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Endogenous knowledge and ethnobotanical importance of *Treculia africana* Decne. ssp. var. *africana* in southern Benin (West Africa)

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Key words: *Treculia africana,* Forms of use, Use value, Organs, Ethnic groups

Abstract

Treculia africana Decne. is an important food fruit tree encountered in several tropical forests, knowledge of which is being lost in Benin. This study aims to assess the ethnobotanical knowledge of populations living near the forests of southern Benin on the use of *T. africana* while assessing the distribution of its knowledge within ethnic and religious groups. To achieve this, 339 respondents, randomly chosen according to a "step", were interviewed in all five localities of the study area (Lokoli, Niaouli 1, Niaouli 2, Itchèdè and Toffo). Relative citation frequencies (FRC, %) were calculated to describe the socio-demographic characteristics of the respondents. The knowledge of local populations and their relationship with the species were determined by calculating four indices, namely the consensus value for the parts of the plant (CPP), the value of the diversity of uses (UD), the value of fairness of use (UE) and consensual value for forms of use (CMU). These data were subjected to PCA, CFA and a generalized linear model (GLM) with fish family and extension. In total, 12 forms of use categorized into seven types of use were reported. The categories of food, medicinal, fodder, medico-magical, wood and energy use are the most cited. The seeds of the species are the organs most used in food; the bark, root, leaves and oil are used to treat various ailments. Knowledge and use values (total, food, medicinal) of the species vary significantly ($p<0.05$) between ethnic and religious groups. The Nagot ethnic group as well as the endogenous has a better knowledge of the species compared to other ethnic groups and religions. The reported popular uses offer perspectives for the valuation of the species.

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Introduction

Forests, especially tropical rainforests in developing countries, are the earth's reservoir of bioresources (Tchoundjeu *et al*., 2005) which host between 60 and 90 % of the total number of plants on earth (Rogas, 2006). Their contribution to food security and the health of the population becomes quite evident (Fandohan *et al*., 2011). Communities residing in villages and near forests depend primarily on plants and plant products for their income and livelihoods as they have a specific right over forests and their products (Rajesh and Nair, 2018). The Convention on Biological Diversity (CBD) signed in June 1992 in Rio de Janeiro (Brazil) generating the commitment of all the States of the world to sustainably safeguard the environment and biodiversity, has favored the sustained attention enjoyed by the Products, Non-timber forest (NTFP). In Benin, several authors (Gouwakinnou, 2011; Délèké Koko *et al*., 2011; Djègo *et al*., 2011; Lougbegnon *et al*., 2012) have highlighted the key role of Non-Timber Forest Products (NTFPs), especially plant origin for the populations. Indeed, the exploitation of these products contributes directly to the nutritional well-being of the populations, but also constitutes an important source of income used for the purchase of basic necessities, especially during the lean periods (Freiberger *et al*., 1998; Sene, 2018). However, the dependence of societies, especially rural ones, on these forest resources can pose a threat to the balance of ecosystems (Kalinganire *et al*., 2008; Fandohan *et al*., 2017). Preventing the disappearance of these resources requires taking social considerations into account in conservation and sustainable management strategies for forest species (Ganka *et al*., 2022).

Treculia africana, from the Moraceae family, is an economically important but often neglected and underexploited tropical fruit tree native to many tropical countries such as Ghana, Sierra Leone, Nigeria, West Indies and Benin (Akoègninou *et al*., 2006; Dickens , 2013). Seeds of *Treculia africana* are cooked in different ways as lentil or roasted and sold with palm (Enibe *et al.,* 2013). *Treculia africana* seed flours are used in a variety of foods such as porridges, pastries and weaning foods (Nwokocha and Ugbomoika, 2008). Among the Igbo people of Nigeria, the seeds of *Treculia africana* have been recognized as the food of choice for royalty which is specially served to celebrity when performing social obligations like marriage and traditional festivals (Amujiri *et al*., 2018). Apart from food, various authors have reported that the seeds of *Treculia africana* are very nutritious and are a source of vitamins, minerals, proteins, carbohydrates and lipids (Nnorom *et al*., 2015; Jonathan *et al*., 2016; Nwabueze *et al*., 2018; Okonkwo *et al*., 2020). *Treculia africana* is a highly valued economic plant as well as a medicinal plant widely used in herbal medicine.

The aqueous ethanol extract of the bark is very effective in vitro on gastrointestinal pathogenic bacteria (Ogbonnia *et al*., 2008). The biochemical work carried out by Ajayi *et al*. (2017) showed that the crude extract of *Treculia africana* leaves contains apigenin-6-C-glucopyranoside and 2,3-dihydrokaempherol-3-O-glucopyranoside which exhibit strong antioxidant activities which could justify its use in traditional medicine for the management of diseases related to oxidative stress.

However, the species faces a high rate of deforestation as with other setbacks experienced by native food plants due to lack of attention from people (Amujiri, 2016). This situation is also observed in Benin to such an extent that it is classified on the list of endangered species in Benin (Adomou, 2005). Knowledge of local populations of forest species is essential for safeguarding resources (Pinton and Grenand, 2007). Indeed, this knowledge makes it possible to understand the social, cultural and economic values that these communities associate with indigenous resources (Pilgrim et *al*., 2008).

Many studies explored traditional knowledge on the dietary, socio-economic, cultural and medicinal aspects of *Treculia africana* (Enibe, 2007; Uluocha *et al*., 2016; Ajayi *et al.,* 2017; Amujiri *et al*., 2018). Nevertheless, there is a lack of information on ethno-

food and medicinal knowledge on this species in Benin. Therefore, this research aims to document the ethno-food and medicinal knowledge related to *Treculia africana* in Benin. Specifically, the study aims to (i) identify the forms and use values of *Treculia africana* organs and (ii) assess the influence of socio-demographic factors (ethnicity, religion, age, sex) on the use values of the species.

Materials and methods

Study environment

This study was carried out in three municipalities in southern Benin (Allada, Zogbodomè, and Adja-ouèrè) and in particular in the villages of Niaouli I and II, Lokoli, Toffo, and Itchèdê (Fig. 1). The municipality of Allada is in the agro-ecological zone 6 (ZAE 6) then the municipalities of Zogbodomè and Adja-ouèrè are in the Agro-ecological zone (ZAE 7) PANA-BENIN (2008). Agro-ecological zone 6 or the "Terre de barre" zone is characterized by a subequatorial climate with two rainy seasons. The average annual rainfall varies between 800 and 1200 mm in its western part and between 1000 and 1400 mm in its eastern part. The relative humidity varies from 55 to 95%. The average annual temperature is 26.5°C. The soils of this agro-ecological zone are bar soils or ferrallitic soils on the continental terminal.

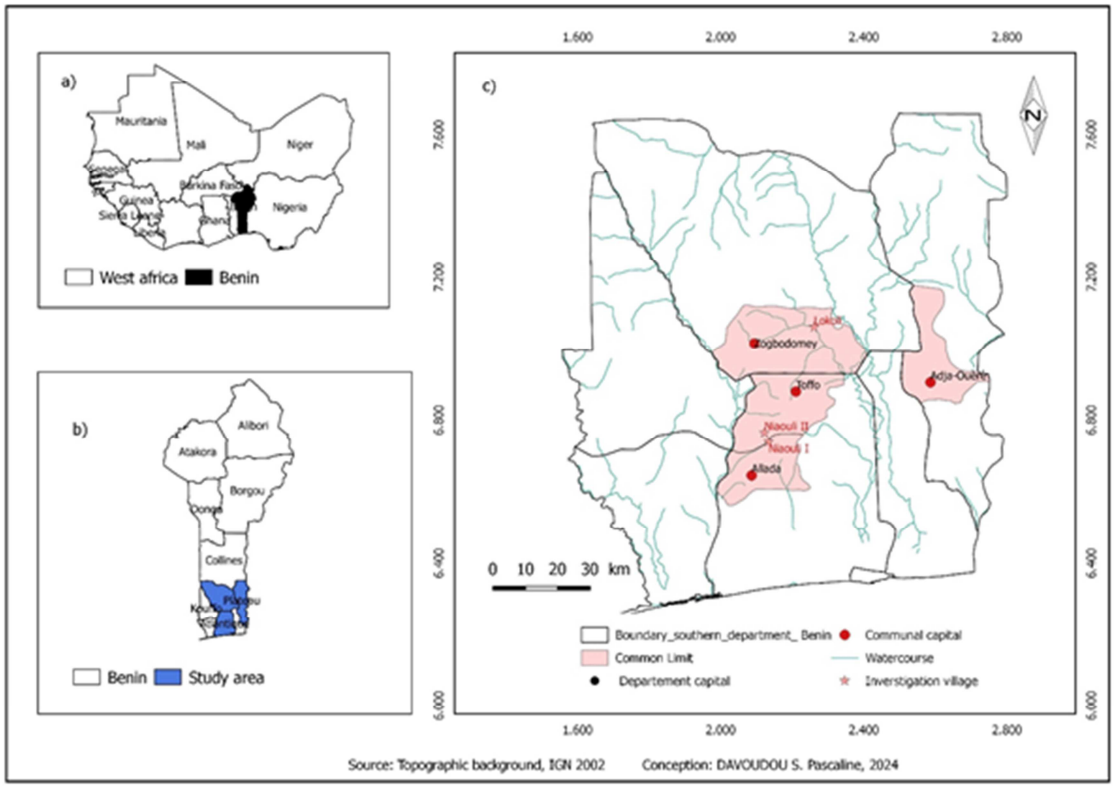

Fig. 1. Maps of Benin and the communes and villages surveyed

Agroecological zone 7 or depression zone is characterized by a subequatorial type climate with two rainy seasons with an annual rainfall between 800 and 1200 mm in the western part (Lalo), 1000 1300 mm in the eastern part (Pobè). The relative humidity is considerable (about 85%). The temperature differences are small. There are two types of soil: tropical ferruginous soils and vertisols or black earths.

Two reasons underpinned the choice of these municipalities; the first is the presence of the species in the study area, the second is the frequent use of the species by the ethnic groups bordering the forests of Niaouli, Lokoli and itchèdê-toffo.

Sampling methods and data collection

Preliminary surveys were carried out on 200 people in the three communes, in particular in the localities

of Lokoli, Niaouli 1, Niaouli 2, Itchèdè and Toffo on the use of the species.

Indeed, a sample of 40 people per locality made it possible to obtain the proportion of knowledge of the species p= 0.33. Then the sample size was determined using the binomial approximation of Dagnelie (1998) as follows:

Let N be the sample size across all localities (Eq.1)

$[(U_{1-\frac{\alpha}{2}})^2 \times p(1-p)]/d^2$ where N = sample size; $U_{1-\frac{\alpha}{2}}$ is the value of the reduced normal variable for a probability value α = 0.05; $U_{1-\frac{\alpha}{2}}$= 1.96; p is the proportion of individuals who know the species (p therefore varies from one collection location to another and is equal to the ratio between the number of individuals who know the species and the number of pre-surveyed individuals (Dagnelie, 1998); d is the marginal error fixed at 0.05, with p=0.33 we have: N= 339.

Finally, the sampling "step" was calculated for each locality, which is equal to the total number of households in the locality provided by data from the National Institute of Statistics and Economic Analysis (INSAE) divided by the number of individuals to be surveyed in the locality. The choice of households was therefore based on the “skip to” obtained.

Table 1. Summary of sampling results

Localities	Number of households according to INSAE	Weight of households in a locality in all localities	Number to be surveyed per locality	Sampling skip
TOFFO	263	0.13	44	6
ITCHEDE	84	0.04	14	6
NIAOULI 1	334	0.16	54	6
NIAOULI 2	422	0.21	71	6
LOKOLI	932	0.46	156	6
TOTAL	2035	1	339	

Table 1 presents the results after calculation, in particular the number of households according to INSAE, the weight of households calculated in all the localities, the number of individuals to be surveyed and the sampling "step".

The administration of the questionnaire was each time preceded by the presentation of a sample of seeds of *Treculia africana* to ensure that the species is known by the respondent.

Statistical analysis of data

The calculated parameters are the relative citation frequencies (RFC, %), the knowledge of local populations about *Treculia africana* and their relationship with the species.

The relative citation frequencies (RFC, %) were calculated to describe the socio-demographic characteristics of the respondents and then to assess knowledge of the total, food and medicinal, medico-magical, wood and energy, worship and fodder uses of *Treculia africana Decne. var. africana* according to ethnic group and age category.

$$RFC = \frac{FC}{N} \times 100 \quad \text{(Eq. 2)}$$

With FC, the number of respondents who mentioned a given specific use and N, the total number of respondents.

The knowledge of local populations on *Treculia africana* and their relationship with the species were determined through the calculation of four indices. These are:

1. the consensus value for the parts of the plant (CPP),
2. the value of the diversity of uses (DU),
3. the value of equitable uses (EU), and
4. the consensus value for the forms of use (CMU).

These indices indicate the way in which the species is used as well as the distribution of knowledge of these uses among the interviewees.

The CPP measures the degree of consensus between the interviewees on the parts of the *Treculia africana* plant used (Monteiro *et al.*, 2006). It was calculated by the following formula:

$$CPP = \frac{Px}{Pt}$$

with Px the number of times a given part of the plant is cited and Pt the total number of citations for all parts.

The UD measures the importance of use categories and how they contribute to the total value of uses. It was calculated using the formula below (Byg and Baselev, 2001):

$$UD = \frac{Ucx}{Uct}$$

where Ucx is the number of indications listed per category and Uct the total number of indications for all categories.

The UE measures the degree of homogeneity of knowledge of the categories of use (Byg and Baslev, 2001). It was calculated as follows:

$$UE = \frac{UD}{UDmax}$$

with UD the value of the diversity of uses and $UDmax$ maximum value

The CMU Measures the degree of consensus among the interviewees on the forms of use of *Treculia africana* (Monteiro *et al.*, 2006). Its formula is as follows:

$$CMU = \frac{Mx}{Mt}$$

where Mx is the number of citations for a given form of use and Mt the total number of citations for all forms.

A principal component analysis (PCA) in the FactoMineR package (Husson *et al.*, 2008) was performed to describe the links between consensus values for parties and socio-cultural groups. Similarly, a principal component analysis (PCA) was carried out to describe the links between the consensual value for the forms of use of the plant and the socio-cultural groups on the one hand. And on the other hand, a factorial correspondence analysis (FCA) in the FactoMineR package (Husson *et al.,* 2008) was carried out to describe the links between plant organs and use categories.

The use value (total) and by category of use (food and medicinal) was calculated according to the socio-demographic characteristics of the respondents according to the approach of Gomez-Beloz (2002). A generalized linear model (GLM) with family and Poisson extension was used to study the effect of the socio-demographic characteristics (ethnic group, age category, gender, marital status and religion) of the respondents on the use values in the MASS (Venables and Ripley, 2002) and pscl (Jackman, 2020) packages. The overall model was simplified after testing all specific models. The best model was selected using the "Akaike Information Criterion" (AIC) (model with the lowest AIC value). Once a significant difference was identified, the student-Newman-Keuls (SNK) post-hoc test was performed to highlight differences in socio-economic factors with respect to values of use at 5% (level of probability).

Results

The collected data is structured in three parts. The first part relates to the characteristics of the respondent, in particular sex, ethnic group, age, main activity, level of education and religious group to which they belong, and marital status (Table 2).

Table 2. Socio-demographic characteristics (relative frequencies, %) of respondents

Socio characteristic	Modality	Proportion (%)
Locality	ITCHEDE	4.42
	LOKOLI	47.2
	NIAOLLI 1	13.27
	NIAOLLI 2	23.89
	TOFFO	11.21
Age category	Adult (30-59 years)	46.61
	Young (<30 year)	43.66
	Old (>60 years)	9.73
Sex	Female	41
	Male	59
Instruction level	None	59
	Primary	23.01
	Secondary	15.63
	University	2.36
Ethnicity	Aïzo	35.1
	Fon	60.18
	Nagot	4.72

Marital status	Single	24.48
	Divorcy	0.59
	Maried	74.93
Residence state	Alotochtone	3.83
	Autochtone	96.17
Main activity	Agriculture	73.45
	Trade	12.68
	Breeding	8.85
	Formal employee	5.01
Religion	Christianism	94.1
	Endogenous	4.42
	Islam	1.47

The second part relates to the local names of the species and their frequency of use as well as the different organs of the species used the forms of use and the diseases treated. The third part deals with the different categories of uses of the species. For the purposes of the analysis, the respondents were divided according to age (young <30 years old; adults, 30-59 years old and old >60 years old) (Assogbadjo *et al.*, 2008).

Local names and frequency of use of Treculia africana

The names used by respondents in the study area to designate *Treculia africana* vary according to the ethnic groups encountered (Table 3). The species is moderately used among the Nagot and Aïzo (frequency greater than 50 %), but weakly used among the Fon (53%); adults and old people use the species with an average frequency more than young people (Table 4).

Table 3. Local name

Ethnicty	Appellation
Aïzo, Fon	Azongbo- Agbli-gbli
Nagot	Igui Affon, Afan

Table 4. Frequency of use

Socio-economic characteristic		Use frequency (%)		
		Weak	Medium	Strong
Ethnicity	Aïzo	35.29	52.94	11.76
	Fon	53.33	26.67	20
	Nagot	14.29	71.43	14.29
Age category	Young	50	33.33	16.67
	Adult	31.82	50	18.18
	Old	45.45	45.45	9.09

Categories of use of control organs of Treculia africana

Several organs of *Treculia africana* are used daily by the different ethnic groups in the study area for various uses, namely: the fruit (Fig. 2), the seed (Fig. 3), the bark, the leaves, the roots, the sap, hulls and young stems. These organs are grouped into seven categories of uses: fodder (85%), medico-magical (55%), wood and energy (32.5%), food (30%), medicinal (17.5%), religious (15%) and vegetable brush (7.5%). The proportions of these categories of uses of *Treculia africana* vary according to the organs of the plant (Table 5).

Table 5. Category of use of Treculia africana in South-Benin

Use categories	FRC (%)	Observation	Organ used
Food	30	Cooking ; oil extraction; use to season the sauce	Seed
Medicinal	17.5	Treatment of diseases and symptoms	Leaf, Root, Bark, sap, Flower
Fodder	85	Feeding snail turtles and sheep	Pod integument, fruit, seed
Medico magic	55	Bewitchment	Fruit
Worship	15	spiritual use	Fruit, leaf
Vegetable brush	7.5	Used as a toothpick	young stems
Wood and Energy	32.5	Used as firewood and charcoal	young stems

Fig. 2. Fruit of *Treculia africana*

Fig. 3. Seeds of *Treculia africana*

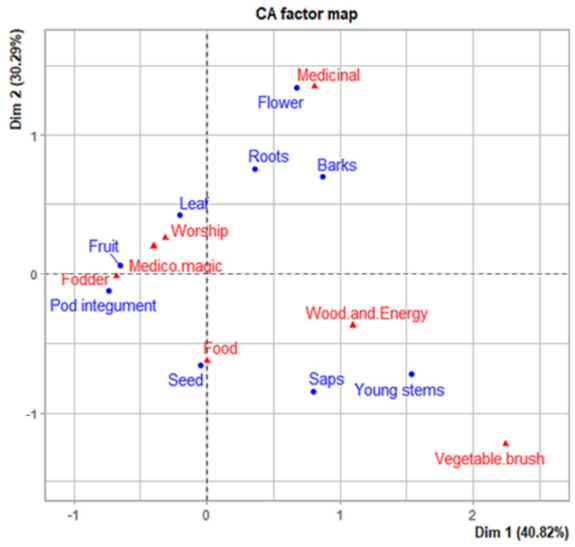

Fig. 4. AFC biplot of plant's organ and use categories

Fig. 4 shows the projection of the organs and categories of use in the factorial plan at the end of the Factorial Correspondence Analysis (FCA). The results indicate that the first two axes explain 71 % of the total information; which guarantees good precision in the interpretations. The seeds of the plant are mainly used as food. The barks, roots and flowers are used in the medicinal field while the fruit and the shells are used as fodder and also in medico-magic. The young stems are used as a vegetable brush and also as wood and energy. The leaves are used in cultic and medico-magical uses (Fig. 4).

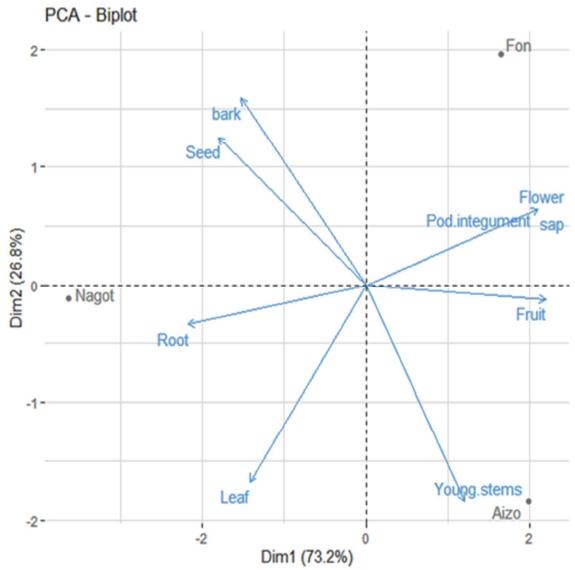

Fig. 5. Biplot of plant organs and ethnic group

Relationship between ethnic groups and organs of Treculia africana

The results of the Principal Component Analysis (PCA) of the consensus values for the organs of *Treculia africana* and the ethnic groups surveyed show that 100 % of the information was explained by the first two components (Fig. 5). The Nagots in the use of *Treculia africana* give more importance to the seeds, roots and bark, while the Aizo give less importance to these organs. The Fon attach more importance to fruits, saps, flowers and shells while the Aizo use more young stems and leaves.

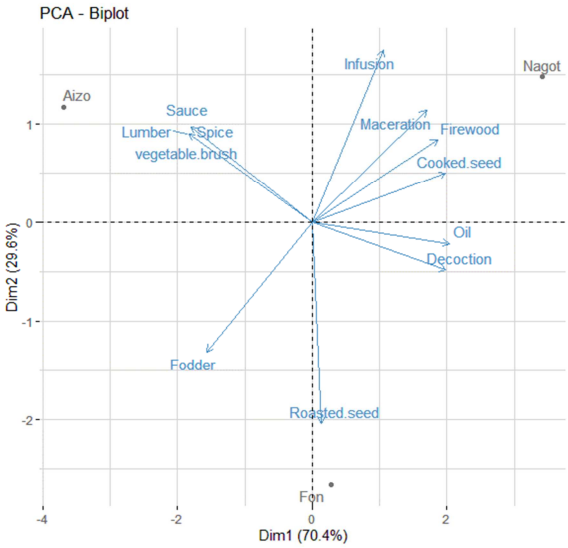

Fig. 6. Biplot of use form and ethnic group

Forms of use of Treculia africana

The ethnic groups in the study area use the organs of *Treculia africana* in twelve (12) forms: oil extraction, cooked seed, roasted seed, sauce, spice, fodder, vegetable brush, maceration, decoction infusion, firewood/charcoal, structural wood. The results of the Principal Component Analysis of the consensus values for the forms of use of *Treculia africana* show that 100% of the information was explained by the first two axes (Fig. 6). In the figure, the Nagot use the organs of *Treculia africana* in the form of oil, cooked seed, maceration, decoction infusion and firewood/charcoal. The Aizo use the organs of *Treculia africana* in the form of sauce, vegetable brush, spice and timber. The Fon use the organs of *Treculia africana* in the form of fodder and roasted seed.

Table 6. Influence of sociodemographic factors on the use value of *Treculia africana* (Result of GLM)

Social characteristic	Total use value			Food use value			Medicinal use value		
	Estimate	Standard error	P value	Estimate	Standard error	P value	Estimate	Standard error	P value
Ethnicity Reference: Aizo	-	-	-	-	-	-	-	-	-
Ethnicity: Fon	0.103	0.172	0.555	0.454	0.650	0.490	1.318	0.862	0.137
Ethnicity: Nagot	0.519	0.190	0.011	1.832	0.656	0.009	2.611	0.889	0.007
Sex Reference: Man	-	-	-	-	-	-	-	-	-
Sex: Woman	0.057	0.174	0.744	0.764	0.623	0.230	0.875	0.644	0.185
Age category Reference: Adult	-	-	-	-	-	-	-	-	-
Age category: Old	-0.643	0.203	0.004	-1.413	0.952	0.149	-0.911	0.843	0.289
Age category: Young	0.077	0.225	0.734	0.937	0.758	0.227	0.285	0.940	0.764
Marital status Reference: Married	-	-	-	-	-	-	-	-	-
Marital status: Sigle	-0.342	0.350	0.337	-0.398	1.424	0.782	-17.177	5940.838	0.998
Main activity Reference: Agriculture	-	-	-	-	-	-	-	-	-
Main activity: Formal employee	-0.020	0.332	0.953	0.148	1.352	0.913	-16.527	5773.165	0.998
Main activity: Trade	0.077	0.310	0.806	-0.464	1.218	0.706	-19.524	4892.811	0.997
Religion Reference: Christianism	-	-	-	-	-	-	-	-	-
Religion: Endog	0.585	0.174	0.002	1.871	0.544	0.002	1.702	0.569	0.006
Religion: Islam	0.323	0.564	0.571	-14.316	3609.502	0.997	-17.304	11624.134	0.999

Modes of use of the organs of Treculia africana

The seeds of *Treculia africana* are prepared and seasoned to be eaten with bread or "gari". These same roasted seeds are shelled then crushed and put in the sauce. The oil extracted from the seeds is used in the preparation of various dishes. *Treculia africana* is used alone or with other species (*Pentaclethra macrophylla, Parkia biglobosa*) and/or with certain products to treat diseases/symptoms. The sap accelerates the closure of the fontanelle in newborns. The liquid is applied to the split part. Similarly, the bark boiled with potash is filtered and mixed with peak milk to cure severe anemia. Boiled bark of *Treculia africana* and *Pentaclethra macrophylla* cure kwashikor. Boiled *Treculia africana* leaf combined with its bark cures typhoid fever. The bark of *Treculia africana* with its root fights against sticky, black and other menstruation in women. The bark of *Treculia africana* is soaked in “sodabi” alcohol or in water to obtain a solution to fight against sexual weakness and develops the penis. One to two drops of the oil extracted from the seeds of *Treculia africana* (Fig. 7) in a person's ear is very effective in curing earache. You can also pass the oil on the outer parts of the skin against itching, fungal infections and fever.

The fruit of the species is used as a snail trap. Ripe fruit is cut and laid in damp places as bait. The smell of ripe fruit attracts snails. Also the raw seeds of the species are given to snails, turtles and sheep in breeding.

Fig. 7. Oil extracted from the seeds of *Treculia africana (*Source: Prise de vue Davoudou, 2024)

Young stems and young branches are used as toothpicks. This form of use also poses a great threat to the regeneration of the species and may lead to the extinction of the species.

Use value in relation to the socio-demographic profile of informants

Table 6 presents the influence of socio-demographic factors on the use values of *Treculia africana*. The analysis of this table shows that the use values (total,

food and medicinal) of *Treculia africana* vary significantly according to the ethnic group and the religion ($p < 0.05$). Total use values vary significantly according to age ($P < 0.05$). The factor gender, marital status and activity have no significant effect ($p > 0.05$) on the use values (total, food and medicinal) of *Treculia africana* (Table 6).

Total use values were higher ($p < 0.05$) among the Nagot (4.14 ± 1.34) compared to the Fon (2.73 ± 0.72), while the Aizo (2.46 ± 0. 67) had the lowest values (Fig. 8a). Indeed, the Nagot (1.20 ± 4.40) followed by the Fon (0.30 ± 1.63) had higher food use values ($p < 0.05$) of *Treculia africana* than the Aizo (0.19 ±1.31) (Fig. 8b). Similarly, medicinal use values were also higher ($p < 0.05$) in the Nagot (3.52 ± 1.94) compared to the Fon (0.96 ± 0.53), while the Aizo (0. 25 ± 0.14) hold the lowest ($p < 0.05$) knowledge of the plant (Fig. 8c). Moreover, the elderly have less knowledge than the other age groups (Figs. 8d, 8e, 8f).

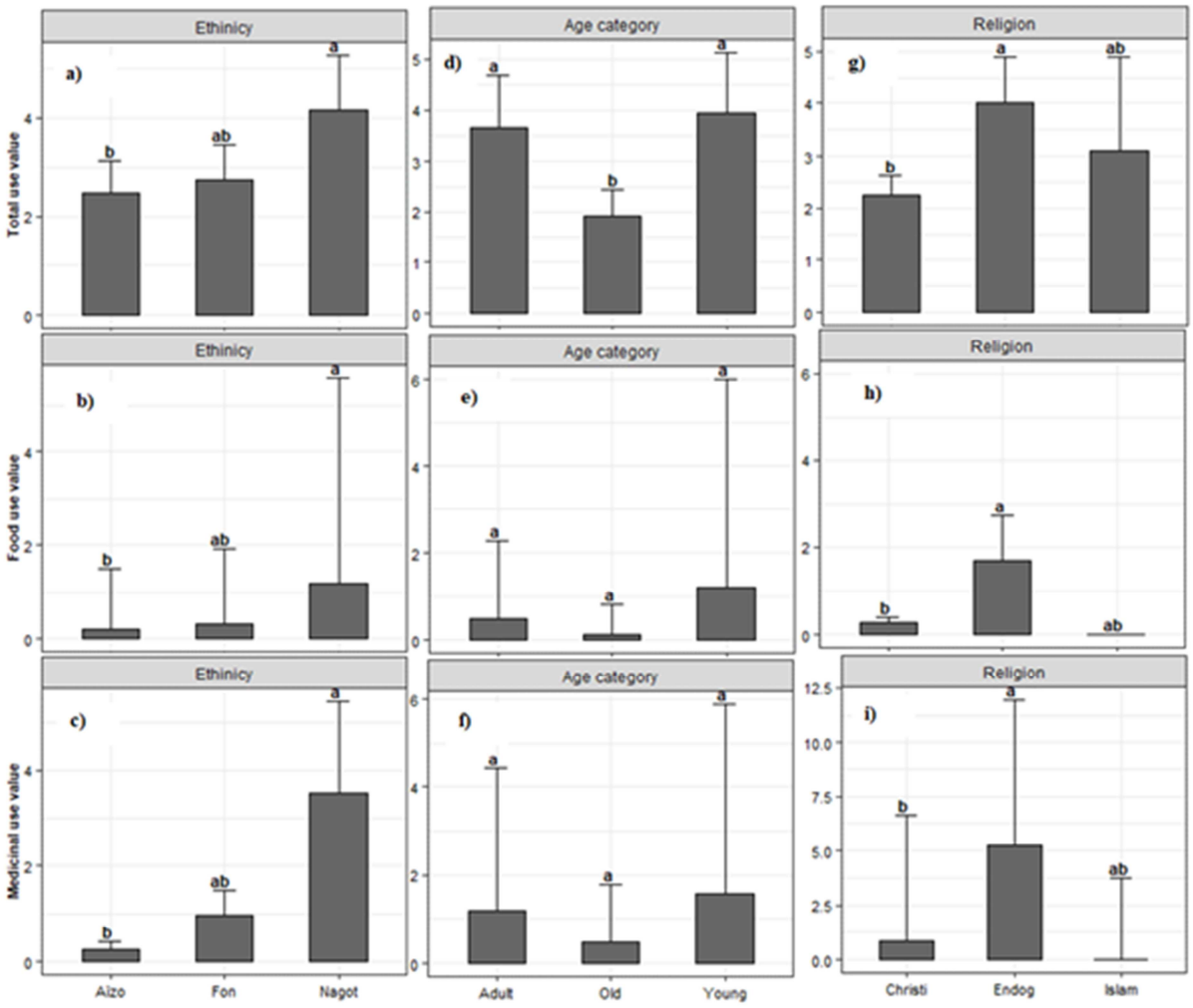

Fig. 8. Influence of sociodemographic factors on the use value of *Treculia africana* Decne spp (barplot with error bar)

However, within religions, the endogenous (4.01 ± 0.88) had a better knowledge of the total uses of the species followed by Islam (3.09 ± 1.79) and Christianity (2.24 ±0.38) (Fig. 8g). In addition, the endogenous followed by Christianity knew better the food and medicinal uses of *Treculia africana* than Islam (Figs 8h, 8i).

Discussion

Uses of the different parts and ethnobotanical knowledge on Treculia africana in southern Benin

This study highlights the importance of *Treculia africana* for the populations of the study area. Almost all plant organs are important in the daily life of people. The uses of *Treculia africana* are similar to

those of *Pentadesma butyracea Sabine*. The organs of the tree (seed, bark, root, leaf, sap, young stem) have multiple uses. A total of twelve forms of use have been identified in the study area. These results are consistent with research work carried out in the sub-region by some authors. The seeds of *Treculia africana* are prepared and seasoned to be eaten with bread. These uses have also been noted by Enibe *et al.* (2013) and Amujiri (2016). The sap is used to accelerate the closure of the fontanelle in newborns, but Magilu (2006) indicates its use on the breast against mastitis in cows. The Sap prevents the production of pus and facilitates the flow of milk. The use of the sap is also noted by Field Survey (2008) who claim that it could be applied as an antibacterial agent in ear drops and also used for the treatment of burns caused by fire.

Bark boiled with potash is filtered and mixed with peak milk to cure severe anemia. Nwankpa *et al.* (2017) found out that the ethanol stem bark extract of Treculia africana is able to stimulate the formation of red blood cells (erythropoiesis) and an active phagocytic agent against foreign compounds and may be useful for hemopoietic conditions. Boiled *Treculia africana* leaf combined with its bark cures typhoid fever. This use of the leaf is also noted by Ajayi *et al.* (2017). According to these authors, the crude extract of the leaves of *Treculia africana* has chemical compounds with strong antioxidant activity, which could justify its use in ethnomedicine and traditional medicine.

Among the ethnic group Fon, the fruit of the species is mainly used as a snail trap. Ripe fruit is cut and laid in damp places as bait. The smell of ripe fruit attracts snails. This use is not mentioned by the Nagots. Here, the Nagot find their usefulness in medico-magic for mystical purposes.

Young stems and young branches are used as toothpicks. This form of use could affect the growth of young plants that rarely reach the fruiting stage (Natta, 2003). In addition, the oil extraction from the seeds of *Treculia africana* is specific to Nagot. In this locality, this ethnic group particularly uses the oil of *Treculia africana* to cure earaches. This use was absent in the literature and could offer interesting research perspectives on the quality of the oil in pharmaceuticals and phytochemistry.

The low frequency of use of the seeds of the species in the diet by the Aizo and the Fon could be explained on one hand, by the ignorance of the different methods of cooking the seed by the new generation and on the other hand, by changing eating habits. Additionally, the time for processing and cooking the seeds is long labor demanding and this resulted in the neglect of fruits and their use as fodder. Similarly, our investigations revealed that the species only exists in the forests studied but is very rare around villages or in the agricultural land of local residents. This rarity can be explained by the high rate of deforestation near the concessions and the non-cultivation of the species in the fields. For these residents, the species is surrounded by a myth and its presence in a locality would block its development. Thus, the non-planting of the species in agricultural lands may be linked to the perception of the populations who cut down the large plants of this species near the concessions or in the fields because the large ripe fruit of *Treculia africana* would kill anyone on whom it would fall accidentally. This is consistent with work done by Nuga and Ofodile (2010) on threats to this same species in southern Nigeria. It is therefore important that a similar study be extended to other departments of Benin in order to have a sufficient database for a conservation program for the species.

Local perception and diversity of uses of populations on Treculia africana

Perceptions on the appellation of *Treculia africana* var. *africana* vary according to the ethnic groups encountered. For example, the Aïzo and the Fon designate *Treculia africana* “Azongbo-agbligbli” as being a tree shrouded in mystery. The fruits of the species being very large, when falling from the tree emit a noise similar to the groans of a suffering person. The vernacular name of a species is therefore the revelation of the morphological trait

of the species (Fandohan *et al.*, 2017; Assogba *et al.,* 2017).

In terms of ethnobotanical knowledge, the study revealed that there is a difference between ethnic groups with regard to the total, food and medicinal use values of *Treculia africana*.

The Nagot have a better knowledge of the uses of the species than the Fon and the Aïzo. On the one hand, this could be explained by the proximity of its populations to Nigeria, where the plant is very well known (Enibe, 2007). Indeed, according to the author, the seeds of *Treculia africana* are accepted as a staple food in substitution to cassava, rice and yam for rural populations of south-eastern Nigeria. The Nagots' greater familiarity with the plant can, on the other hand, also be explained by marriage. Indeed, Atakpama *et al.* (2012) confirmed that marriage strengthens inter-ethnic relations which remain dynamic in time and space. This explanation is all the more likely as, according to the literature (Nnorom *et al.*, 2015), the local name of the species in Nagot (i.e, "Afon") is similar to the local name of the species among the Yorubas of South-East and South-West Nigeria.

The total use values of the species vary according to age. Old people have less knowledge than young people and adults, certainly because they are not in regular contact with the species. In view of all the above, we can confirm our hypothesis that local knowledge of *Treculia africana* varies according to socio-cultural group and age. But this knowledge does not vary by sex.

The total, food and medicinal use values of *Treculia africana* vary significantly according to religion. Endogenous have more knowledge than other religions (Islam and Christianity).

This result could be explained by their regular contact with the species through ceremonies and confirms the hypothesis that knowledge and the degree of knowledge about plants depend on the cultures and habits and customs of peoples (Sundriyal *et al.*, 2004). This hypothesis is all the more verified as endogenous people have a very great medicinal knowledge than other religions. It then follows from the results that our hypothesis that the knowledge and degree of knowledge of *Treculia africana* depends on the religion of the ethnic groups bordering the forests of southern Benin is verified.

We can say that *Treculia africana* is a very useful tree for people. All the organs of the species are important and are used in different ways by the populations of the study area. However, the multiplicity of uses of the species could also have impacts on its ecology since it has been shown that the effects of anthropization can impact the structure and stability of populations of preferred plants (Gaoué and Ticktin, 2007).

Conclusion

This study on the endogenous knowledge and ethnobotanical importance of *Treculia africana* Decne. was conducted among the ethnic groups bordering the forests of Niaouli, Lokoli and itchèdè-toffo. It made it possible to build a database on knowledge and the different forms of use of the organs of *Treculia africana* in Benin. It also showed that the species has a very high food and medicinal value. Its importance varies according to ethnic groups and religion, with a particularity linked to Nagot and endogenous religions which hold more knowledge on the use of the species. A study on the importance of *Treculia africana* in ritual and taboo ceremonies is necessary for its conservation in Benin. The use of *Treculia africana* oil by the Nagot for the effective treatment of earache also suggests studies on the properties of the oil in pharmacology. It is also necessary to extend this study to the level of the other ethnic groups of Benin in order to have a sufficient database for a better plan of valorization of the species.

References

Adomou AC. 2005. Vegetation patterns and environmental gradients in Benin. Implications for biogeography and conservation. PhD thesis, Wageningen University, Wageningen, The Netherlands, p. 136.

Ajayi OS, **Aderogba MA**, **Obuotor EM**, **Majinda RRT**. 2017. Antioxidant activities of the extracts and isolated compounds from *Treculia africana* (Decne) leaf. Nigerian Journal of Natural Products and Medicine **21**, p. 32–38.
https://dx.doi.org/10.4314/njnpm.v21i1.5.

Akoegninou A, **Van der Burg WJ**, **Van der Maesen LJG**, **Adjakidjè V**, **Essou JP**, **Sinsin B**, (éds). 2006. Flore analytique du Bénin. Leiden, Pays-Bas, Backhuys Publishers, p.1034.
https://library.wur.nl/WebQuery/wurpubs/fulltext/281595.

Amujiri AN, **Nwosu MO**, **Nzekwe U**, **Osayi EE**, **Sani MB**. 2018. Studies on the phenology of African breadfruit (*Treculia africana* Decne) in South Eastern Nigeria. Environmental and Ecological Research **6**(4), p. 248–258.
DOI: 10.13189/eer.2018.060405.

Amujiri AN. 2016. Studies on the morphology, phenology, and effect of location on the germination of African breadfruit (*Treculia africana* Decne). Unpublished thesis submitted in partial fulfillment for the award of Ph.D. in Ecology, Department of Plant Science and Biotechnology, University of Nigeria, Nsukka, 180pp.

Assogbadjo AE, **Kakaï RG**, **Chadare F**, **Thomson L**, **Kyndt T**, **Sinsin B**, **Van Damme P**. 2008. Folk classification, perception, and preferences of baobab products in West Africa: consequences for species conservation and improvement. Economic Botany **62**, p. 74–84.
https://doi.org/10.1007/s12231-007-9003-6.

Atakpama W, **Batawila K**, **Dourma M**, **Pereki H**, **Wala K**, **Dimobe K**, **Akpagana K**, **Gbeassor M**. 2012. Ethnobotanical knowledge of *Sterculia setigera* Del. in the Sudanian zone of Togo (West Africa). International Scholarly Research Notices **2012**(1), p.723157.
https://doi.org/10.5402/2012/723157.

CJB. 2007. Base de données des plantes d'Afrique. Lien: http://www.ville-ge.ch/musinfo/bd/cjb/africa/details.php?langue=fr&id=177539.

Dagnelie P. 1998. Statistiques Théoriques et Appliquées. De Boeck et Larcier, Brux, Belg.

Déléké Koko KIE, **Djego J**, **Gbenou J**, **Sylvie M**, **Adote H**, **Sinsin B**. 2011. Étude phytochimique des principales plantes galactogènes et emménagogues utilisées dans les terroirs riverains de la zone cynégétique de la Pendjari. International Journal of Biological and Chemical Sciences **5**(2), p. 618–633. DOI:10.4314/ijbcs.v5i2.72127.

Dickens ED. 2013. Propagation of *Treculia africana* as influenced by seed storage and propagation media. Agricultura Tropica et Subtropica **46**, p. 52–57.
DOI: 10.2478/ats-2013-0009.

Djego J, **Djego-Djossou S**, **Cakpo Y**, **Agnani P**, **Sinsin B**. 2011. Évaluation du potentiel ethnobotanique des populations rurales au Sud et au centre du Bénin. International Journal of Biological and Chemical Sciences **5**, 1432–1447.
https://doi.org/10.4314/ijbcs.v5i4.10.

Enibe DO. 2007. Consumer acceptability test in South Eastern Nigeria. Discovery and Innovation **19**, p. 271–273.

Enibe SO, **Akubuo CO**, **Mbah BN**, **Onweluzo JA**, **Enibe DO**, **Oduro I**, **Ellis WA**. 2013. Progress in agronomic, nutritional and engineering development research on *Treculia africana* tree crop. *Treculia africana*, 198–214.
https://cgspace.cgiar.org/rest/bitstreams/87353/retrieve.

Fandohan AB, **Chadare FJ**, **Gouwakinnou GN**, **Tovissode CF**, **Bonou A**, **Djonlonkou SFB**. 2017. Usages traditionnels et valeur économique de *Syncepalum dulcificum* au Sud-Bénin. Bois et Forêts des Tropiques **332**, 17–30.
https://doi.org/10.19182/bft2017.332.a31330.

Freiberger CE, **Vander DJ**, **Pastuszyn A**, **Glew RS**, **Mounkaila G**, **Millson M**, **Glew RH**. 1998. Nutrient content of the edible leaves of seven wild plants from Niger. Plant Foods for Human Nutrition **53**, 57–69. https://doi.org/10.1023/A:1008080508028.

Ganka G, **Salako KV**, **Fandohan AB**. 2022. Importance des cultes dans la préservation des espèces d'arbre, le cas du samba (*Triplochiton scleroxylon* K. Schum.) au Bénin. Bois et Forêts des Tropiques **351**, 53–65. https://doi.org/10.19182/bft2022.351.a36866.

Gaoué OG, **Ticktin T**. 2007. Patterns of harvesting foliage and bark from the multipurpose tree *Khaya senegalensis* in Benin: variation across ecological regions and its impacts on population structure. Biological Conservation **137**, 424–436. https://doi.org/10.1016/j.biocon.2007.02.020.

Gomez-Beloz A. 2002. Plant use knowledge of the Winikina Warao: the case for questionnaires in ethnobotany. Economic Botany **56**, 231–241. https://doi.org/10.1663/0013-0001(2002)056[0231:PUKOTW]2.0.CO;2.

Gouwakinnou GN. 2011. Population ecology, uses, and conservation of *Sclerocarya birrea* (A. Rich.) Hoschst. (Anacardiaceae) in Benin, West Africa. PhD Thesis, University of Abomey Calavi, Abomey-Calavi, p.223.

INSAE. 2016. Cahier des villages et quartiers de ville du Département de l'Ouémé (RGPH-4, 2013), p.42.

INSAE. 2016. Cahier des villages et quartiers de ville du Département du ZOU (RGPH-4, 2013), p.39.

INSAE. 2016. Cahier des villages et quartiers de ville du Département du Plateau (RGPH-4, 2013), p.29.

Kalinganire A, **Weber JC**, **Uwamariya A**, **Kone B**. 2008. Improving rural livelihoods through domestication of indigenous fruit trees in the parklands of the Sahel. In: Akinnifesi FK, Leakey RRB, Ajayi O, Sileshi G, Tchoundjeu Z, Matakala P, (eds). Indigenous fruit trees in the tropics: Domestication, utilization, and commercialization. Wallingford, United Kingdom, CABI, p.186–203.

Lougbegnon TO, **Houessou LG**, **Gbesso FGH**, **Anagonou LES**, **Sinsin B**. 2012. Ethnobotanical study of the African star apple (*Chrysophyllum albidum* G. Don) in Southern Benin (West Africa). Journal of Ethnobiology and Ethnomedicine **8**, 40. https://doi.org/10.1186/1746-4269-8-40.

Magilu MW. 2006. Étude ethnobotanique et production fruitière de *Treculia africana* Decne de la région de Kisangani (Province Orientale) et de la région de Gungu (Province de Bandundu)/RDC, mémoire présenté en vue de l'obtention du diplôme de Licencé en Sciences, option: Biologie, Orientation: Botanique, p. 118.

Mbakwe R. 2005. The influence of budwood physiology on the gestation period of fruit crops: Studies on *Treculia africana* (African breadfruit). Journal of Agriculture and Food Science **3**, 1–4. https://www.ajol.info/index.php/jafs/article/view/41624/8906.

MEPN. 2008. Programme d'Action National d'Adaptation aux changements climatiques du Bénin (PANA-BENIN, 2008), p.81.

Nnorom I, **Ewuzie U**, **Ogbuagu F**, **Okereke M**, **Agwu P**, **Enyinnaya I**. 2015. Mineral content of Ukwa, African breadfruit (*Treculia africana*) from South-Eastern Nigeria: Effect of methods of preparation. International Journal of Plant & Soil Science **4**, 230–240. https://doi.org/10.9734/IJPSS/2015/12603.

Nuga OO, **Ofodile EAU**. 2010. Potentials of *Treculia africana* Decne—an endangered species of Southern Nigeria. Journal of Agriculture and Social Research (JASR) **10**, 91–99. https://doi.org/10.4314/jasr.v10i2.67577.

Ogbonnia SO, **Enwuru NV**, **Onyemeh EU**, **Oyedele GA**, **Enwuru CA**. 2008. Phytochemical evaluation and antibacterial profile of *Treculia africana* Decne bark extract on gastrointestinal bacteria pathogens. African Journal of Biotechnology **7**, 1385–1389. https://www.ajol.info/index.php/ajb/article/download/58680/47008

Okoronkwo KA, **Nwagbaoso OC**, **Okoronkwo BC**. 2020. Chemical and amino acid composition of African breadfruit (*Treculia africana*). International Network Organization for Scientific Research (INOSR) Applied Sciences **6**, 1–10. http://www.inosr.net/wp-content/uploads/2020/02/INOSR-AS-61-1-10-2020..pdf.

Pauwels L. 1993. Nzayilu N'ti: Guide des arbres et arbustes de la région de Kinshasa-Brazzaville. Ed. Jardin Botanique de Belgique, 495 pp.

Pilgrim SE, **Cullen LC**, **Smith DJ**, **Pretty J**. 2008. Ecological knowledge is lost in wealthier communities and countries. Environmental Science & Technology **42**(4), 1004–1009. https://doi.org/10.1021/es070837v.

Pinton F, **Grenand P**. 2007. Savoirs traditionnels, populations locales et ressources globalisées. Les Marchés Biodiversité, Paris, IRD Éditions, p. 165–194.

R Core Team RA. 2021. Language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Rajesh B, **Nair N**. 2018. Ethnobotanical studies of medicinal plants used in traditional (folk) medicines. International Journal of Science and Research **8**, 437–442.

Rogas M. 2006. The Bio-Trade Initiatives: Programme for biodiversity-based development. Biodiversity Conservation and Management Monitor **38**, 11–14.

Sebastien L, **Julie J**, **Francois H**. 2008. FactoMineR: An R package for multivariate analysis. Journal of Statistical Software **25**(1), 1–18. https://doi.org/10.18637/jss.v025.i01.

Sene AL, **Niang K**, **Faye G**, **Ayessou N**, **Sagna MB**, **Cisse M**, **Diallo A**, **Cisse OK**, **Gueye M**, **Guisse A**. 2018. Identification des usages de *Sclerocarya birrea* (A. Rich) Hoscht dans la zone du Ferlo (Sénégal) et évaluation du potentiel biochimique et nutritionnel de son fruit. African Journal of Food, Agriculture, Nutrition and Development **18**, 13470–13489. https://doi.org/10.18697/ajfand.82.17015.

Simon J. 2020. pscl: Classes and methods for R developed in the Political Science Computational Laboratory. United States Studies Centre, University of Sydney, Sydney, New South Wales, Australia. R package version 1.5.5. https://github.com/atahk/pscl/.

Tchoundjeu Z, **Atangana AR**, **Degrade A**. 2005. Indigenous methods of preserving bush-mango kernels in Cameroon. American Journal of Applied Sciences **2**, p. 1337–1342.

Uluocha OB, **Udeagha AU**, **Udofia SI**, **Duruigbo CI**. 2016. Socio-economic contribution of African breadfruit (*Treculia africana* Decne) toward sustainable livelihood in Eastern Nigeria. Journal of Research in Forestry, Wildlife and Environment **8**, 40–57. https://www.ajol.info/index.php/jrfwe/article/view/140783.

Venables WN, **Ripley BD**. 2002. Modern Applied Statistics with S. Fourth Edition. Springer, New York. ISBN 0-387-95457-0.