



Ethnobotanical and Socio-economic Value of *Blighia sapida* (K.D. Koenig) in Togo

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Authors' contributions

This work was carried out in collaboration among all authors. Authors AN, HS and KA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript.

Authors AN, TS, MM and FTB managed the analyses of the study. Authors AN, HS, LBM and KA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: In Africa, and particularly in Togo, fruit trees occupy a special place because of their medicinal and food virtues,. This study aimed to identify the different uses of *Blighia sapida* in Togo.

Methodology: investigations were conducted among 300 *B. sapida* users in nine villages in the prefectures of Tône, Kozah and Haho of Togo. The choice of the study area was based on its representativeness in relation to the geographical distribution of *B. sapida*; the presence of resource persons with endogenous knowledge, and the existence of markets where *B. sapida* organs and fruits are traded. Data collection phase took place in households and markets. The questionnaire solicited information on the socio-demographic characteristics of the respondents; the use of this plant species by the populations, the routes of administration or formulations as well as the quantity sold per day.

Results: *Blighia sapida* is used for nutritional, therapeutic and cosmetic purposes with the main route of administration being oral. Respondents were predominantly female over 55

years of age. The supply of the fruits of this plant is by purchase and the average amount sold daily is 2500 F (≈4 €).

Conclusion: This study showed that various organs of *B. sapida* are used by the communities. It is a first step towards the valorization of plant resources.

Keywords: Ackee apple; food security; survey; vegetable species.

1. INTRODUCTION

Despite a multitude of food and therapeutic plants in the world, food insecurity remains a problem, especially in developing countries. According to FAO data, the number of people suffering from hunger daily in the world is approximately 855 million, including 820 million from developing countries, 25 million is in transition and 10 million in so-called developed countries. Furthermore, Sub-Saharan Africa is seen as one of the poorest regions in the world [1].

In Africa, fruit trees occupy a special place because they are involved in livelihood sustainability via their medicinal, food, agricultural and even socio-economic value [2]. Therefore, ethnobotanical investigations are needed to capture indigenous knowledge related to fruit trees in Africa, seeing that this orally conveyed knowledge is subject to loss and change. Documenting this knowledge would also assist in the development of traditionally improved drugs and food formulations containing macronutrients and micronutrients. In addition, there has been a growing interest in food plants in recent decades because they play a role as nutraceuticals. Thus, the potential beneficiation of indigenous genetic resources for especially rural populations is of immense value as conventional medicines and food formulations are not within the reach of these populations. Moreover, these plants are also used as pesticides [3]. Notwithstanding, the therapeutic and nutritional merits of these plants are only based on purely empirical bases, most often without any scientific proof.

Blighia sapida, commonly known as Ackee apple, is a tree whose fruits are consumed for their nutritional value by the Togolese. It is found in several regions of the world (Africa, Jamaica and Haiti). According to Dossou et al. [4] this fruit tree has medicinal values. Roots, leaves, bark and seeds are used in the food sector, and in traditional medicine to treat certain pathologies [4]. The aril of *Blighia sapida* is of great nutritional importance for humans and is eaten

raw, boiled or fried [5]. Thanks to its richness in fats (48.5%), special attention is paid to this plant species [6]. Moreover, in Jamaica it is regularly part of the diet [7].

Despite the proven nutritional values of the aril of *B. sapida*, this species remains a formidable source of poisoning. Its fruit is toxic, especially when consumed at an early stage of maturation. Indeed, the consumption of the unripe fruit of this plant has been the cause of many deaths in children due to the high concentration (1000 ppm) of hypoglycine A [8].

Several studies have been conducted in Togo and elsewhere on the virtues of nutraceutical plants, but the ethnobotanical survey and the scientific work carried out in Togo and in the sub-region on *B. sapida* are almost non-existent. Nevertheless, some work has been carried out on *B. sapida*, particularly on the physicochemical composition of the arils of this plant in Côte d'Ivoire [8]. Because of its importance for the Togolese population and the harmful effects generated especially by the immature arils, it is therefore urgent to carry out an ethnobotanical and socioeconomic study to discover the real therapeutic and food potential of *B. sapida* in order to expand and deepen knowledge of its use, and subsequent more sustainable management. Thus, the main objective of this work was to carry out an ethnobotanical and socio-economic survey on *B. sapida* to understand the value of this species to the Togo population.

2. MATERIALS AND METHODS

2.1 Study Area

The investigation took place in three prefectures (Kozah, Haho and Tône) of Togo (Fig. 1). The three study sites were selected based on three main reasons: i) the representativeness in relation to the geographical distribution of *Blighia sapida* in the local plant formations according to the analytical flora of Togo [9], and the water and forest service which were completed by the exploratory phase, ii) the presence in these

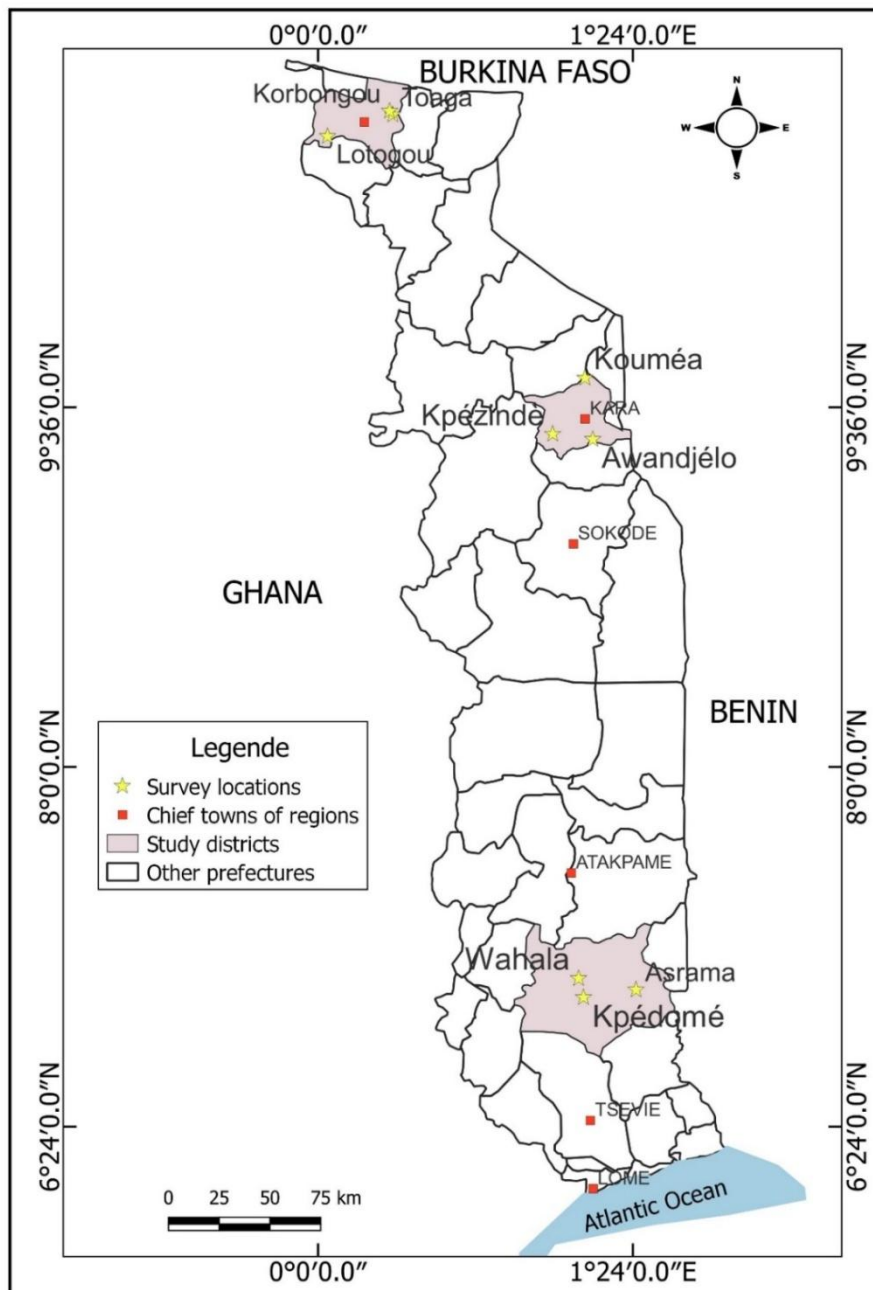


Fig. 1. Localities surveyed in Togo

localities of resource people with endogenous knowledge of the *Blighia sapida* plant, and iii) the existence of markets where the products this species are sold.

2.2 Sampling Methods and Data Collection

2.2.1 Ethnobotanical aspects

Data collection took place within households and markets by administering a survey

sheet to collect quantitative and qualitative data in villages of Kouméya, Awandjélo and Kpezindè for the prefecture of Kozah, Wahala, Kpedomé and Asrama for the prefecture of Haho and Lotougou, Toaga and Korbongou for the prefecture of Tône. The sample was 300 persons, following the normal approximation of the binomial distribution of Dagnélie [10]. The decisive stage of data collection in the field took place during the months of March to October 2021.

Thus, in the targeted prefectures, the administration of the questionnaire required three collection methods: i) the “focus group” which allows the questionnaire to be filled in during the talks and debates; ii) the individual survey which consists of interviewing a single person and iii) finally the semi-structured interview method [11, 12] which allows men and women to be questioned separately. To do this, a preliminary survey of our respondents was carried out beforehand with local authorities (traditional chiefs, mayors, elders) and the water and forest service in order to obtain their consent to participate in our study.

Furthermore, socio-economic and socio-linguistic groups were randomly targeted. In addition, for easy access to information, this study required a translator, or not, depending on the need. Finally, the ethnobotanical information concerned the habitat and management method of *Blighia sapida*, the socio-demographic characteristics of the respondents (age, sex, level of education), the uses used (roots, fruits, leaves), places of supply, routes of administration or formulations, as well as the prohibitions, and the side effects linked to each preparation.

2.2.2 Socio-economic aspects

The socio-economic survey was conducted using the semi-structured interview method [12], and was carried out mainly in the markets. The sample size of our respondents was fixed at 45 users per prefecture of *B. sapida* fruits, evenly distributed in the three localities using the normal approximation of Dagnelie [10]. Thus, per village, 15 people were selected, taking into account the richness of their display, as well as their age. This survey concerned the selling prices of *B. sapida* fruits, the quantities sold per day, quantitative and qualitative information relating to the socio-economic characteristics of the actors involved, as well as the marketing channels.

2.3 Statistical Analysis

The ethnobotanical and socio-economic data were coded and inserted into the Excel 2016 databases and analyzed by the Minitab 17.0 and GraphPad Prism 7 software. The data collected was grouped by prefecture, by village and by sociolinguistic group in order to verify whether or not there is a link (using the Chi-square) between ethnic groups and the different uses made of the organs of *B. sapida*. Finally, the quantitative and

qualitative variables relating to the socio-economic data were subjected to an analysis of variance (ANOVA) relating to the profitability of the organs and fruits sold.

3. RESULTS

3.1 Ethnobotanical Aspects

3.1.1 Uses of *Blighia sapida*

Only the aril was reported to have nutritional potential. It is usually eaten raw, or incorporated into a sauce, fried or dried. *Blighia sapida* oil contributes significantly to the diet of many Togolese, because it is used by a certain tribe to improve the taste of dishes. During the food lean period when there is a shortage of food, dried arils of this plant are significantly involved in the diet of communities. The immature fruit is used to catch fish. In the prefectures of Haho and Kozah. Crushed seeds and valves thrown into waterways where the fish are poisoned and die, and then collected for consumption.

Medicinally, *B. sapida* is used to treat childhood diseases, such as jaundice, by combining the bark of *B. sapida* with the roots and flowers of other species. Roots of *B. sapida*, in combination with honey, are used as an aphrodisiac and to treat sexual fatigue. The oil is used as an antimicrobial application in the preservation of food.

Culturally, *B. sapida* is used as an incense to ward off evil spirits among Kabyè and Mobo peoples. The arils are used to chase away evil spirits because among the Kabyè they mystically protect the women producers of the local drink (tchoukoutou) and protect the product against the deterioration of the flavor of the drink to be marketed.

Cosmetically, the valves of the fruits are burned and the ashes put in a pierced basin whose orifices are protected by stalks of dry cereals. Hot water is poured over the ashes while kneading them; the resultant liquid is then boiled for an hour until a dark precipitate is obtained; then add melted shea butter and leave on the heat for 75-90 minutes, stirring regularly. A gray colored paste is then obtained, which constitutes the traditional soap which is sold in markets. The seeds are sometimes used in conjunction with the valves for making this soap. This knowledge is generally held by women.

According to 35% of respondents, in addition to these different uses mentioned above, *B. sapida* plays several functions: providing firewood to households, protects the soil against water and wind erosion, participates in synergy with other plants to the practice of market gardening.

and 95 years old with an average age of 50 years old. Subjects over the age of 55 represent more than a third of the study population. The analysis of this table shows that the animists are more in the majority (60%) while the Kabyè represent the most majority ethnic group (48%).

3.1.2 Sociodemographic characteristics of respondents

Respondents in our study area were of several ethnicities and different age groups. Thus, Table 1 presents the characteristics relating to the ethnic group, the religion, the level of study, the age and the sex of the respondents. The ethnobotanical investigations focused on 300 individuals, 89% of whom were female against 11% male. In addition, the age group of the respondents is between 30

3.1.2.1 Organs used, the method of preparation and the route of administration

The most used organ is arils (90%), being used in almost all the sampled localities. This organ is consumed after cooking or drying. The most preferred mode of preparation of the other parts of the plant used (leaves, flowers and root bark or/and stem/branch bark) are decoction. Regarding the administration routes, the only route was oral.

Table 1. Socio-demographic characteristics of respondents during the survey

Features	Modalities	Respondents (%)			
		Kozah	Haho	Tone	Average
Age	[30 years -40 years [	20	25	15	20
	[40 years -50 years [	20	15	15	16.67
	[50 years -60 years [	30	40	30	33.33
	[60 years -95 years]	30	20	40	26.67
Gender	Male	15	2	15	10.67
	Female	85	98	85	89.33
Education Level	Illiterates	90	85	66	80.33
	Primary School	5	15	14	11.33
	Secondary School and above	5	0	20	8.33
Religion	Animists	80	30	70	60
	Christians	10	40	20	23.33
	Muslims	10	30	10	16.67
Ethnic group	Kabyè	80	50	15	48.33
	Ewe	5	25	0	10
	Moba	5	0	60	21.67
	Kotokoli	10	25	25	20

Table 2. Different organs used, preparation method and administration route of *Blighia sapida*

Parts used	Frequency of citation	Preparation method (Frequency of citation)	Administration route
Leaves	4%	Decoction (100%)	Oral route
root bark or/and stem/branch bark	5%	Decoction (80%), infusion (20%)	Oral route
Flowers	1%	Decoction 100%)	Oral route
Arils	90%	Cooking (80%), drying (20%)	Oral route

3.1.3 Habitat, management method and prohibitions related to the use of *Blighia sapida*

Blighia sapida is often cultivated in its natural habitat range as a fruit and shade tree. In the surveyed area, it prefers fertile, deep and well-drained soils, but it is also found on infertile sandy soils and on calcareous soils. In dry areas, it is often present on termite mounds. It does not tolerate waterlogged soils, and does not tolerate water-logged soils. Regarding the prohibitions and side effects associated with the use of this plant, only unripe arils are recognized for their adverse effects, which includes vomiting, diarrhea, and nausea.

3.2 Socio-economic Aspects

The selling prices of this species vary from 50 FCFA (≈ 0.08 €) to 100 FCFA (≈ 0.16 €) per three fruits depending on the season; and that the sum sold daily was on average 2500F (≈ 4 €). This amount sold is not significant between the prefectures ($p>0.05$). In addition, the supply of *B. sapida* fruits is generally done by purchase.

4. DISCUSSION AND CONCLUSION

4.1 Ethnobotanical Aspects

4.1.1 Uses of *Blighia sapida*

The results from this survey revealed that *B. sapida* is used for nutritional, therapeutic and cosmetic purposes. This plant can therefore be qualified as a food. Despite these virtues, scientific data on this plant are almost non-existent in Togo; this state of affairs therefore requires in-depth scientific studies to verify its harmlessness. These results would be in agreement with those of Dossou et al. [4] who revealed the same observations concerning the studied plant in Benin. In this study, several ethnic groups were prospected in order to identify the affinities and particularities with regard to the use of the organs of this plant. It should also be noted that this vegetable species is integrated into the eating habits of the entire population surveyed. These results corroborate those of Batawila et al. [13] who obtained similar results during a survey of vegetable plants in Togo. Moreover, speaking of the significant role of wild plants, an anthropological study carried out in Senegal reveals that wild vegetable species are to be appreciated because they provide fruits, seeds, leaves, sap, terminal buds,

some of which are eaten raw, outside meals [14]. In addition, according to FAO [1], in India it has been estimated that 50 million households enrich their diet with these fruits collected from the surrounding forest and bush.

4.1.2 Socio-demographic characteristics of respondents

The results of the present study showed that almost all of the surveyed population recognizes that the consumption of the studied vegetable plant is a fact of inheritance but some ethnic groups like the Moba have acquired the food habit of *B. sapida* through cultural mixing. These results corroborate those of Batawila et al. [13] who revealed similar results on vegetable plants in Togo. In addition, the survey sampled several people with different levels of education because the level of knowledge about malnutrition, the consequences of malnutrition depend on the age and level of education of the respondents. According to the data of this study, the inhabitants of the population market the products of *B. sapida* to meet the needs of households such as: health problem, the schooling of children and the purchase of school supplies. These results are consistent with those of Dossou et al. [4] from Benin who reported that substantial assets from *B. sapida* are invested in schooling and family welfare.

4.1.3 Habitat, management method and prohibitions related to the use of *Blighia sapida*

Our investigation indicated that the method of cooking would have a significant impact on the toxicity and nutritional value of this plant. This was also reported by Vodouche et al. [15] who claimed that cooking in boiling water increased the protein and lipid contents of *Amaranthus hybridus* and *Solanum macrocarpum* lipids and the proteins of *Ocimum gratissimum*, which are three vegetable species acclimatized in Benin. Apart from the nutritional virtues, this species has significant therapeutic potential and can therefore be a good candidate in the treatment of many pathologies. According to the survey, the main route of administration of *B. sapida* products is the oral route because most of the diseases are caused by a dysfunction of an internal organ.

Data recorded in this study showed that this plant species is known by more than 90% of the people surveyed and consumed by 82% of them. These results are consistent with those of

Batawila et al. [13] who estimated the recognition and consumption rate of approximately 85% of the sampled population. Regarding the availability of fruits and vegetables, Shiundu [16] stipulates that the picking vegetables harvested in the rainy season are dried and reduced to powder, and preserved to cover the dry season or lean seasons. Indeed, according to Vodouche et al. [15], the nutritional value of wild vegetables would be an argument for their promotion since they are rich in vitamins, proteins and mineral salts that the body needs to ensure its nutritional balance, especially during lean periods. The most consumed parts of this vegetable species are represented by the fruits in their natural state or cooked because this most appreciated part is full of enormous nutritional potential.

4.2 Socio-economic Aspects

According to the information collected, the women involved in the marketing of *B. sapida* fruits allows them to derive considerable financial income. This state of affairs is close to the African reality where the sale and marketing of articles are mainly the domain of women. Various studies in sub-Saharan Africa have shown the preponderant role of women and children in the management of vegetable crops [17]. This study revealed that *B. sapida* organs represent a promising source of income generation for communities and clearly showed its impact in the diet and economy of rural populations.

5. CONCLUSION

This study has shown that *Blighia sapida* occupies a prominent place in the lives of Togolese because it contributes to food and medicinal security. This investigation proves to be a very commendable approach to the point where it classifies this plant species among functional foods. In addition, this emphasized the high nutritional potential of *Blighia sapida* for the population surveyed and demonstrates the special attention that must be given to this plant in order to fight against its disappearance. In perspective, we intend to verify the harmlessness of this vegetable species for its unambiguous use because the therapeutic and nutritional merits of these plants are only based on purely empirical bases, most often without any scientific proof.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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