BloEx - Journal
Britain International of
EXACT Sciences Journal
Publish: | January - May - September |
E-ISSN: 2686-1208
P-ISSN: 2686-1216
http://biarjournal.com/index.php/bioex

Survey of Edible Caterpillars in Gbado-Lite City (North Ubangi, Democratic Republic of the Congo) and Medicinal Value of Their Host Plants

Koto-Te-Nyiwa Ngbolua[1*], Robijaona Rahelivololoniaina Baholy[2], Rakotondrazafy Jennie Irma Norosoa[3], Ruphin Djoza Djolu[4], Colette Masengo Ashande[5], Felix Mboka Mune[6], John Koyanza Wangombe-Dawe[7], Michel Mobale Mongeke[8], Jean-Jacques Domondo Amogu[9], Blaise Mbembo-Wa-Mbembo[10], Moises Monizi Mawunu[11]

[1,9,10]Department of Biology, Faculty of Science, University of Kinshasa, Kinshasa, Democratic Republic of the Congo
[2]Doctoral School of Industrial Agricultural and Food Process Engineering, University of Antananarivo, Antanarivo, Madagascar
[3]Department of Animal Biology, Pharmacology, Faculty of Science, University of Antanarivo, Antanarivo, Madagascar
[4,5,6,7,8]Department of Environment, Faculty of Science, University of Gbado-Lite, Gbado-Lite, Democratic Republic of the Congo
[8]Higher Institute of Agronomic Studies of Bokonzi, Gemena, Democratic Republic of the Congo
[6,11]Agronomy Department, Polytechnic Institute of Kimpa Vita University, Uíge, Angola
*Corresponding Author Email: jpngbolua@unikin.ac.cd; ngbolua@gmail.com

Abstract:
The purpose of this study was to conduct a survey of edible caterpillars and the ethno-medical value of their host plants in Gbado-Lite using the "snowball" sampling technique. The results of this study show that Anaphe panda, A. venata, Elaphrodes lactea, Imbrasia epimethea, I. oyemensis, I. truncata and Pseudanthera discrepans are the most consumed caterpillars. Drying is the most used preservation method (82.4%); ground collection is the most used harvesting method (86.3%) while evisceration (45.1%) and dehairing (33.3%) are the main cooking methods used. Harvesting is done more in the forest (94.1%) from May to July (86.3%). The vast majority (98%) of host plants are used in traditional medicine; leaves (53%) and bark (45%) are the most used parts, while decoction is the most used method of preparing therapeutic recipes (92%). The felling of trees (39%) and traditional agriculture (26%) are to varying degrees the main causes of the disappearance of edible caterpillars and their host plants. Incomplete cooking (78.4%) and/or the host plant (19.6%) are the main causes of consumer poisoning. It is therefore desirable that sustainable participatory management strategies for edible caterpillars and their host plants be put in place in North Ubangi Province. These include community agroforestry, which should be practiced in peri-urban areas in order to strengthen the resilience of communities to climate change while at the same time fighting hunger and poverty. Indeed, the domestication of species would allow annihilating the pressure on wild resources, to conserve them, to fight against deforestation and to ensure the availability and sustainability of edible caterpillars. Those phytochemical, pharmacological and toxicological studies could be carried out on host plants in order to identify compounds of medical interest contained in these plants.

Keywords:
edible caterpillars; agroforestry; biodiversity conservation; community resilience; Democratic Republic of Congo

I. Introduction

The Democratic Republic of Congo (62% of whose territory is covered by forest, representing 57.5% of the total area of the Congo Basin) is a reservoir of biodiversity [Ngbolua, 2011a; Ngbolua, 2011b; Asimonyio, 2015; Kambale, 2016a; Kambale, 2016b]. This large terrestrial biome is part of the Congo Basin, which is home to over 900 species of

butterflies (Sunderland, 2002). This phytogeographic region, through its exceptional vegetation and natural fauna constitutes an important source of medicine and food. Indeed, the riparian population for its subsistence, in addition to practicing agriculture, collects both woody and non-woody forest products for food, medical, etc. (Ngbolua, 2018).

It is now recognized that the consumption and trade of non-timber forest products (NTFPs) contribute to the food security of the population (FAO, 2001). However, due to the globalization of the world's economies and the increasing demand for natural resources, the rate of exploitation of NTFPs has increased considerably [Wilkie, 2000; Biloso, 2008], leading to overexploitation of several species and degradation of collection sites. This over-exploitation of natural resources is a threat to the survival of forest peoples, but more than that, it can lead to irreversible depletion of species and biodiversity. Among NTFPs, caterpillars are edible and their host plants are exploited by local people for various uses. These plants are subject to artisanal logging associated with poor slash-and-burn agriculture, which can lead to their eventual disappearance, as is the case in the North Ubangi province of the Democratic Republic of Congo (Kpula, 2021).

It should also be noted that, despite their socio-economic and food importance, edible caterpillars are little valued in North Ubangi because of poor knowledge of these resources. The hypothesis is that a good knowledge of edible caterpillars and their host plants in Gbado-Lite would positively influence their sustainability, exploitation and conservation. The aim of this study is to investigate edible caterpillars and the ethno-medical value of their host plants in Gbado-Lite, with a view to their sustainable use. The specific objectives of this study are to describe the socio-demographic profile of the respondents; to inventory the different types of edible caterpillars and their host plants; to determine the harvesting period; the method of harvesting, the method of conservation, the method of cooking and the habitat of the caterpillars; to determine the main medical or other uses of these host plants (diseases treated, parts used, method of preparation of recipes, administration methods, etc.). This study will enable reflection on strategies for the sustainable management of edible caterpillars and host plants in the province of North Ubangi. This is to ensure the sustainability of the products and services offered by these resources for the benefit of both present and future generations.

II. Research Methods

2.1. Study Area

The present study was carried out in the town of Gbado-Lite (Latitude: 4° 16' 41" North; Longitude: 21° 00' 18" East; Altitude: 300-500 m above sea level). The town of Gbado-Lite (Figure 1) is located in the Ubangian ecoregion, a sub-region of the Northeastern Congolian lowland forests. This ecoregion is one of the 200 global priority terrestrial ecoregions known as the G200 [Ngbolua, 2019a; Ngbolua, 2019b; Ngbolua, 2019c; Ngbolua, 2020a; Ngbolua, 2020b; Ngbolua, 2020].

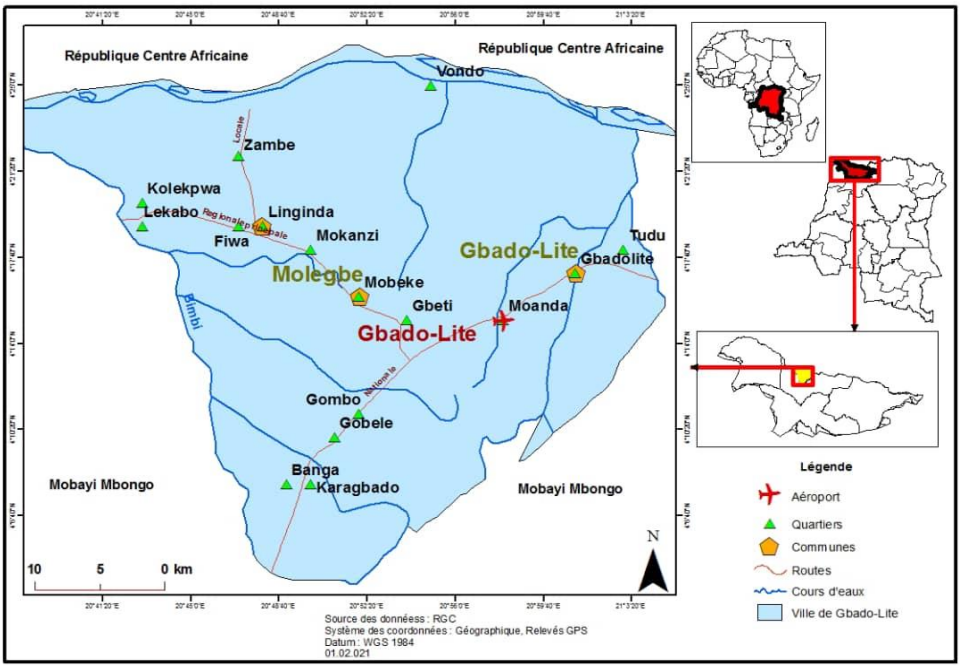

Figure 1. *Geographical location of the town of Gbado-Lite*

2.2. Methodology

The 'snowball' sampling technique was used. This technique consists of identifying a competent informant for the subject of study and then this informant after being interviewed indicates in turn another competent informant from the same community, until the desired sample size is reached. This process continued until all the selected expert informants in this study were investigated (Masengo, 2021a). The interview was conducted in Lingala and the survey sheets designed in French were used as a basis for the interviews. Respondents were interviewed individually on the basis of a survey form. The main data collected related to socio-demographic data (sex, age, level of education and marital status) and ethnozoological and ethnobotanical data (types of edible caterpillars and their host plants; harvesting period; harvesting methods, preservation methods, cooking methods, caterpillar habitats; main medical/other uses of these plants: diseases treated, parts used, methods of preparing recipes, administration routes, etc.). The study was conducted according to the principles of the Declaration of Helsinki: free consent of respondents, etc. [Mongeke, 2018; Ngbolua, 2019; Ngbolua, 2013; Masengo, 2021b; Ngbolua, 2018; Tingu (2019). Microsoft Excel version 2010, SPSS version 20 and Origin version 8.5 Pro were used for data processing and analysis.

III. Results and Discussion

3.1 Results

Figure 2 shows the distribution of respondents by gender.

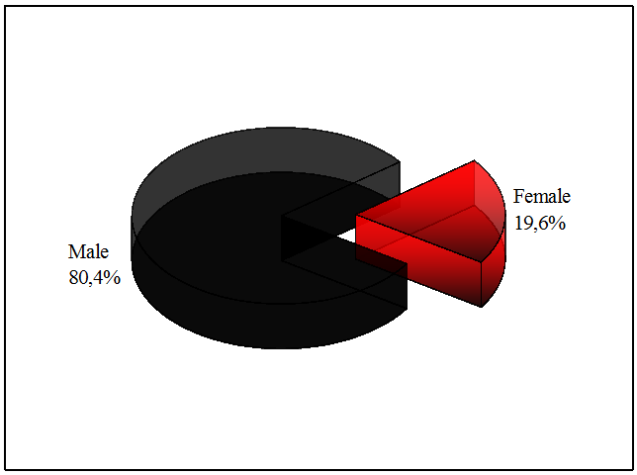

Figure 2. *Distribution of Respondents by Gender*

Figure 2 shows that the majority of respondents are men (80.4%) compared to women (19.6%). Figure 3 shows the distribution of respondents according to their marital status.

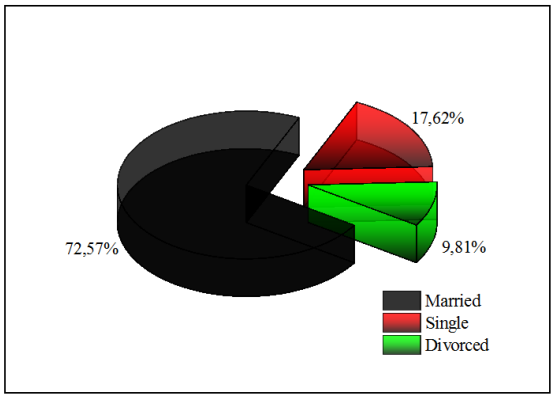

Figure 3. Distribution of Respondents by Marital Status (%)

Figure 3 shows that married people (72.57%) are in the majority compared to single people (17.62%) and divorced people (9.81%). Figure 4 shows the distribution of respondents by age group.

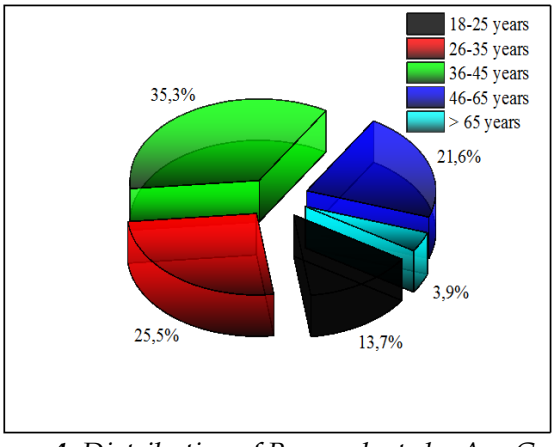

Figure 4. *Distribution of Respondents by Age Group*

Figure 4 shows that the majority (35.3%) of respondents are between 36-45 years of age. 25.5% of respondents are between 26-35 years of age; 21.6% are between 46-65 years of age and 13.7% are between 18-25 years of age. Finally, just under a tenth (3.9%) of respondents are over 65.

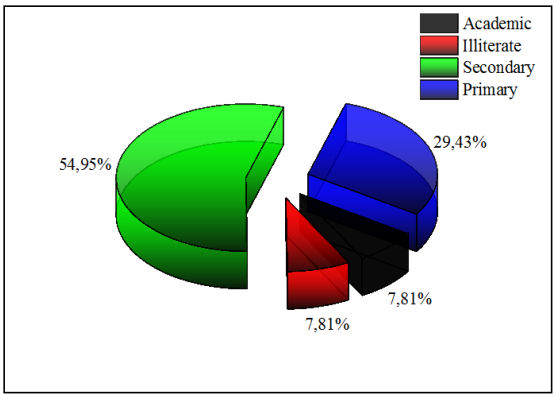

Figure 5. *Distribution of Respondents by Level of Education (%)*

Figure 5 shows the distribution of respondents according to their level of education. Figure 5 shows that the majority (54.9%) of respondents had secondary education. 29.4% of the respondents had primary education, and 7.8% were university graduates. In addition, 7.8% of respondents are illiterate. It is now accepted that the level of education of the population has a remarkable impact on the adoption of innovations and/or transfer of knowledge, technology to increase productivity in all sectors of activity and in decision making (Lautenschläger, 2017). The present study reveals that the majority of the respondents (54.9%) had secondary education indicating the need for capacity building of the population in biodiversity conservation, a subject taught only at the tertiary level.

Table 1 gives the opinion of the respondents on edible caterpillars and the medicinal use of host plants.

Table 1. Respondents' Views on Edible Caterpillars and the Medicinal Use of Host Plants

Opinion of respondents		**Frequency**	**Percentage**
Caterpillar storage methods			
	Fire drying	42	82,4
	Sun drying	9	17,6
	Total	51	100,0
Methods of harvesting caterpillars			
	Picking up on branche	7	13,7
	Ground pick-up	44	86,3
	Total	51	100,0
Cooking modes			
	Boiling	11	21,6
	Depilation	17	33,3
	Evisceration	23	45,1
	Total	51	100,0
Other uses of caterpillar host plants			
	No	13	25,5
	Yes	38	74,5
	Total	51	100,0

Edible plants			
	No	16	31,4
	Yes	35	68,6
	Total	51	100,0
Medicinal plants			
	No	1	2,0
	Yes	50	98,0
	Total	51	100,0
Harvesting period			
	August - November	7	13,7
	May - July	44	86,3
	Total	51	100,0
Habitats			
	Forest	48	94,1
	Fallow land	2	3,9
	Savannah	1	2,0
	Total	51	100,0

With regard to the opinion of the respondents on the methods of preserving edible caterpillars, the majority (82.4%) of people use fire drying against only 17.6% who use solar drying. 86.3% of respondents collect their caterpillars on the ground, compared to 13.7% who use fire to dry them. The most common method of cooking is the removal of the viscera content of young larvae or evisceration (45.1%), followed by hair removal (33.3%). Finally, caterpillars are boiled before preparation for 21.6% of respondents. It should be noted that the consumption of young caterpillar larvae that have not been properly eviscerated of their toxic leaf content (alternative hosts) is said to be at the root of many of the intoxications observed in Gbado-Lite recently.

74.5% of the respondents stated that these host plants are also used for other purposes; of these, 98% of the host plants are used in traditional medicine and 68.6% as food. In addition, 86.3% of respondents said that edible caterpillars are harvested in May and July of each year. The forest (94.1%) is the main habitat for these host plants, followed by fallow land (3.9%) and savannah (2%). These results show that deforestation or traditional slash-and-burn agriculture can cause biodiversity erosion.

Table 2. Caterpillars, Host Plants and Their Medicinal Uses

Host plants	**Treated disease**	**Edible caterpillars**	**Vernacular name**
Funtumia africana (Benth.) Stapf	Diarrhoea, stomach ache, malaria, cancer		
Petersianthus macrocarpus (P. Beauv.) Liben	Evacuation of bile (digestion of fats), stomach pains, pneumonia, jaundice.	Imbrasia epimethea Drury, 1773	Gegere
Ricinodendron heudelotii (Baill.) Heckel	Mental disorder, spleen, cough, dysentery, elephantiasis, mycosis, gonorrhoea.	Imbrasia truncata Aurivillius, 1909	Mbanga
Erythrophleum suaveolens (Guill. & Perr.) Brenan	Headaches, filariasis		
Albizia adianthifolia (Schum.) W. Wight	Malaria, conjunctivitis, haemorrhoids.	Elaphrodes lactea Gaede, 1932	Poso
Pycnanthus angolensis (Welw.)	Cough, psychosomatic disorders,		

Warb.	tooth decay, gastritis.		
Piptadeniastrum africanum (Hook. f.) Brenan	Tooth decay, splenomegaly, convulsions, pelvic pain, colds.		
Scorodophloeus zenkeri Harms	Rash, splenomegaly, bronchitis.		
Bridelia atroviridis Müll. Arg.	Constipation, diarrhoea, haemorrhoids	Anaphe panda Boisduval, 1847	Ngola
Maesopsis eminii Engl.	Splenomegaly, verminosis, gonorrhoea, sexual asthenia, sterility, constipation	Pseudanthera discrepans Butler 1908	Mbengeli ou yambalo
Entandrophragma cylindricum (Sprague) Sprague	Generalized pain, intestinal worms	Imbrasia oyemensis Rougeot, 1955	Mboyo
Triplochiton scleroxylon K. Schum.	Diabetes, oedema, pain	Anaphe venata Butler, 1878	Gbadogbado (putu)

Table 2 shows that Elaphrodes lactea consumes the leaves of four host plants: *Albizia adianthifolia*, *Piptadeniastrum africanum*, *Scorodophloeus zenkeri* and *Pycnanthus angolensis* (Welw.); *Imbrasia epimethea* was found on three host plants (*Funtumia africana*, *Petersianthus macrocarpus* and *Ricinodendron heudelotii*); *Imbrasia truncata* was found on two host plants (*Erythrophleum suaveolens* and *Ricinodendron heudelotii*) and the other edible caterpillars were only found on one species, namely *Anaphe venata* (*Triplochiton scleroxylon*) and *Imbrasia oyemensis* (*Entandrophragma cylindricum*), *Pseudanthera discrepans* (*Maesopsis eminii*). Lautenschläger et *al.* (2017) in their work on edible insects in northern Angola reported the presence of Imbrasia epimethea on Ricinodendron heudelotii, *Celtis gomphophylla*, *Entada abyssinica*. While *Imbrasia truncanta* was reported on *Uapuca vanhouttei*; *Imbrasia oyemensis* on *Entandrophragma cylindrica* and *Anaphe panda* on *Bridelia micrantha* and *Anaphe venata* on *Sterculia tragacantha*. This result can be explained by the different habitats and agroecological zones between the two works. The most consumed caterpillars in Gbado-Lite city are shown in figure 6.

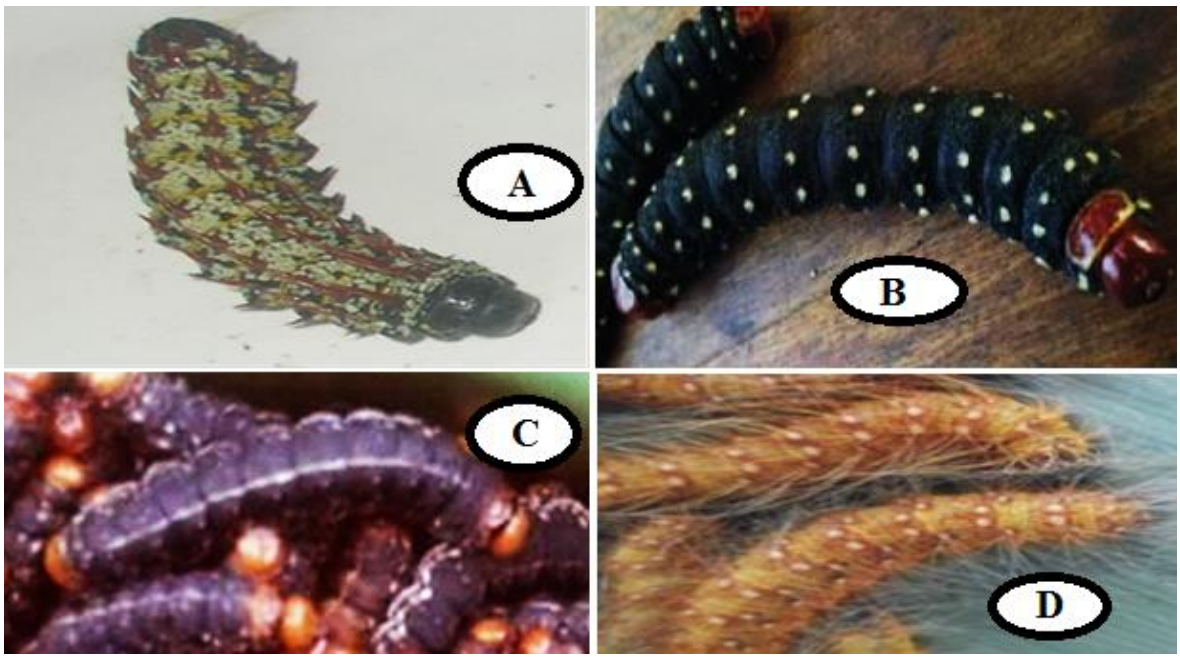

Figure 6. *Photos of some of the most consumed caterpillars in Gbado-Lite (A: Imbrasia oyemensis; B: Imbrasia truncata; C: Elaphrodes lactea; D: Anaphe venata).*

Figure 7 shows the parts of caterpillar host plants used as traditional medicines by traditional practitioners in Gbado-Lite city.

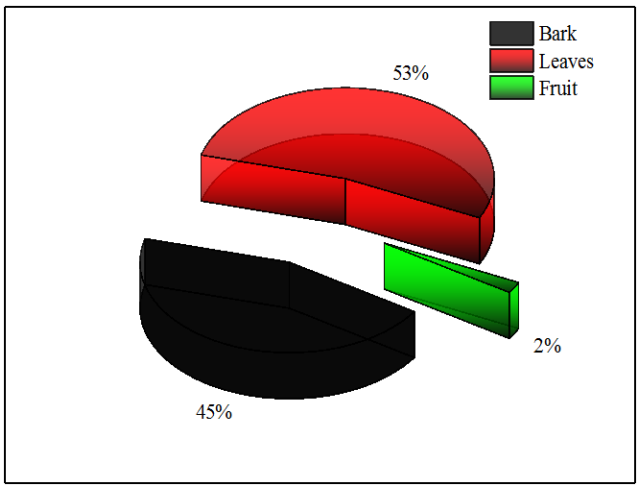

Figure 7. *Parts Used of Caterpillar Host Plants as Traditional Medicines (%)*

Figure 7 shows that leaves (52.9%) and bark (45.1%) are the parts most used in traditional medicine by the Gbado-Lite population. In addition, the fruits account for barely a tenth, or 2%.

Ecologically, the use of leaves is a non-destructive (non-invasive) and sustainable practice in herbal medicine. The high frequency of leaf use is partly due to the ease and speed of harvesting (Ngbolua, 2013) but also because most secondary metabolites are accumulated in the leaves.

Figure 8 shows the different ways in which traditional edible caterpillar host plant recipes are prepared in Gbado-Lite.

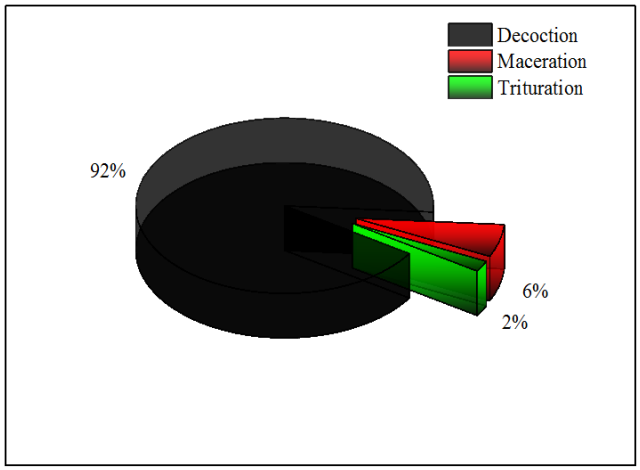

Figure 8. *Preparation Methods of Traditional Recipes Based on Edible Caterpillar Host Plants*

Figure 8 shows that decoction (92.2%) is the main mode of preparation of therapeutic recipes based on edible caterpillar host plants used in Gbado-Lite. The other preparation methods are maceration (5.9%) and trituration (2%).

The prevalence of decoction is explained by the fact that this method of preparing therapeutic recipes allows the disinfection of the raw plant material and also collects most of the active principles and attenuates or cancels the toxic effect of recipes. Infusion, on the other hand, prevents thermal denaturation of the active ingredients (Ngbolua, 2013).

Figure 9 shows the causes of the disappearance of edible caterpillars and their host plants in the peri-urban areas of Gbado-Lite.

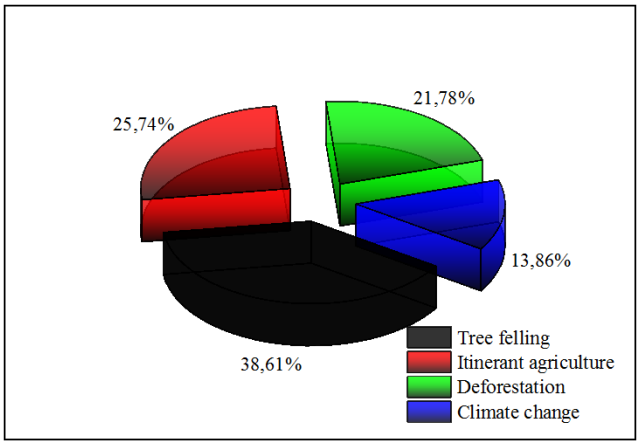

Figure 9. *Causes of the Disappearance of Edible Caterpillars and Their Host Plants (%)*

Figure 9 shows that tree felling (39.2%), traditional agriculture (25.5%), deforestation (21.6%) and climate change (13.7%) are to varying degrees the main causes of the disappearance of edible caterpillars and their host plants in the peri-urban area of Gbado-Lite.

Table 3. Respondents' Opinions on Caterpillars Poisoning in Gbado-Lite City

Respondents' opinions		**Frequency**	**Percentage**
[1] Assessment of caterpillars			
	Fairly good	3	5,9
	Good	44	86,3
	Very good	4	7,8
	Total	51	100,0
[2] Food poisoning by caterpillars			
	No	1	2,0
	Yes	50	98,0
	Total	51	100,0
[3] Causes of caterpillar poisoning			
	Other	1	2,0
	Cooking	40	78,4
	Host plants	10	19,6
	Total	51	100,0
[4] Strategy for host plant conservation			
	Other	1	2,0
	Domestication	20	39,2
	Prohibition of deforestation	30	58,8
	Total	51	100,0

Edible caterpillars are well appreciated by households in Gbado-Lite (86.3%). However, cases of food poisoning from edible caterpillars are reported every year in Gbado-

Lite according to 98% of households surveyed. Incomplete cooking (78.4%) and/or the host plant (19.6%) are the main causes of consumer poisoning (Table 3). It is believed that edible caterpillars, in the absence of their usual hosts, may use alternative plants as an ecological niche. These could be toxic plants that release and accumulate toxic principles in the caterpillar's digestive tract. Thus, if the caterpillar is consumed in its juvenile state and not fully cooked, this would result in toxicity in humans.

According to Ngbolua (2019a), the North Ubangi ecological region in the Democratic Republic of the Congo is a priority area for biodiversity conservation. However, it is currently under unprecedented anthropogenic pressure. In order to guarantee the future of this ecoregion in a sustainable way, it is therefore desirable to create forest plantations (carbon sinks) using edible caterpillar host trees/plants in peri-urban areas in order to limit the pressure on the forest. Indeed, caterpillars contribute to the nutritional balance in most households during the harvest season. In addition, people also use the host plants in traditional medicinal practices. Although edible caterpillars help to combat food insecurity, they remain essentially a harvesting/picking product. However, they have the potential to provide humans with essential nutrients such as proteins, lipids, vitamins and minerals needed for health and nutritional balance. In addition, they also have a high food conversion rate (the amount of food required to produce a 1 kg increase in weight) as cold-blooded animals, so this is an environmental advantage that argues for community agroforestry as the best strategy for community resilience to deforestation. Indeed, the forest constitutes an important source of animal protein for the population in forest regions, which helps to combat undernourishment and malnutrition and protein deficiency [FAO, 1994; Okangola, 2016; Ngbolua, 2017].

IV. Conclusions

The objective of this study was to conduct a survey on edible caterpillars and the ethno-medical value of their host plants in Gbado-Lite for a better understanding, with a view to their sustainable use.

This study shows that:

1. Drying is the most common method of preserving caterpillars (82.4%);
2. 86.3% of respondents use ground collection as a harvesting method;
3. The most commonly used cooking method is evisceration (45.1%) followed by dehairing (33.3%), also the caterpillars are boiled before preparation for 21.6% of respondents;
4. Harvesting is done more in the forest (94.1%) from May to July (86.3%);
5. 74.5% of respondents said that these plants are also used for other purposes as medicines in traditional medicine (98%);
6. 98% of respondents use host plants to treat diseases, with leaves (52.9%) and bark (45.1%) being the main parts used, while decoction is the most commonly used method of preparing recipes (92.2%);
7. Tree felling (39.2%), traditional agriculture (25.5%) and deforestation (21.6%) are to varying degrees the main causes of the disappearance of edible caterpillars and their host plants in the peri-urban area of Gbado-Lite;
8. Incomplete cooking (78.4%) and/or the host plant (19.6%) are the main causes of consumer poisoning.

It is therefore desirable that participatory and sustainable management strategies for caterpillars and their host plants be put in place in North Ubangi Province. These include community agroforestry or sustainable agriculture, in particular the Agro-sylvo-pastoral

method to be practiced in peri-urban areas in order to strengthen the resilience of communities to climate change while at the same time fighting hunger and poverty. Indeed, the domestication of species allows annihilating the pressure on wild resources, to conserve them, to fight against deforestation and to ensure the availability and sustainability of caterpillars. Those phytochemical, pharmacological and toxicological studies be carried out on host plants to identify compounds of medical interest contained in these plants.

Acknowledgements

The authors would like to thank the different socio-cultural groups and households surveyed for their free consent to participate in this study and the disclosure of knowledge.

References

Asimonyio J. A., Ngabu J. C., Lomba C. B., Falanga C. M., Mpiana P. T., Ngbolua K. N. (2015) Structure et diversité d'un peuplement forestier hétérogène dans le bloc sud de la réserve forestière de Yoko (Ubundu, République Démocratique du Congo) [Structure and diversity of a heterogeneous forest stand in the southern block of the Yoko Forest Reserve (Ubundu, Democratic Republic of Congo)]. International Journal of Innovation and Scientific Research 18 (2): 241-251.

Biloso M. A. (2008). Valorisation des produits forestiers non ligneux des plateaux des Batéké en périphérie de Kinshasa, thèse présentée pour l'obtention du titre de Docteur en Sciences Agronomiques et Ingénierie Biologique, Université Libre de Bruxelles [Valorisation of non-timber forest products from the Batéké plateaux on the outskirts of Kinshasa, thesis presented to obtain the title of Doctor in Agronomic Sciences and Biological Engineering, Free University of Brussels].

FAO (1994). Manuel de la situation mondiale de l'alimentation et de l'Agriculture [Handbook on the State of Food and Agriculture].

FAO (2001). Le rôle de la diversité biologique dans l'alimentation de l'humanité. Sécurité alimentaire. [The role of biological diversity in feeding humanity. Food security] Publications, www.fao.org/biodiversity.

Kambale J. -L. K., Shutsha R. E., Katembo E. W., Omatoko J. M., Kirongozi F. B., Basa O. D., Bugentho E. P., Yokana E. I., Bukasa K. K., Nshimba H. S., Ngbolua K. N. (2016a). Etude floristique et structurale de deux groupements végétaux mixtes sur terre hydromorphe et ferme de la forêt de Kponyo (Province du Bas-Uélé, R.D. Congo) [Floristic and structural study of two mixed plant groups on hydromorphic soil and farmland in the Kponyo forest (Bas-Uélé Province, D.R. Congo)]. International Journal of Innovation and Scientific Research 24 (2): 300-308.

Kambale J. -L. K., Asimonyio J. A., Shutsha R. E., Katembo E. W., Tsongo J. M., Kavira P. K., Yokana E. I., Bukasa K.K., Nshimba H. S., Mpiana P. T., Ngbolua K. N. (2016b). Etudes floristique et structurale des forêts dans le domaine de chasse de Rubi-Télé (Province de Bas-Uélé, République Démocratique du Congo) [Floristic and structural studies of the forests in the Rubi-Télé hunting area (Bas-Uélé Province, Democratic Republic of Congo)]. International Journal of Innovation and Scientific Research 24 (2): 309-321.

Kpula N. M., Ngbolua K. N., Assi R. L., Nzamonga A. G., Andia P. L., Masengo C. A. (2021). Pratique de l'agriculture traditionnelle sur brûlis dans la commune de Molegbe (Gbado-Lite, Nord-Ubangi) en République Démocratique du Congo [Traditional slash and burn agriculture in the commune of Molegbe (Gbado-Lite, North Ubangi) in the Democratic Republic of Congo]. Marocaine des Sciences Agronomiques & Vétérinaires 9 (4): 730-735.

Lautenschläger T., Neinhuis C., Monizi M., Mandombe J. L., Förster A., Henle T., Nuss M. (2017). Edible insects of Northern Angola. African Invertebrates 58 (2): 55–82. https://doi.org/10.3897/AfrInvertebr.58.21083

Masengo C. A., Bongo N. G., Robijaona B., Ilumbe G. B., Ngbolua K. N., Mpiana P. T. (2021a). Etude ethnobotanique quantitative et valeur socioculturelle de Lippia multiflora Moldenke (Verbenaceae) à Kinshasa, République Démocratique du Congo [Quantitative ethnobotanical study and socio-cultural value of Lippia multiflora Moldenke (Verbenaceae) in Kinshasa, Democratic Republic of Congo]. Revue Marocaine des Sciences Agronomiques & Vétérinaires 9 (1): 93-101.

Masengo C. A., Inkoto C. L., Munsebi J. M., B. L. Mandjo B. L., Mpiana P. T., Ngbolua K. N. (2021b). Connaissance et usages de Quassia africana (Simaroubaceae) par les peuples Mongo, Yaka et Yombe de Kinshasa en République Démocratique du Congo [Knowledge and uses of Quassia africana (Simaroubaceae) by the Mongo, Yaka and Yombe peoples of Kinshasa in the Democratic Republic of Congo]. Revue Marocaine des Sciences Agronomiques & Vétérinaires 9 (4): 761-769.

Mongeke MM, Ngbolua KN, Bakola RD, Inkoto CL, Elikandani PN, Mowuli CY (2018). Survey on the plants used in Traditional medicine by Bambenga: Pygmy from Dongo Sector (Territory of Kungu, Province of Sud-Ubangi) in Democratic Republic of the Congo. Revue Marocaine des Sciences Agronomiques & Vétérinaires 6 (4): 469-475.

Ngbolua K. N., Ambayi S. B., Bongo N. G., Djolu D. R., Nzamonga G. A., Masengo A. C., Koyagialo J. L., Gbatea K. A., Ndaba M. M., Kowozogono K. R. (2017). Preliminary survey on the bushmeat sector in Nord-Ubangi Province (DR Congo): Case of Gbado-Lite city and its surroundings. J. Advanced Botany and Zoology 5 (3): 1-7, 2017. doi: 10.5281/zenedo.1024570.

Ngbolua K. N., Benamambote B. M., Mpiana P. T., Muanda D. M., Ekutsu E., Tshibangu D. S. T., Gbolo B. Z. (2013). Ethno-botanical survey and Ecological Study of some Medicinal Plants species traditionally used in the District of Bas-Fleuve (Bas-Congo Province, Democratic Republic of Congo). Research Journal of Chemistry 01 (02): 1–10.

Ngbolua K. N. (2018). Données préliminaires sur la biodiversité du Nord-Ubangi en République démocratique du Congo [Preliminary data on the biodiversity of North Ubangi in the Democratic Republic of Congo]. Editions Universitaires Européennes, Riga: Latvia. ISBN: 978-613-8-44529-6.

Ngbolua K. N. (2020). Ethnobotanique quantitative: Approches méthodologiques pour l'évaluation et la valorisation du savoir endogène en régions tropicales [Quantitative Ethnobotany: Methodological approaches for the evaluation and valorisation of endogenous knowledge in tropical regions]. Editions Universitaires Européennes, Riga: Latvia. ISBN: 978-613-9-53635-1.

Ngbolua KN, Inkoto CL, Mongo NL, Ashande CM, Masens YB, Mpiana PT. (2019). Étude ethnobotanique et floristique de quelques plantes médicinales commercialisées à Kinshasa, République Démocratique du Congo [Ethnobotanical and floristic study of some medicinal plants marketed in Kinshasa, Democratic Republic of Congo]. Revue Marocaine des Sciences Agronomiques & Vétérinaires 7 (1): 118-128.

Ngbolua K. N., Kumbali N. G., Mbembo-wa-Mbembo B., Kohowe P. S., Kogana K. F., Bongo N. G., Masengo A. C., Djolu D. R. (2020a). First Report on Three Cases of Monkey pox in Nord Ubangi Province (Democratic Republic of the Congo). Britain International of Exact Sciences (BIoEx) Journal 2 (1): 120-125.

Ngbolua K. N., Ndanga B. A., Gbatea K. A., Djolu D. R., Ndaba M. M., Masengo A. C., Likolo B. J., Falanga M. C., Yangba T. S., Gbolo Z. B., Mpiana P. T. (2018). Environmental Impact of Wood-Energy Consumption by Households in Democratic

Republic of the Congo: A Case Study of Gbadolite City, Nord-Ubangi. International Journal of Energy and Sustainable Development 3 (4): 64-71.

Ngbolua K. N., Ndanga B. A., Gbatea K. A., Djolu D. R., Ndaba M. M., Masengo A. C., Ngemale G. M., Motende B. N., Ndolete G. J-P., Djolu D. R., Libwa M. B., Bong N. G. (2019a). Evaluation of Artisanal Logging Sector in Democratic Republic of the Congo: A Case Study of Peri-urban Forest of Gbadolite City, Nord-Ubangi. International Journal of Plant Science and Ecology 5 (2): 25-30.

Ngbolua K. N., Ngemale G. M., Masengo A. C., Ndolete G. J. P., Bongo N. G., Ndanga B. A., Tshibangu D. S. T., Tshilanda D. D. (2020b). Survey on the Sale of Megaphrynium Macrostachyum (Marantaceae) Leaves in Gbado-Lite City and Surroundings (Nord Ubangi Province, Democratic Republic of the Congo). Budapest International Research in Exact Sciences (BirEx) Journal 2 (2): 157-167.

Ngbolua K. N., Nzamonga G. A., Gbatea K. A., Nzale M. S., Masengo A. C., Ndolete G. J-P., Bongo N. G., Zakwani L. N., Libwa M. T. B., Yangba T. S., Gerengbo K. G. (2019b). Knowledge on Non-Timber Forest Products (NTFPs) Marketed in Democratic Republic of the Congo: A Case Study of Gbadolite City and Surroundings, Nord Ubangi. Agricultural and Biological Sciences Journal 5 (1): 20-28.

Ngbolua K. N., Rakotoarimanana H., Rafatro H., Urverg R. S., Mudogo V., Mpiana P. T., Tshibangu D. S. T. (2011a). Comparative antimalarial and cytotoxic activities of two Vernonia species: V. amygdalina from the Democratic Republic of Congo and V. cinerea subsp vialis endemic to Madagascar. International Journal of Biological and Chemical Sciences 5 (1): 345-353.

Ngbolua K. N., Rafatro H., Rakotoarimanana H., Urverg R. S., Mudogo V., Mpiana P. T., Tshibangu D. S. T. (2011b). Pharmacological screening of some traditionally-used antimalarial plants from the Democratic Republic of Congo compared to its ecological taxonomic equivalence in Madagascar. International Journal of Biological and Chemical Sciences 5 (5): 1797-1804.

Ngbolua K. N., Zuangbo I., Molongo M., Masengo A. C., Djolu D. R., Yabuda H., Bongo N. G, Gbolo Z. B., Monde -te-K. G. (2019c). Effect of Agricultural Residues Based-Compost on the Yield of Amaranthus hybridus L. (Amaranthaceae) in Gbado-Lite City, Nord-Ubangi (Democratic Republic of the Congo). Budapest International Research in Exact Sciences (BirEx) Journal 1 (4): 53-61. doi: https://doi.org/10.33258/birex.v1i4.477.

Okangola E., Solomo E., Tchatchambe W. B., Mate M., Upoki A., Dudu A., Asimonyio A. J., Bongo N. G., Mpiana P. T., Ngbolua K. N. (2016). Valeurs nutritionnelles des chenilles comestibles de la ville de Kisangani et ses environs (Province de la Tshopo, République Démocratique du Congo) [Nutritional values of edible caterpillars from the city of Kisangani and its surroundings (Tshopo Province, Democratic Republic of Congo)]. International Journal of Innovation and Scientific Research 25 (1): 278-286.

Sunderland T., Profizi J. P. (2002). Nouvelles recherches sur les rotins africains [New research on African rattlesnakes]. Acte n° 9 de la Rencontre Internationale des Experts. CARPE. 146p.

Tingu C., Mathunabo A. (2019). Analyse de la situation socio-économique et alimentaire des ménages des provinces du Nord et Sud Ubangi en RDC [Analysis of the socio-economic and food situation of households in the provinces of North and South Ubangi in DRC]. Marocaine des Sciences Agronomiques & Vétérinaires 7 (1): 203-211.

Wilkie D. (2000). Le programme CARPE sur les PFNL [The CARPE NTFP programme]. In Sunderland, T. C. H, L. E. Clerk et P. Van Tomme (eds). Les Produits Forestiers Non Ligneux en Afrique Centrale. Recherches actuelles et Perspectives pour la conservation et le développement [non-timber forest products in Central Africa. Current Research and Perspectives for Conservation and Development]. F. A. O., Rome, pp. 3-17.