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# Ethnobotanical study of the use of *Plectranthus glandulosus* in the Department of Lac-Lere-Chad

**Dessenbe Théophile[1,2], Mbaïlao Mbaïguinam[1], Nukenine Elias N.[1]**

**Abstract**: The traditional use of plants has always occupied an important place in practices in Chad. The Mayo Kebbi Ouest region is a tangible example. Thus, an ethnobotanical survey was conducted in this region with the aim of highlighting the use of *Plectranthus glandulosus* in the department of Lac-Lere during the month of May to July 2018 with a global sample of 513 people answering our various questions based on information relating to their profiles and their knowledge of the plant. The identification of the plant was made with the help of a botanist. The analysis of the results showed that this plant is widely used in the department of Lac-Lere in insecticidal (76.4%), medicinal (64.3%) and culinary (55.02%) form. The foodstuffs most protected by this plant are, among others, maize (31.3%) and cowpea (30.6%). Its leaves are the most used (77.4%) and generally fresh (82.5%). *P. glandulosus* has a crop preservation power that can last more than three (3) months (67.2%) due to its insecticidal effects.

**Keywords**: Ethnobotanical survey, Insecticide, Lac-Lere, *Plectranthus glandulosus*, *Traditional use.*

[1]**Address:** Department of Biological Sciences, University of Ngaoundere, PO B ox 454, Ngaoundere, Cameroon
[2]**Address:** Research Laboratory of Natural Substances, Faculty of Exact and Applied Sciences University of Ndjamena, Chad

***Corresponding author**: theophiledessenbe@gmail.com

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## 1. INTRODUCTION

Insect pests of foodstuffs, mainly Coleoptera, can cause the total loss of stock. The methods used to limit damage and losses by farmers are generally synthetic chemical insecticides (Demessie *et al*., 2008), which often leads to resistance, pollute the environment and harm health. consumers (Nukenine *et al*., 2007).

Plants produce active substances with insecticidal properties, aseptic or growth regulating. Most of the time, these active substances are secondary metabolites which originally protect plants herbivores (Deravel *et al*, 2013). Plants are the main medicinal means for public health care. Phytotherapy was widespread, but today it is disappearing because of this new pharmacopoeia (Nacoulma, 1996).

*Plectranthus glandulosus* is a plant species of the genus *Plectranthus* found in West African flora (Hutchiton and Daziel, 1958), in Chadian flora (Dessenbe *et al*., 2022) and in Cameroonian flora (Pele and Berre, 1966; Amvam zollo et al., 1998). This plant species belongs to the *Lamiaceae* (*Labiaceae*) family. It is a strongly aromatic annual plant that can exceed more than 2 m in height (Nukenine *et al.*, 2011). The stem is covered with woolly hairs with opposite leaves that are less hairy, broadly ovate, acuminate at the apex, with crenate edges (Said et al., 2011). It is characterized by holdfast roots which appear at the level of secondary ramifications at the base of the stem when the plant gains height. Each armpit carries a bud that can give rise to a secondary or tertiary branch. It bears two-lipped purple flowers when in bloom (Pamplona, 1999). Found mainly in sub-Saharan Africa and Madagascar, the genus *Plectranthus* extends to the south of the Arabian Peninsula, India and, for a few species, Malaysia, Indonesia, Australia and some Pacific islands (Forster et al., 2002; Van Jaarsveld, 2006). It is also present in Chad.

In Chad, *P. glandulosus* is used in traditional medicine to treat various pathologies; this herbal drug is well known in Cameroon for its properties medicinal and especially its effectiveness against insect pests, especially beetles

(Nukenine *et al*., 2007). A strong knowledge of the use of plants is still alive in all regions of Chad and no one suspect the wealth of knowledge tradition accumulated around this plant.

This study, carried out in the department of Lac-Lere, aims to gather as much information as possible on traditional uses, in particular insecticide of *P. glandulosus* and this with the local population of the region of Mayo Kebbi Ouest. Indeed, this traditional knowledge could be quite an important basis for the elaboration of a scientific knowledge that would allow both its valorization, its preservation and perpetuity.

## 2. MATERIAL AND METHOD

### 2.1. Ethnobotanical survey

The ethnobotanical survey, which is field work, consists of meeting farmers to find out about their method of preserving foodstuffs in stock by using *P. glandulosus*. This survey is essential insofar as it allows us to orient ourselves in order to target certain biological tests. The tool for this work is to develop a series of questionnaires (Anyinam 1995). It is semi-structured with semi-open questions to keep a certain flexibility in the conversation and to open exchanges with the informant (Gérique, 2006). Thanks to its use, this survey was carried out. Knowledge of the traditional use of plants in folk medicine and in crop protection makes it possible to determine the most promising parts by taking into account criteria based on the absolute number of citations of the parts used, its degree of specificity for accurate (Cheriti *et al*., 2005).

### 2.2. Description and choice of survey location

Locality located in the South-West of Chad, in the region of Mayo-Kebbi Ouest, the Prefecture of Lac-Lere was born between the 14th and 17th centuries with the installation of the Moundang ethnic group constituting the old core of its settlement. (Passinring, 2006). Lac-Lere with geographical coordinates, latitude 9°46'12" North and longitudes 14°09'0" East, rests on a tectonic basin of post Mesozoic age (Passinring, 2006).

The prefecture of Lac-Lere, as its name suggests, includes the lakes of Léré and Tréné. It stretches about 70 km from East to West, and 40 km from North to South. Lac-Léré and Tréné, fed by the Mayo-Kebbi river, cover an area of about 46.7 km$^2$ and are full of enormous fishing and pastoral potential. They constitute the vital basis of local populations and their livestock thanks to the diversity of species of fish, aquatic mammals and pastoral areas with high fodder potential. This natural heritage is coveted and intensely attractive to transhumant herders and farmers (Passinring, 2006).

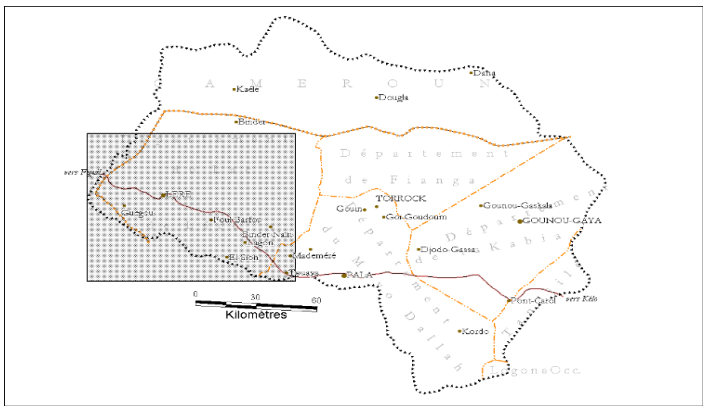



**Figure 1.** Geographical representation of the map of the department of Lac-Lere

### 2.3. Data collection methodology

**a. Sampling**

During this ethnobotanical survey on *Plectranthus glandulosus*, the weekly market in the department of Lac-Léré was chosen as the sampling site. The sample of this plant was collected locally, precisely in Tréné, a village located 10 km from the city of léré to be presented to all farmers for identification. The plant was previously confirmed by the help of the Botanist, University of Ndjamena, Dr Ali Brahim. The sampling we used is random and simple. To carry out this type of sampling, we based ourselves on three factors; the sale of foodstuffs as a whole, the arrival of farmers from the surrounding villages with the stored foodstuffs put up for sale, and the traders reselling the foodstuffs on the market.

**b. Quiz**

The study method is based on an ethnobotanical questionnaire sheet submitted to respondents during individual interviews. The ethnobotanical survey form was completed with 513 people of all genders. This questionnaire concerns some data on the profile of each respondent and the ethnobotanical data collected. (Fatima *et al*., 2017).

**c. Collection of data**

The ethnobotanical survey lasted from May 12 to July 23, 2018. To collect ethnobotanical data, a sample of 513 farmers and traders were randomly interviewed. Respondents were questioned individually using a questionnaire form completed by oral questioning. Some data collected during the surveys relate to the informant (civility, sex, occupation, age, etc.), and others relate to the plant such as the local name of the species, the organs used, their methods of preparation, the type of foodstuffs protected by it, etc. (Fatima *et al*., 2017).

**d. Statistical analysis**

Sphinx software was used to design the questionnaires. The collected questionnaires were analyzed carefully. Quantitative data were entered, analyzed, and graphs designed using Sphinx plus 2 software, version 5.0 (2011).

**e. Legal aspect**

The persons surveyed are informed that the filling of the questionnaire is done anonymously and that the exploitation of the data is carried out in a strict framework of university research.

## 3. RESULTS

The ethnobotanical survey carried out in the field made it possible to question 513 people of all genders, made up of 89.08% men, 10.92% women, of whom 90.02% have in-depth knowledge of *P. glandulosus* and use them in the protection of crops in storage. The local name of *P. glandulosus* according to the population is "Vohn" in Moundang dialect and generally used by insertion in foodstuffs during conservation.

### 3.1. Distribution of respondents on knowledge of *Plectranthus glandulosus* according to general information

#### 3.1.1. Breakdown by gender of respondents

Men, women and young people are concerned by the use of plants in crop protection. However, in the present survey, more men use plants with insecticidal effect in conservation. Thus, 89.08% of plant users are men, against 10.92% of women (Figure 2).

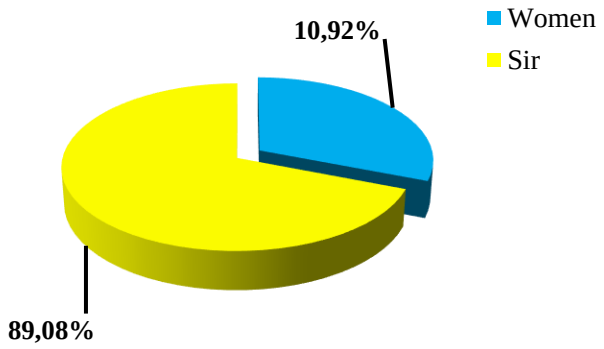



**Figure 2.** Frequency distribution of respondents according to gender.

#### 3.1.2. Distribution of respondents by length of residence

Table 1 shows that 302 people out of 513, or 58.9% of our respondents, have lived for between 15 and 20 years in the Mayo-Kebbi Ouest region, mainly in the Department of Lac-Lere. Those having lasted between 5 to 10 years, 10 to 15 years and more than 20 years are represented respectively by 3.5%, 24.2% and 13.4%.

**Table 1.** Frequency of repair of respondents according to the duration of their residences in the region.

| Duration of residence | Frequency(n) | Percentage (%) |
|---|---|---|
| **5 to 10 years** | 18 | 3.5 |
| **10 to 15 years** | 124 | 24.2 |
| **15 to 20 years old** | 302 | 58.9 |
| **Over 20 years** | 69 | 13.4 |
| **Total** | **513** | **100%** |

#### 3.1.3. Distribution of respondents according to their socio-professional activities

Figure 3 shows us that 432 out of 513, or 84.2%, of the people who use *P. glandulosus* in crop protection are farmers. Next come traders, represented by 7%, workers and retirees with 4.1% and 3.7% respectively.

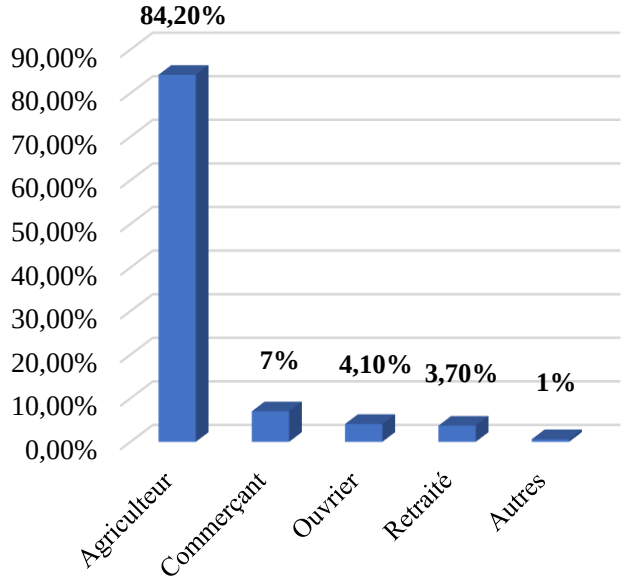



**Figure 3.** Frequency of distribution according to socio-professional categories of respondents

#### 3.1.4. Distribution of respondents according to age groups of respondents

The results show that people aged between 46 and 65 are the most cited in the present study with a frequency of 60.8% (Table 2). Then come the age groups ranging from 25 to 45 years (19.5%). People over 65 and under 25 are represented with a rate of 15.6% and 3.7% respectively.

**Table 2.** Frequency of distribution according to age groups of respondents

| Age group of respondents | Frequency (n) | Percentage (%) |
|---|---|---|
| **Under 25** | **19** | **3.7** |
| **25 to 45 years old** | **100** | **19.5** |
| **46 - 65 years old** | **312** | **60.8** |
| **Over 65** | **82** | **15.6** |
| **Total** | **513** | **100%** |

### 3.2. Distribution of respondents on knowledge of *Plectranthus glandulosus* according to specific information related to the plant

#### 3.2.1. Distribution of respondents according to knowledge of *P. Glandulosus*

Most of the local population of the department of Lac-Lere has a wide knowledge about *P. glandulosus*. 463 people out of 513, or 90.2% of our respondents, claim to know *P. glandulosus* against 9.8% having no knowledge (Figure 4).

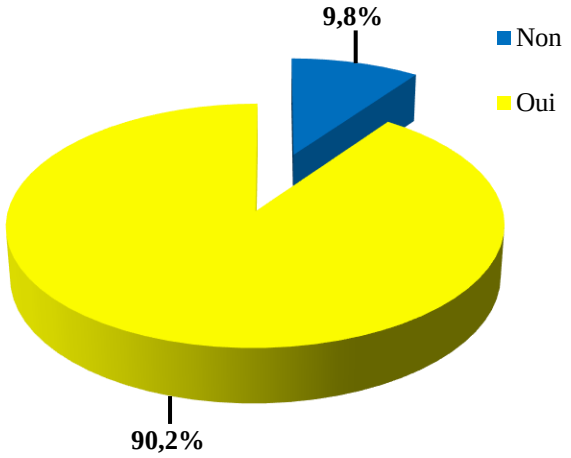
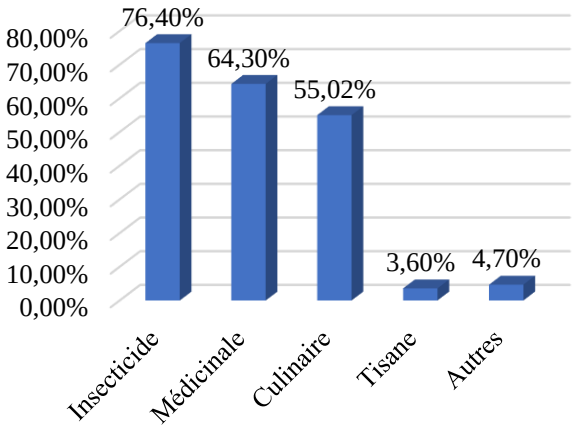



**Figure 4.** Frequency distribution of respondents according to their knowledge of *P. glandulosus*

#### 3.2.2. Distribution of respondents according to the use of *Plectranthus glandulosus*

In total, 4 types of use of *P. glandulosus* were known in the Lac-Lere department, including culinary, medicinal, insecticidal and herbal tea use. The results show that *P. glandulosus* is used more as an insecticide with a rate of 76.4%; followed by culinary use with a rate of 55.02% (Figure 5). This plant is also used for medicinal purposes (64.3%) and in the form of herbal tea (3.6%). Other types of use, namely fumigation and inhalation, are cited with a rate of 4.7%.




**NB:** The Class of this studied variable is not exclusive but exhaustive to our questionnaire.

**Figure 5.** Frequency of distribution of respondents according to the types of use of *P. glandulosus*

#### 3.2.3. Breakdown of respondents by use of *P. glandulosus* in crop protection

The different responses given by the local population show that *P. glandulosus* is widely used in crop protection. It appears that 87.7% of the population claim to use this plant to the detriment of other chemical insecticides against 12.3% who have no knowledge of the insecticidal use of this plant in the conservation of foodstuffs (Figure 6).

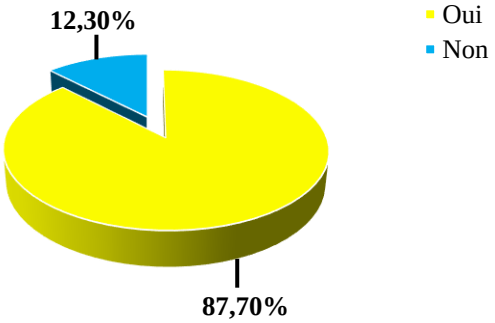



**Figure 6.** Frequency of distribution of respondents on the use of *P. glandulosus* in the protection of foodstuffs

#### 3.2.4. Distribution of respondents according to the types of foodstuffs protected by *P. Glandulosus*

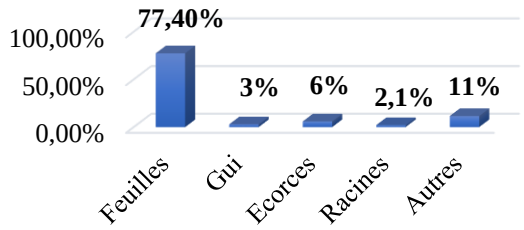
The use of *P. glandulosus* by the population is widespread in the department of Lac-Lere. This plant is used in the protection of several foodstuffs with varying rates of use. These are maize, peanuts, sesame, beans, sorghum and ground peas. This table shows that 31.3% of the population use this plant in the protection of maize against 30.6% in the protection of beans (Table 3). Sorghum, ground pea, peanut, and sesame, with a rate of 16.7% respectively; 6.9%; 6.8% and 1.7%.

**Table 3.** Frequency of distribution of respondents according to the types of foodstuffs protected by *P. glandulosus*

| Food type | Frequency(n) | Percentage (%) |
|---|---|---|
| But | 161 | 31.3 |
| Peanut | 35 | 6.8 |
| Bean | 157 | 30.6 |
| ground pea | 36 | 6.9 |
| Sesame | 9 | 1.7 |
| Sorgo | 8 | 16.7 |
| Others | 29 | 6 |
| Total | 513 | 100% |

### 3.2.5. Distribution of respondents according to the parts used of *P. glandulosus* in crop protection

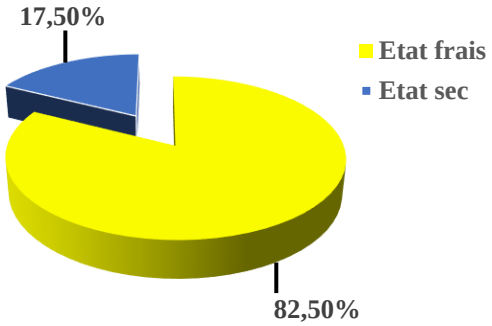
Respondents claim that 4 parts of *P. glandulosus* are used in the crop protection system, including leaves, roots, barks, and mistletoes. It appears that the leaves are used more (77.4%) than the other parts. Barks, roots and mistletoes are used less with a respective percentage of 6.0%; 3.0% and 2.1% (Figure 7). The other part being indicated in this figure is represented by 11% and indicates the entire use of the inflorescences of the plant in the protection of foodstuffs.




**Picture 7.** Frequency distribution of respondents on the parts used of *P. glandulosus* in crop protection

### 3.2.6. Distribution of respondents according to the state of use of *P. glandulosus* leaves in crop protection

The present study shows that the leaves of *P. glandulosus* are widely used fresh in storage. Thus, 82.5% of the local population preserve their foodstuffs by using *P. glandulosus* leaves in a fresh state against 17.5% in a dry state (Figure 8). This conservation is done by inserting fresh leaves into the commodity in storage (97.5%) until the end of the diffusion of its insecticidal effectiveness.




**Picture 8.** Frequency of distribution of respondents according to the state of use of *P. glandulosus*

### 3.2.7. Distribution of respondents according to the state of use of *P. glandulosus* leaves in crop protection

In the preservation system, some farmers use the dry leaves of *P. glandulosus* by proceeding through their own drying systems before any use. The figure below shows the different methods of drying *P. glandulosus* leaves. It appears from this result that *P. glandulosus* used in the dry state in the conservation of crops undergoes a drying procedure done in the shade (12.3%) than in the sun (1.6%) (Figure 9). 86.15% preserve their food with fresh leaves.

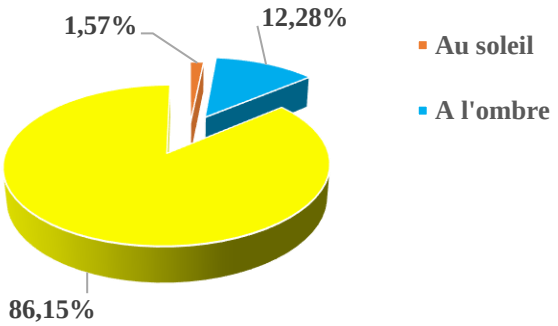



**Figure 9.** Frequency distribution of respondents according to methods of drying *P. glandulosus* leaves

### 3.2.8. Distribution of respondents according to the duration of insecticidal efficacy of *P. glandulosus* during storage

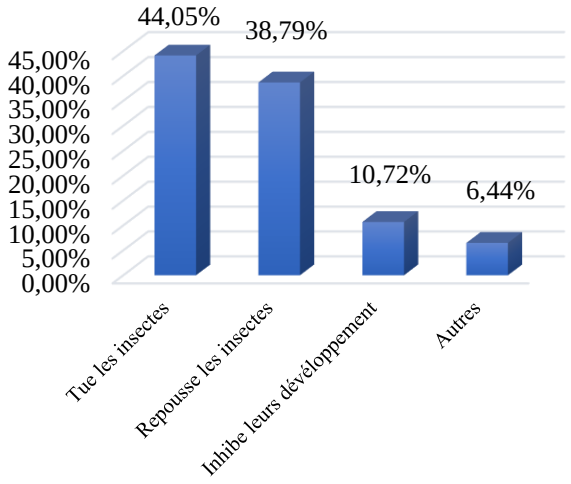
The plant inserted into the foodstuff in storage induces an effectiveness of variable duration depending on the people surveyed. 345 people out of 513, i.e. 67.2% of respondents, affirm that *P. glandulosus* can keep crops for between 2 to 3 months (Table 4). 11.5% of respondents claim that it protects between 1 to 2 months; 11% between 3 to 4 months and 8.2% at more than 4 months.

**Table 4.** Frequency of distribution of respondents according to the shelf life of foodstuffs by *P. glandulosus*

| The duration of the conversation | Frequency (n) | Percentage (%) |
|---|---|---|
| **Less than 1 month** | **11** | **2.1%** |
| **1 to 2 months** | **59** | **11.5%** |
| **2 to 3 months** | **345** | **67.2%** |
| **3 to 4 months** | **56** | **11%** |
| **More than 4 months** | **42** | **8.2%** |
| **Total** | **513** | **100%** |

### 3.2.9. Distribution of respondents according to the insecticidal activity of *P. glandulosus*

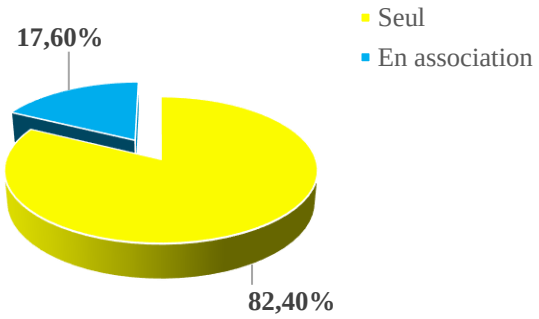
The effects of plant leaves act on insects in several ways. They can be repellent i.e. repel insects, lethal i.e. kill insects and inhibitory i.e. inhibit the development of insects. In the present work, the results show that *P. glandulosus* is more insecticidal than repellent according to the responses of the people surveyed with a rate of 44.05% and 38.79% respectively (Figure 10). Only 10.7% of the surveyed population indicate that this plant inhibits the growth of insects.




**Picture 10.** Frequency of distribution of respondents according to their knowledge of the insecticidal activity of *P. glandulosus*

### 3.2.10. Distribution of respondents according to the insecticidal activity of *P. Glandulosus*

The use of this plant in the field of traditional medicine is variable with several methods and techniques. The present survey of the local population shows that this plant is less used in association with other plants with a rate of 6.3% against 82.4% indicating its use alone in the treatment of pathologies (Figure 11).




**Picture 11.** Frequency distribution of respondents according to their knowledge of the medicinal use of *P. glandulosus*

## 4. DISCUSSION

The ethnobotanical survey carried out on the whole of the department of Lac-léré, highlights the use of *Plectranthus glandulosus* by the population as an insecticide with a wide knowledge of elaborate use, i.e. 87.70%. The results showed that the people surveyed are mostly male, mostly over 46 years old. This is explained by the fact that in Chad, the sale of agricultural products is reserved for men. In addition, the use of plants in food preservation is an ancestral practice that is transmitted from generation to generation (Adjanohoun *et al*., 1989; Klotoé *et al*., 2013).

Most of the people responding to our questionnaire during this study are permanent residents of the mayo-kebbi west region, mainly from the department of Lac-Léré with an average duration of 15 to 20 years (58.9%) of life there. This confirms the fact that knowledge related to the use of medicinal plants in a locality is reserved for indigenous people with a close connection to their environment (Jayakumar *et al*., 2010).

We note that farmers are the most cited in this study and represent 84.2%. This result corroborates with those of Benkhnigue *et al*., 2011, which states that farmers are the most exposed to crop enemies and through the active search for solutions, discover alternatives for the protection of their crops. The virtues of *P. glandulosus* are deferred. Respondents indicated that this plant has culinary, medicinal and insecticidal properties. *P. glandulosus* was found to be more insecticidal in the department of Lac-Lere (76.40%); this justifies its use in the protection of foodstuffs in storage. This result corroborates with those of Danga *et al*., 2015, Nukenine *et al*., 2011, Nukenine *et al*., 2009, Tofel *et al*., 2016 which confirm its insecticidal effect in storage thanks to the presence of its secondary metabolites put in evidence.

The parts most used in food preservation are the leaves of *P. glandulosus* (77.4%), followed by the bark (6%). Although the use of the leaves is represented by a large percentage, it was noticed during the survey that in the field the users tend to uproot the whole plant instead of focusing only on the desired part (mainly the leaves). On the other hand, there is a clear relationship between the part of the exploited plant used and the effects of this exploitation on its existence (Cunningham, 1996). Knowing that the leaves are the seat of

photosynthesis and sometimes of the storage of secondary metabolites responsible for the biological properties of the plant (Bigendako-polygenis and Lejoly, 1990), the ease and speed of harvesting (Bitsindou, 1986) may be the cause of the high rate of use of the foliage by the population of the region. These results corroborate with those of Tahri *et al*. 2012.

*Plectranthus glandulosus* is used more alone (82.4%) than in association in the preservation of crops. Its predominance is therefore monospecific. This predominance is to the advantage of the user. Indeed, associations of plants, not assorted, are sometimes dangerous (Kouadio *et al.,* 2016). In Africa, about 30% of fatal accidents are due to the use of mixtures (El-Said et al., 1969).

In addition to the diversified virtues of *P. glandulosus*, its insecticidal effect is protective of several foodstuffs in storage, by acting on different types of insects, mainly beetles. The results indicate that P. glandulosus is widely used in the protection of maize (31.3%), beans (30.6%) and sorghum (16.7%) in Chad. These results can be explained by the fact that the insect enemies of these commodities are all weevils belonging to the same family (Coleoptera).

The forms of use of herbal drugs vary from one plant to another. After the ethnobotanical surveys, according to the people surveyed, *P. glandulosus* is used more in the fresh state than in the dry state in the conservation of foodstuffs in storage. These results can be explained by the fact that the fresh leaves of the plants have more properties than those which are dry which would have lost their properties and/or secondary metabolites under the effect of heat. This work corroborates with that of Sellami *et al*., 2011 which indicates that plants belonging to the *Lamiaceae* family such as *P. glandulosus* are known to keep their volatile compounds on or near the surface of the leaves, then easily lose them when the temperature increases. This could explain the loss of hydrocarbon constituents from sun-dried leaves. It is widely reported that sun-drying plant materials has an effect on their chemical composition and therefore reduces their effectiveness when used as drugs or insecticides (Caboni *et al*., 2009; Najafian and Agah 2012; Shahhoseini *et al.*, 2013). This result corroborates with those of Tofel 2016, which indicates that sun-dried leaves had lower levels of volatile compounds than shade-dried leaves.

Farmers having indicated that the plant was used in a dry state, inform that the leaves of *P. glandulosus* are dried in the shade. This result corroborates that of Nukenine *et al*., 2007; which indicates that the secondary properties and/or metabolites of plant leaves volatilize under the effect of heat. Heat has a power to degrade the properties of plants.

The preservative power of *P. glandulosus* against insects remains persistent, averaging up to three (3) months (67.2%). This power would be due to the presence of secondary metabolites contained in the leaves which are released gradually during the storage period. These results confirm the work of Tofel, 2016 which states that *P. glandulosus* can preserve foodstuffs for up to three (3) months against pests, mainly beetle insects.

## 5. CONCLUSIONS

The ethnobotanical survey that we conducted confirms the use of *Plectranthus glandulosus* in the department of Lac-Lere in Chad by the local population. It made it possible to collect information on its use. This revealed multitudes of uses indicating that *P. glandulosus* is a plant widely used in the department of Lac-lere in insecticidal form (76.4%) in the protection of foodstuffs, medicinal (64.3%) and culinary (55.02%). %). This study showed that *P. glandulosus* is more used in the protection of maize (31.3%) and cowpea (30.6%) in storage compared to other foodstuffs. The most used parts were the leaves (77.4%), generally in the fresh state (77.3%), but dried in the shade when it comes to use in the dry state. It also shows that *P. glandulosus* could preserve the foodstuffs beyond three months of storage (67.3%). At the end of this study, we can say that *P. glandulosus* is promising in the protection of harvests and can constitute a track for the research of new alternatives to synthetic chemical insecticides if ever it constitutes a relevant in-depth research project.

**Thanks**
Our thanks go to the local authorities who agreed to allow this survey to take place in their constituency areas, to the 513 people who agreed to answer our questions, to Dr. Ali Brahim, Botanist at the University of Ndjamena d for agreeing to identify the plant before the study, to Pr. Nukenine Elias N. and Pr. Mbaïlao Mbaïguinam for helping to direct this research.

**Peer-review**
Externally peer-reviewed.

**Conflict of Interest**
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