the respondents' equity index (EI) (Byg and Baslev, 2001, Monteiro *et al.*, 2006).

Table 1 Uses and knowledge clue calculated for *Ricinodendron heudelotii*

Clues	Calculation	Description
Interviewee diversity clue ID = U_x/U_t	ID, Number of use citations by a given informant (U_x) divided by the total number of uses (U_t)	Measures how many interviewees used a given species and how this knowledge is distributed among the interviewees
Interviewee equitability clue IE = ID/ID_{max}	IE, Interviewee diversity value (ID) divided by the highest diversity index value found (IDmax)	Measures the degree of homogeneity of the interviewees' knowledge
Consensual values for uses (CTU) CTU = (TU/*U*t)/*S*	CTU, number of times a given use is reported (TU) divided by the total number of uses (U_t). This value is then divided by the types of use separated within each category (S).	Measures the degree of concordance among interviewees with regard to the uses of a given species

A factorial analysis of the correspondences (AFC) was then carried out the results obtained, transformed into a contingency table to describe the relations existing between forms of use, organs used and sociolinguistic groups on the one hand as well as age categories and sex on the other hand with the software R Gui (version 2.15.3).

Collection and analysis method of phytochemical data

Samples of fresh leaves were harvested from the *R. heudelotii* trees and transported to the laboratory on the same day, where they were dried for about ten to fourteen days in the absence of light in a constant temperature chamber. The dried leaves were then removed and then thoroughly powdered with an electric grinder (*FLOUR MILLS of Nigeria, EL MOTOR No. 1827*) and the ground product was stored for analysis.

Preparation of the crude extracts

2extractssuch as aqueous and ethanolic, were prepared. To do this, 50 g of powder from the leaves of each provenance were dissolved in 500 mL of solvent (distilled water for aqueous extract and ethanol 96 ° for ethanolic extract). The mixture was left in maceration for seventy-two hours (72h) and the macerate obtained is filtered three times successively on hydrophilic cotton.

Phytochemical analysis

The phytochemical screening of the extracts was carried out according to the method used by Houngbeme *et al.* (2014) and Boko-haya *et al.* (2016): the Mayer and Dragendorff tests for alkaloids, the Fehling test for free reducing sugars and glycosides, the Liebermann-Burchardtest for triterpenoids and steroid, Shinoda and sodium hydroxide tests for flavonoids, Ferric chloride test for tannins, Guignard test for free cyanogenic derivatives and Borntrager test for free anthraquinones.

Larval toxicity test

The toxicity test was carried out according to the method used by Houngbeme *et al.* (2015). The eggs of *Artemia salina* are incubated in sea water until hatching of young larvae (48 hours). A stock solution of each of the extracts was prepared by dissolving 200 mg of extract in 4 ml of distilled water to obtain a weight concentration of 50 mg/mL. We then proceeded with ten (10) successive half dilutions (1/2) of the stock solution with seawater. In each of the prepared solution, 16 larvae were introduced. All solutions including the control solutions (containing no active substance) are left under continuous stirring for 24 hours.

Microscopic counting of the number of surviving larvae in each solution made it possible to evaluate the toxicity of the solution. In the case of deaths in the control medium, the data are corrected by the Abbott formula:

%death = [(test – withness)/withness)] x 100

The data of dose-response were transformed by logarithm and the half lethal concentration (LC_{50}) was thus determined by linear regression.

To assess the toxicity level from the LC_{50} values, reference was made to the correspondence table drawn up by Mireille Mousseux in 1995.

RESULTS

Vernacular names of *R. heudelotii*

There is a diversity of the indigenous names of the species according to the ethnic groups (Table 2). This fact proves that the plant is well known by the various sociolinguistic groups.

Table 2 Local names of *Ricinodendron heudelotii* according to different ethnic group

Ethnies	Local names
Nago et Yoruba	egui madou, erimodan, egui guelede
Holli	Akpokpo
Mahi	Akpokpotin

Egui means tree, madou corresponds to a large giant animal found in the savannah once in the geographical area. Some masks are carved from the animal's effigy even though the representations are dominated by feminine images.

Knowledge level of the species

Table 3 presents the values of the diversity (ID) and equity (EI) index calculated for ethnic groups and age and sex categories. With the ethnic groups, the ID values, which are relatively close, show that the users of *Ricinodendron heudelotii* all have practically the same level of knowledge of the species. The IE

values indicate that knowledge about *Ricinodendron heudelotii* is distributed uniformly within the Mahi and Nago. In Holli, knowledge of the species is clearly unevenly distributed and therefore less homogeneous. For the age and sex categories, active men (AM) have more knowledge about the species; they are followed by the old men (VM) and women (AF) then by the old women (VF) having for ID = 0,25 respectively; 0.20 and 0.19. The EI values show homogeneous knowledge in AM and VF (IE = 0.33) on the species.

Table 3 Fairness and diversity clues des of individuals

		ID	IE
		Mean	Mean
Ethnic groups	Holli	0.20±0.12	0.4±0.19
	Nago	0.21±0.13	0.3±0.19
	Mahi	0.19±0.23	0.38±0.19
	Total 1	0.2±0.11	0.36±0.11
Sex and age categories	Female Adult	0.2±0.15	0.38±0.07
	Male Adult	0.25±0.01	0.33±0.08
	Female Young	0.17±0.19	0.33±0.01
	Male Young	0.16±0.12	0.32±0.05
	Female Old	0.19±0.05	0.33±0.03
	Male Old	0.20±0.15	0.40±0.20
	Total 2	0.17±0.18	0.41±0.02

Values and traditional uses of the specie

Table 4 shows the consensus on the use values of Ricinodendron heudelotii. Four interviews were cited by the respondents. Handicraft use comes first (63%), followed by food (36%) and medicinal (31%) and magic (10%).

Table 4 Consensus on use values

Usages	Holli	Nago	Mahi	CTU
Craft work	0,4	0,8	0,65	0,63
Food	0,08	0,2	0,8	0,36
Medicinal	0,45	0,4	0,08	0,31
Magic	0,2	0,11	0,00	0,10

The wood is used in the manufacture of Guèlèdè masks (Photo 1), tam-tams (Photo 2), animal representations and sometimes men (twins) displayed in museums and houses. The sculptors locally called "Ashi" are the holders of this knowledge that can not be learned. According to local tradition, the profession of sculptor is a divine gift and anyone who has not received it can not exercise it even after his apprenticeship. Some sculptors argue that the cut of the plant is preceded by a consultation with the help of "Obi" or cola nuts to know its availability to the cutter may face the cracking of the plant once on the ground with sometimes of large amount of water coming out of the trunk. The wood of R. heudelotii is very light and therefore easy to wear on the head unlike other woods devoted to masks such as *Spondias mombin* and *Asltonia congensis,* heavier. According to these sculptors, the chips obtained after having cut the mask are buried in earth. Moreover, the cutting of the wood cannot start in the presence of a woman but it can pass without stopping during the cut. The tam-tams made from the wood are specially used in the ceremonies of popular rejoicing, the dance "Iwé". A popular song devoted to the plant magnifies its performances in the use of masks by Guèlèdè and stipulates that "even if there are more than 200 vegetal species used in the manufacture of Guèlèdè masks, the wood of *R. heudelotii* remains very exceptional.

Photo 1 Drums made from the wood of *Ricinodendron heudelotii*

Photo 2 Guelede masks made from the wood of *Ricinodendron heudelotii*

The leaves of young plants are consumed regularly by sheep, goats and hinds. As for the fruits (Photo 4), the monkeys take pleasure in eating the fresh mesocarp while leaving the seeds (Photo 3) intact inside. The activity of monkeys thus replaces the laborious labor of depulping made by man. This activity is encouraged since men do not consume the *R. heudelotii* mesocarp.

Photo 3 Crunched fruits and the exposure of *Ricinodendron heudelotii* seeds by monkeys

Photo 4 Seed of *Ricinodendron heudelotii*

The drink of triturated leaves fights against male infertility. The infusion of leaves, combined with other plants fight malaria. The dried bark powder is mixed with the local soap called "side" to wash the body in order to combat asthenia. Bark ash can be lapped or applied to areas of the body that have received the snake or scorpion bite. Heated and crushed roots are used as sponges and are used to wash the body to combat itching. The oil extracted from the seeds treats the infantile fever called "Igbona". The decoction of the bark fights infections of the soles of the feet. The bark associated with a specific number by sex is used to combat obesity; also makes it very light and very practical for athletes.

The spell of witch origin is annihilated by the leaves which are well washed, triturated and drunk.

Preference of plant uses

The results on the numbers of each ethnic group and each age and sex category in the uses of *Ricinodendron heudelotii* are summarized in Table 5.

Table 5 Use number according age and sex categories and ethnic group

Usages	Nago	Mahi	Holli	AF	AM	JM	JF	VM	VF
Médicinal	36	26	10	1	20	1	1	19	5
Alimentaire	25	30	2	0	40	0	0	10	0
Artisanal	100	35	13	5	90	8	1	43	10
Magique	25	10	6	0	10	0	0	10	3

From the analysis of this table, it appears that the different uses are well represented among the ethnic groups but with varying proportions. On the other hand, in terms of age and sex categories, some uses are not represented, while those represented are of varying proportions.

Use of species according to age and sex categories

Figure 2 presents the projection of the uses of R. heudelotii and the age and sex categories in the factorial axis system. The first two axes explain 95.7% of the information and make it possible to better analyze the preferences of the local populations in the uses of *R. heudelotii* according to the age and sex categories.

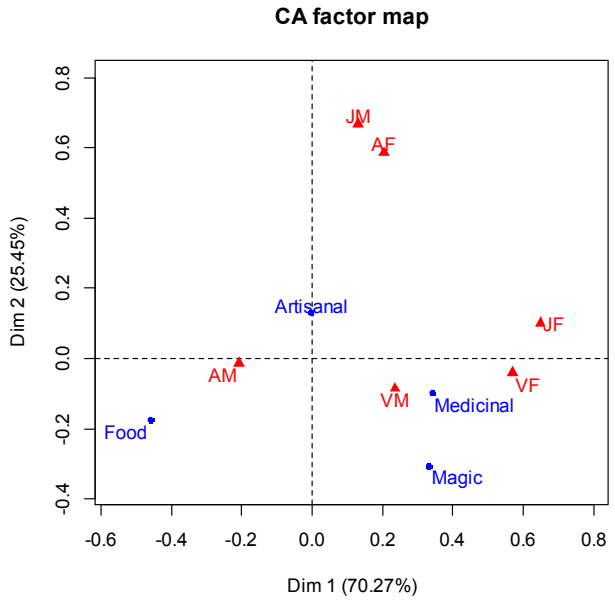

Figure 2 Use preference projection of *Ricinodendron heudelotii according* sex and age categories in the axis system

On axis 1, older people of both sexes have more knowledge about the use of *R. heudelotii* in the treatment of diseases. On the other hand, adult men have more knowledge of the uses of the species as a source of food for animals (axis 1); the majority of these men are hunters, who see in real time monkeys and herbivores consumers. In the same way, adult men are most represented in the manufacture of Guèlèdè masks with the trunk of the *R. heudelotii*, this justifies their strong knowledge on artisanal use unlike adult women and young men (axis 2).

Use of the species according to ethnic group

Figure 3 presents the projection of the uses of *R. heudelotii* by the ethnic groups in the system of factorial axes. Axis 1 explains 80.7% of the information related to the preferences of use of *R. heudelotii* by ethnic groups, whereas axis 2 explains 19.0% of this information, ie a total of 95.6% of the information retained. It can be seen from this figure that on axis 1, the Nago use more *R. heudelotii* for handicraft-related services while the Mahi recognize the use of *R. heudelotii* more in the diet. On axis 2, the Holli use more *R. heudelotii* for its medicinal uses.

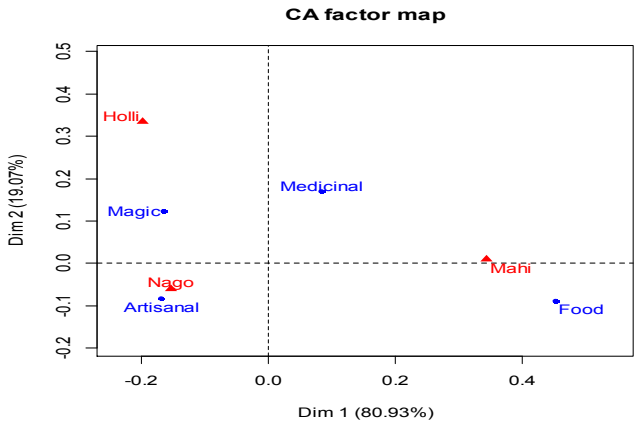

Figure 3 Use preference projection of *Ricinodendron heudelotii* according ethnic group in the axis system

Peasant conservation form of the species

Most interviewees acknowledged that the cut of the species was forbidden by the ancestors, but the last decade was marked by an anarchic cut of certain species that shaded the *Ricinodendron heudelotii*. But since these species disappeared the local populations began by exploiting *Ricinodendron heudelotii* in several forms (firewood, craft, etc.). A single sculptor prunes the plant (Photo 5) to exploit its branches seasonally; the others cut the entire trunk to make the masks.

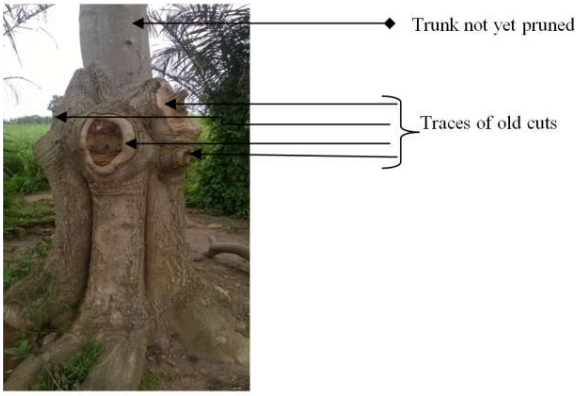

Photo 5 Foot of *R. heudelotii* pruned 4 times periodically.

Plant phytochemical groups

The results of the phytochemical screening are summarized in Table 5. This table shows that the leaves of *Ricinodendron heudelotii* contain various secondary metabolites and varied according to the provenance. The absent compounds are gallic tannins, leuco-anthocyanins, cyanogenic derivatives, triterpenes, steroids, coumarins, quinone derivatives, C and O-heterosides and cardiotonic heterosides.

Whatever the source of the plant, the leaves contain tannins, flavonoids, anthocyanins, alkaloids, reducing compounds and mucilages. One can conclude that these compounds are the most frequent in the leaves of the studied plant. Nevertheless, free anthracenics and saponosides are specific to Ketou leaves. Eight (08) secondary metabolites are present in the leaves of Ketou against six (06) for the leaves of Itchèdè. The number and nature of metabolites varies from one ecological station to another. These secondary metabolites present, which possess various pharmacological properties, in particular anti-edematous, anti-inflammatory, antibacterial, antiviral, antimalarial, cicatrizing, could partially justify the traditional use of the plant against the various pathologies mentioned.

Table 6 Phytochemical composition of *Ricinodendron heudelotii* leaves according to the origin

Chemicals compounds	Results according harvest station	
	Kétou	Itchèdè
Catechism tannins	++	++
Gallic tannins	-	-
Flavonoids	++	++
Anthocyanins	++	++
Leuco anthocyanins	-	-
Alkaloids	++	+
Reducing compounds	++	+
Mucilage	+	++
Saponosides	+	-
Cyanogenic derivatives	-	-
Triterpene	-	-
Steroid	-	-
Coumarin	-	-
Quinone derivatives	-	-
Anthracenics free	+	-
C -heteroside	-	-
O -heteroside	-	-
Cardiotonic derivatives	-	-
Total	8*	7*

*NB: +: positive test; ++: positive highly test; - : négative test; *: Plant number containing a chemical group*

Cytotoxicity activity

The results of the leaf toxicity, evaluated by the sensitivity of larvae of *Artemia salina*, are shown in figures 4 and 5. The LC_{50} of the testedextracts are greater than 100 µg / mL; therefore, these extracts of the *Ricinodendron* plant have not any safety on the shrimp larvae and can be considernot toxic on the above-mentioned human cells, whatever the zone of origin (1 and 2). These extracts are therefore tolerant to shrimp larvae.

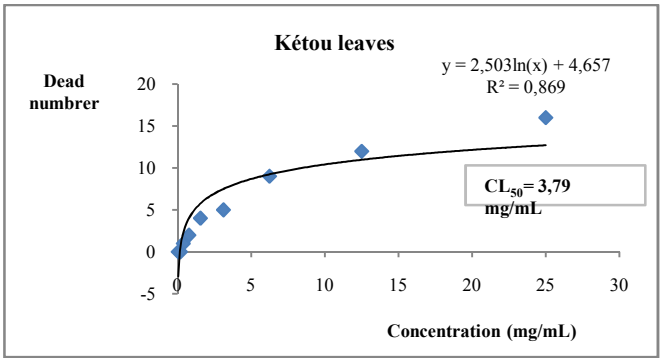

Figure 4 Hydro-ethanolic extract larvae sensitivity curve of Ketou leaves

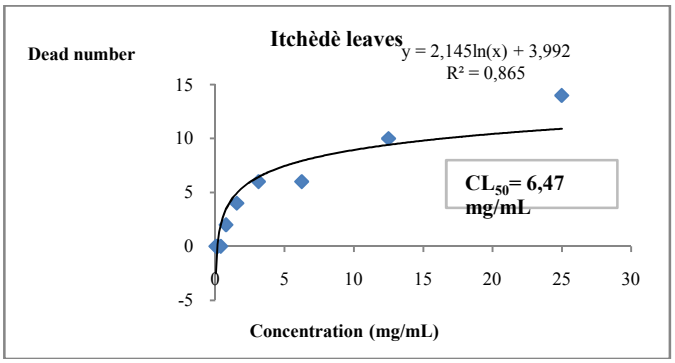

Figure 5 Hydro-ethanolic extract larvae sensitivity curve of Ichèdè leaves

DISCUSSION

Endogenous knowledge of Ricinodendron heudelotii

The organs of *R. heudelotii* are used by Beninese populations for several uses such as animal food, medicinal, spiritual, artisanal. These numerous uses of *R. heudelotii* prove that the species has a social importance for the local populations. These results are similar to those obtained by Schumann *et al.* (2012) on the baobab. Among the uses, the artisanal is predominant (63%) because the plant serves very effectively in the making of masks of Guelede and drums. This practice is confirmed by several authors, Kayode *et al.*, (2016); Vroh *et al.*, (2014) and Dechamps (1970, 1974, 1975) for whom 65-70% of masks in the Democratic Republic of Congo are made from only *Ricinodendron heudelotii* wood.

The medico-magical uses are also important (41%). Most of the diseases cited are already listed in the literature. Bark appears as the main organ used for the treatment of diseases. The decoctus of the bark is used to treat ovarian cysts (Ngene, 2015), obstetric fistulas (Lagou, 2016), hemorrhoids (Dibong, 2015); kidney problems, sores and muscle pain (Nole, 2016); it has a purgative effect (N'guessan, 2009) and facilitates childbirth in association with *Ehretia cymosa* (Nguessan, 2010). It has been shown that the decoction of the bark also intervenes in the treatment of plantar infections, which is close to the results of Ngene (2015) which showed that the decoction of the bark intervenes in the treatment of the infections. The use of bark in association with other plants in the fight against obesity has not been implicitly mentioned in the literature; it is the same for the use of the roots crushed as a vegetable sponge and in the fight against the itching. Similarly, asthenia is treated by the dried bark added to the local soap called "Coto"; this same recipe is also used in the treatment of bites of venomous

origin. The oil extracted from the seeds, in skin massage is effective against infantile fever and seems close to the work of Laird *et al.* (1997) with the difference that the powdered seeds are mixed with palm oil. As for the leaves, their use in the treatment of male infertility as well as that of malaria in association with other plants were mentioned for the first time in this study; enriching the recipes on the uses of *R. heudelotii.*

For the food use (36%), with the exception of fruit consumption by monkeys and leaves by some ruminants (sheep, goats and antelopes), no respondents cited the consumption of oil or seeds as sauce condiments for humans. All interviewees except one (1) do not know that the seeds contain edible oil or can thicken sauces; yet this use is the most predominant of the species, which gives it great economic value and also contributes to combating undernutrition in other producing countries (Cameroon, Côte d'Ivoire, etc.). This under-exploitation of the species can contribute significantly to its genetic erosion in Benin due to the lack of knowledge of the market value of the seeds. Better still, the predominant artisanal use due to growing demand from cultural consumers (Guelèdé has since 2001 become UNESCO's intangible heritage) also reinforces the loss of genetic diversity and contributes to the state's vulnerability, species.

Phytochemical screening and toxicity of R. heudelotii leaves

The presence of alkaloids confirms the strong prescription of leaf decoction in the treatment of malaria (Okwu *et al.*, 2006). Several other authors have confirmed this antimalarial activity of alkaloids (Malgras, 1992; Ntiejumokwu*et al.*, 1990).

These same alkaloids would justify the gastrointestinal anti-spasm effects (Nacoulma, 1996). It has been reported that tannins exhibit low antibacterial activity and anti-hypertensive, antiviral, (Kolodzeiej et al., 1999, Bruneton, 1999). One can thus understand the use of the plant by the respondents in cases of diarrhea, fevers. The total absence of cardiotonic heterosides greatly reduces the toxicological risks associated with the use of *Ricinodendron heudelotii*. These results corroborate those of Badiaga (2011) and Kaboré et al (1995) on *N. latifolia* (Smith). The use of Ricinodendron heudelotii in the treatment of itching by local populations is linked to the presence of coumarin, known for its anti-edematous properties. These results are similar to the ones of Bruneton (2009).

For toxicity, *Ricinodendron heudelotii* leaves are non-toxic, regardless of provenance, as all the extracts (ethanolic and aqueous) tested have an LC_{50} greater than 0.1 mg / mL (limit of toxicity) according to Mireille Mousseux (1995). The uses of fruits are therefore not subject to intoxication of the organism of consuming animals but also of that of man.

CONCLUSION

Ricinodendron heudelotii is a well-known plant of the Beninese populations located in the South which make four (04) different categories of uses: medicinal, magic, food and artisanal because of its richness of active ingredients and its harmlessness on the one hand and the lightness of its wood on the other hand. However, it remains underused as the seeds that are rich in edible oil remains unknown to most populations. It should be noted that the plant can be an alternative solution in the fight against some diseases and contribute greatly for the reduction of poverty. It must be valued through the production of information and scientific data relating to its ecology, production and management.

Conflict of interest
The authors declare they have no conflict of interest

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