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Therapeutic utility of plants from the Mountains of Man, Côte d'Ivoire

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ABSTRACT

To find out the medicinal contribution to the local population of the plants colonizing the mountains of the town of Man, we traveled 5 mountains and interviewed 129 people from the said town. The chosen mountains are called: Kôh mountain, Mount Zélé, Glaha mountain, Glèhè mountain and Gôhò mountain. These mountains were chosen for their significant plant diversity. Plots made at an altitude of 300 to 400 meters were used to inventory the plants. Two indices were used to evaluate the ethnobotanical data, namely the frequency of citation of species (FC) and the relative exploitation level of these plants (NER). The study made it possible to inventory 48 plant species divided into 44 genera and 26 families. The Fabaceae family is the most represented. Ethnomedic investigations revealed the use of these plants in the treatment of 25 common pathologies. The leaves are the organs most used in these treatments. And the technique for preparing drugs is decoction. The ethnobotanical indices evaluated indicated that the species best exploited by the population are *Alchornea cordifolia* and *Euphorbia hirta* with a NER = 55% each. These indices also reveal that *Chromolaena odorata* (FR = 19.58%) and *Tithonia diversifolia* (FR = 13.23%) are the most common species found at low altitude in the Man Mountains. The results of this work could stimulate further in-depth studies on mountain plants in the search for effective phytomedicines.

Keywords: Ethnobotany, Medicinal plants, Mountains, Man, Côte d'Ivoire

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INTRODUCTION

Man has always used plants to ensure his survival since ancient times ¹. This is explained by the use of these plants in various areas of life, such as housing, food and health ². The relationships between man and plants have led to the emergence of a new branch of botany called ethnobotany. This discipline is therefore a science that studies the use of plants by man in the history of a society and in a given geographical setting ³. It aims to inventory the different uses of plants by various populations, to analyze and interpret the similarities as well as the differences, moving from one population to another ⁴. Ethnobotany has stimulated another important discipline: ethnomedicine. Ethnomedicine encompasses all beliefs and practices related to health and illness within each society ⁵. Ethnomedicine is based on a deep knowledge of medicinal plants and their therapeutic properties. This practice is generally known as traditional medicine, which is also known in developed countries. It is therefore the "ancestor" of modern medicine ⁶. Today, the use of plants for health is widespread not only in developing countries but also in developed societies ⁷. This is due to the fact that despite the progress made by industrialized countries in the field of chemistry, aimed at promoting modern medicine, many populations are massively turning to medicinal plants as their last hope ⁸. Indeed, these plants are often considered effective remedies for common and serious conditions such as asthma, cancer, sickle cell disease, high blood pressure, diabetes and malaria, for which conventional treatments have not yet provided a definitive solution. Furthermore, several scientific studies have highlighted the medicinal properties of plants, confirming their effectiveness in treating various conditions. This growing recognition of the benefits of medicinal plants also contributes to the increase in their use in traditional and modern health systems around the world. In Côte d'Ivoire, this trend is even more pronounced, where more than 80% of the population prefers herbal remedies for their health care ⁹. This preference is explained by various factors, including the geographical distance from health centers, the scarcity or absence of health equipment, long service times in hospitals and the high cost of pharmaceutical products ¹⁰. In addition, socio-cultural considerations play an important role, i.e. traditional medicine is often perceived as being more in line with local cultural beliefs and practices, and it offers accessibility and affordability for many people.

Medicinal plants are present in all surrounding ecological environments, such as plateaus, plains and mountains. The city of Man, the subject of this study, is characterized by a multitude of outcrops, including mountains, which has earned the entire region the title of "18 mountains". Moreover, the mountains are home to the greatest diversity of vascular plant species used for the health of the local population ¹¹. This observation is of great importance because plants in

terrestrial environments are often threatened by the expansion of agriculture and urbanization. It is therefore crucial to list the plants present on the mountains. It is with this in mind that our study focuses on the plants colonizing the Man Mountains. Its objective is therefore to list the plants found in the Man Mountains and to reveal their therapeutic use.

MATERIALS AND METHOD

Presentation of the study environment

The city of Man is located in the West of Côte d'Ivoire, nearly 600 km from Abidjan, the economic capital. It is called the "city of 18 Mountains" because of the many mountain ranges that surround it, thus placing the city inside a basin. The city of Man is one of the largest cities in the West of Côte d'Ivoire. It is located at 7°24'0"N latitude and 7°33'0"W longitude. In the city, five mountains were chosen for their significant vegetation cover to carry out this study. These are called Kôh Mountain, Mount Zélé, Glaha Mountain, Glèhè Mountain and Gôhò Mountain (Figure 1).

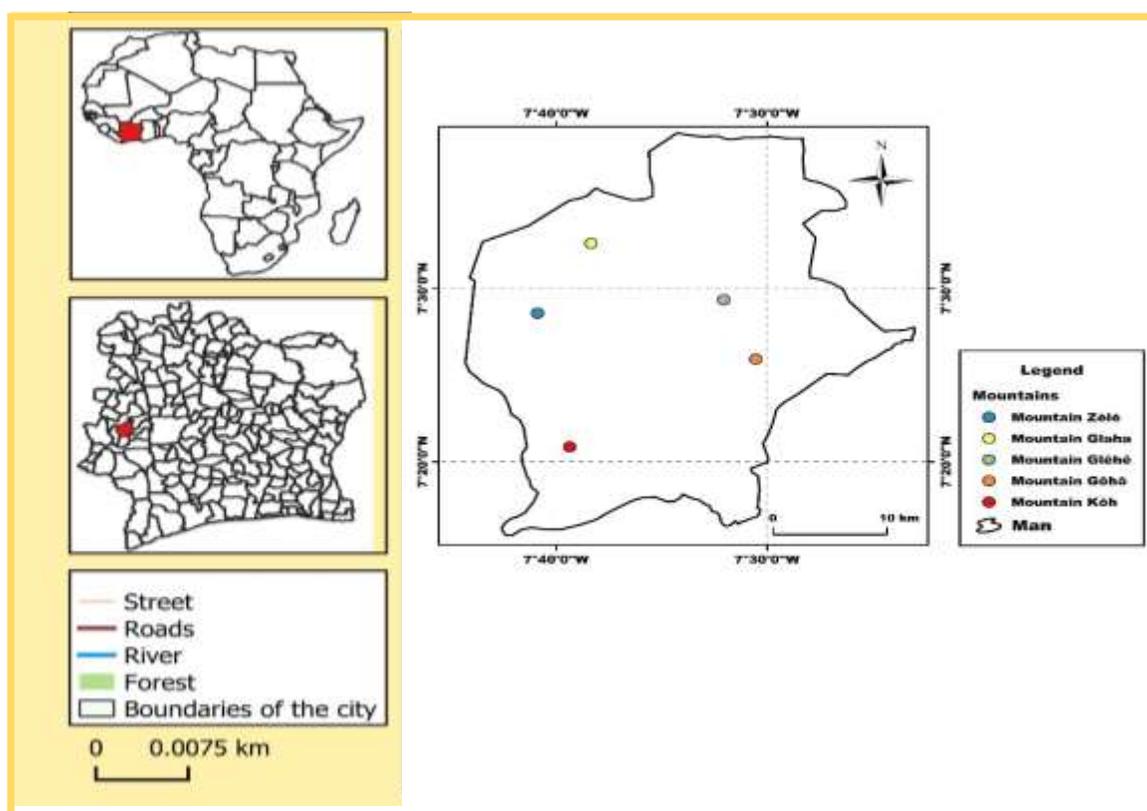


Figure 1: Geographical location of the study environment

Study material

Biological material

The biological material consists of all the plant species found on the mountains of the city of Man.

Technical material

The technical material used during this study consists of a survey sheet for collecting information, pruning shears for collecting specimen samples, plastic bags, old newspapers for storing samples. A GPS and a digital camera were also necessary.

Study methods

Collection of botanical data

The technique used in this study is the surface survey method, a technique commonly used in botany^{12,13}. In our study, this technique consisted of delimiting a 100 m² (10 m x 10 m) plot on each of the five mountains. The plots were carried out at an altitude between 300 and 400 m. This height constitutes the low altitude in the mountains and contains the largest number of plants¹⁴.

Collection of ethnobotanical data

Ethnobotanical survey

The ethnobotanical study was carried out using the "show and tell" method. It consists of presenting the plant samples to the interviewees and collecting information relating to these plants. The ethnobotanical survey was conducted among local residents, medicinal plant sellers and healers. It was carried out using a survey form containing specific questions on the medicinal plants used by the latter (disease treated, part used, state of use, method of administration and preparation technique). These informations were collected from 129 herbalists and traditional practitioners.

Ethnobotanical indices

Frequency of citation of plant species (FCe)

FCe is translated by the ratio between the number of times a species was cited (n) and the total number of citations of all species (N) during the survey¹⁵. It therefore indicates the most cited plants in traditional medicine encountered on the visited mountains.

$$FCe = \frac{\text{number of citations of a plant species}}{\text{Total number of citations of all plant species}}$$

Relative exploitation level (NER)

The relative exploitation level (NER) was obtained by calculating the ratio between the number (n) of conditions treated by a species and the total number (N) of conditions treated by all species¹⁶.

$$NER = \frac{\text{number of conditions treated by a plant species}}{\text{Total number of conditions treated by all plant species}}$$

The NER values obtained allowed us to qualify the level of exploitation of the different species.

The species are divided into the following categories:

1. Very well exploited species if NER is between 75 and 100%;
2. Well exploited species if NER is between 50 and 75%;

3. Moderately exploited species if NER is between 25 and 50%;
4. Little exploited species if NER is between 1 and 25%;
5. Unexploited species if NER = 0.

Statistical analyses

The calculated encounter frequencies were analyzed with SPSS 20 software. These values allowed us to make a hierarchical classification through a dendrogram. To create this dendrogram, we renamed the listed plants according to the Bayer code. According to this code, a plant species is designated by five letters, including the first three letters of the genus and the first two letters of the species. The histograms were produced using Excel 2016 software.

RESULTS AND DISCUSSION

Botanical characteristics of the listed plants

The floristic inventory carried out on five mountains in the city of Man made it possible to identify 48 species of plants divided into 44 genera and 26 botanical families. The plants listed and their botanical characteristics are grouped in Table 1. This table shows eleven plant species of Fabaceae family (42.30%), and four plant species of the Asteraceae family (15.38%). The Apocynaceae, Rubiaceae and Combretaceae families are each represented by three plant species (11.53%). This table also shows two plant species for the Euphorbiaceae, Bignoniaceae and Lamiaceae families (7.69%). The other families are less represented with one species (3.84%). The Fabaceae family is dominant in this study. Soro *et al.* (2021)¹⁷ made the same observation in their study on the Bowé mountain range in the Gontougo region of Côte d'Ivoire. This is also a result consistent with that of Pereki *et al.* (2013)¹⁸ who indicated Fabaceae among the families strongly represented at a low altitude.

Table 1: Inventoried plants and medicinal characteristics

Plant species	Organs used	Preparation techniques	Administration methods	Diseases treated
<i>Albizia adianthifolia</i> (Fabaceae)	Root Leaf	Trituration Decoction	Drink Purge	Stomach wound
<i>Albizia lebbek</i> (Fabaceae)	Leavy stem	Decoction	Drink	Malaria Painful periods
<i>Alchornea cordifolia</i> (Euphorbiaceae)	Leavy stem	Decoction	Drink	Typhoid fever
<i>Allamanda cathartica</i> (Apocynaceae)	Whole plant	Decoction	Drink	Malaria, Typhoid fever
<i>Amphicarpaea bracteata</i> (Fabaceae)	Leaf	Maceration	Drink	Skin diseases
<i>Azadirachta indica</i> (Rubiaceae)	Leaf	Decoction Trituration	Purge	Dry cough Typhoid fever
<i>Blighia sapida</i> (Sapindaceae)	Leaf	Decoction	Drink	Constipation Malaria
<i>Cassia siamea</i> (Fabaceae)	Leaf	Decoction	Drink	Malaria
<i>Centrosema virginianum</i> (Fabaceae)	Whole plant	Decoction	Drink	Stomach ache Skin diseases
<i>Chromolaena odorata</i> (Asteraceae)	Whole plant	Decoction Kneading	Drink Purge	Wounds Ulcer
<i>Clausena lansium</i> (Rutaceae)	Leaf	Decoction	Purge	Childhood fever
<i>Cnestis ferruginea</i> (connaraceae)	Leaf	Decoction	Purge	Constipation
<i>Combretum indicum</i> (Combretaceae)	Leaf	Decoction Kneading	Drink Purge	Diarrhea Stomach ache
<i>Combretum micranthum</i> (Combretaceae)	Leaf	Decoction	Drink	Wormable
<i>Combretum paniculatum</i> (Combretaceae)	Leaf	Decoction Kneading	Drink Purge	Malaria
<i>Costus afer</i> (Costaceae)	Root	Decoction	Gargle	Sore throat
<i>Cyperus eragrostis</i> (Cyperaceae)	Leaf	Decoction	Drink	Headache
<i>Elaeis guineensis</i> (Arecaceae)	Leaf	Decoction	Drink	Bacterial infections
<i>Erigeron sumatrensis</i> (Asteraceae)	Root	Decoction	Drink	Malaria
<i>Euphorbia hirta</i> (Euphorbiaceae)	Whole plant	Decoction Kneading	Drink	Diabetes Hypertension
<i>Ficus exasperata</i> (Moraceae)	Leavy stem	Decoction	Drink	Hemorrhagies
<i>Griffonia simplicifolia</i> (Fabaceae)	Leaf	Decoction	Drink	Hypertension
<i>Heliotropium indicum</i> (Boraginaceae)	Root	Decoction	Drink	Common cold
<i>Hymenolobium flavum</i> (Fabaceae)	Leaf	Decoction	Drink	Childhood fever
<i>Mangifera indica</i> (Anacardiaceae)	Leaf	Trituration	Purge	Malaria
<i>Markhamia lutea</i> (Bignoniaceae)	Whole plant	Decoction	Drink	Malaria
<i>Megathyrus maximus</i> (Poaceae)	Leaf	Decoction	Drink	Diabetes
<i>Mezoneuron benthamianum</i> (Fabaceae)	Leaf	Decoction	Mouthwash	Tooth decay
<i>Mimosa pudica</i> (Fabaceae)	Leaf	Decoction	Drink	Diarrhea
<i>Mitracarpus hirtus</i> (Rubiaceae)	Leaf	Decoction	Drink	Hypertension

<i>Morinda citrifolia</i> (Rubiaceae)	Leaf	Decoction	Drink	Malaria
<i>Musa acuminata</i> (Musaceae)	Root	Decoction	Drink	Malaria Stomach wound
<i>Nauclea latifolia</i> (Rubiaceae)	Leaf	maceration	Drink and purge	Strangulated hernia
<i>Newbouldia laevis</i> (Bignoniaceae)	Root	Trituration	Purge	Diabetes Hemorrhoids
<i>Ocimum gratissimum</i> (Lamiaceae)	Leaf	Décoction	Purge	Female infertility
<i>Parquetina nigrescens</i> (Apocynaceae)	Whole plant	Decoction	Drink and purge	Lower back pain
<i>Passiflora foetida</i> (Passifloraceae)	Whole plant	Decoction	Drink	Hemorrhoids
<i>Phyllanthus acidus</i> (Phyllanthaceae)	Whole plant	maceration	Nasal route	Common cold
<i>Pneumatopteris pennigera</i> (Thelypteridaceae)	Root	Decoction	Drink	Malaria Fever
<i>Salacia owabiensis</i> (Celastraceae)	Leaf	Trituration	Purge	Stomach ulcer
<i>Senna alata</i> (Fabaceae)	Leaf	Decoction	Drink and body bath	Constipation Hemorrhoids
<i>Senna occidentalis</i> (Fabaceae)	Leaf	Decoction	Drink	Typhoid fever
<i>Solanum mauritianum</i> (Solanaceae)	Leaf	Trituration	Purge	Malaria
<i>Solenostemon monostachyus</i> (Lamiaceae)	Whole plant	Decoction	Drink	Headache Vertigo
<i>Synedrella nodiflora</i> (Asteraceae)	Whole plant	maceration	Body bath	Malaria
<i>Tabernaemontana pachysiphon</i> (Apocynaceae)	Leaf	Decoction	Drink	Malaria
<i>Tectona grandis</i> (Verbenaceae)	Leaf	Trituration	Purge	Anemia
<i>Tithonia diversifolia</i> (Asteraceae)	Leaf	Decoction	Drink	Diabetes Malaria

Evaluation of ethnobotanical data by indices

Frequency of citation for plant species (FCe)

The FCe made it possible to make a hierarchical classification of the plants listed through a dendrogram (Figure 2).

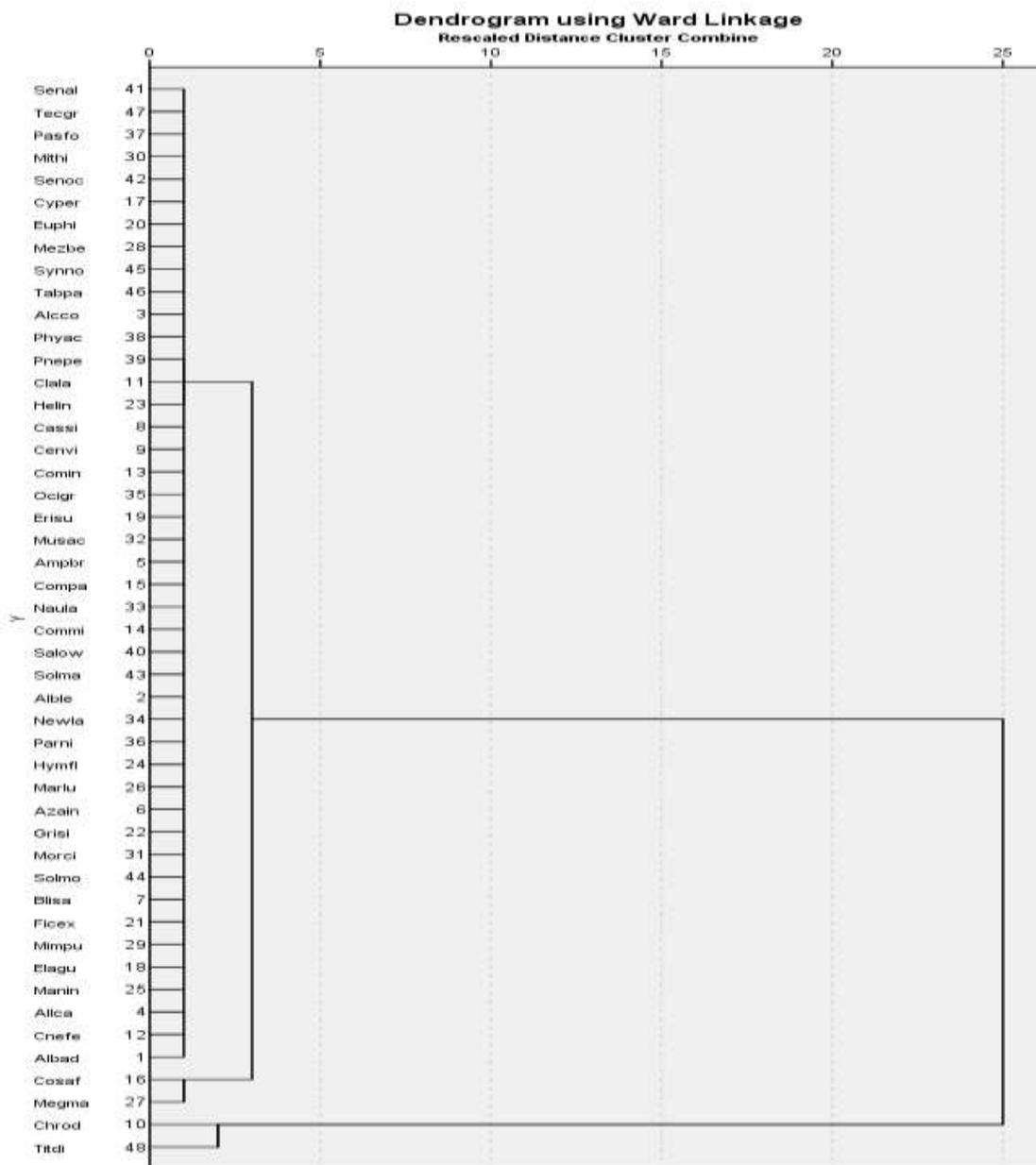


Figure 2: Dendrogram of hierarchical classification of plants listed according to FCe

The figure obtained shows three groups of plants when a cut is made at a cluster distance of 3. The first group consists of two plants which are *Chromolaena odorata* with FR = 19.58% and *Tithonia diversifolia* (FR = 13.23%), which are the most encountered species in this study. The second group is also composed of two plants. These are *Costus afer* (FR = 6.61%) and *Megathyrsus maximus* (FR = 5.03%), which are moderately encountered on the sites. The other plants form the

third group with a frequency of encounter of less than 4%. These are the plants less encountered on the mountains of Man. This section has shown that *Chromolaena odorata* and *Tithonia diversifolia* are the most encountered species on the mountains of the city of Man. The strong presence of these two species could also be explained by the impact of human activities that led to the disappearance of the original plant formations. Indeed, the immediate environment of man is the victim of agricultural practices accompanied by bush fires¹⁹.

Relative Exploitation Level (NER)

The NER values were used to make the distribution represented by Figure 3. According to this figure, no plant has a NER value greater than 75%. There is therefore no very well exploited species. Also, there were no unexploited species (NER = 0). *Alchornea cordifolia* and *Euphorbia hirta* constitute the group of well-exploited plants with a NER value of 55%. There are 17 plants in the group of moderately exploited species (NER between 27% and 45%) while 29 other species are little exploited with NER values lower than 25%. These NER values revealed that *Alchornea cordifolia* and *Euphorbia hirta* are the most used plants in the medicinal recipes of the city.

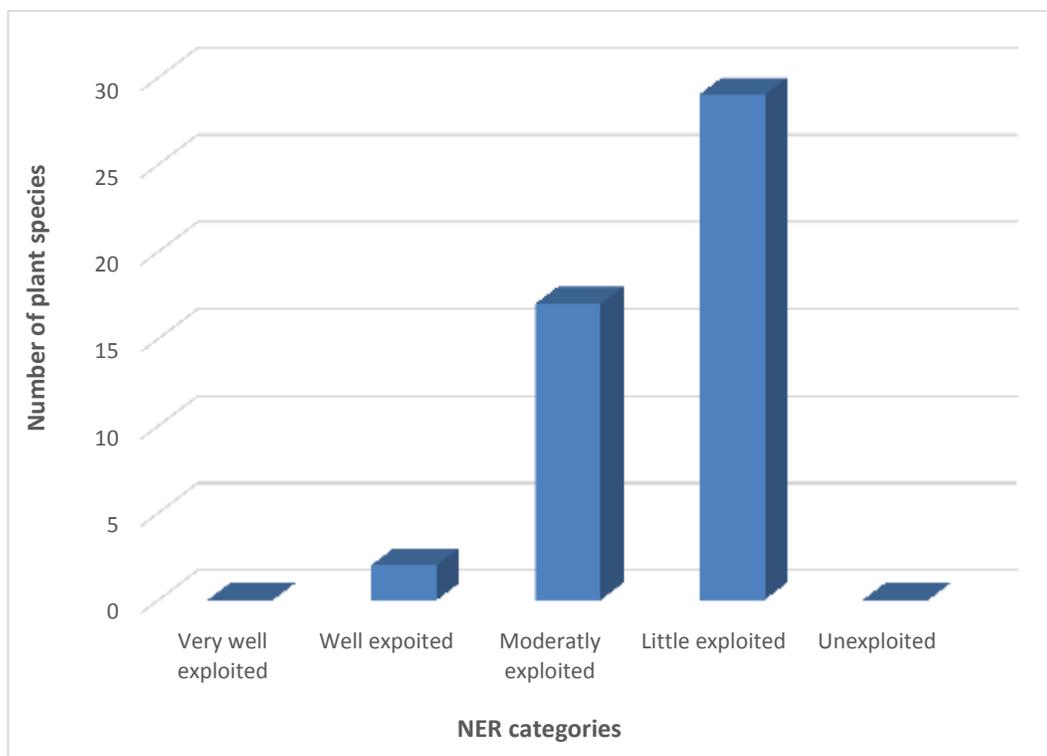


Figure 3: Histogram of the distribution of inventoried species according to NER

CONCLUSION

The study on the plants of the Man mountains made it possible to list forty-eight (48) species of plants divided into forty-four (44) genera and twenty-six (26) families. The Fabaceae family is the most represented with eleven (11) species. These are all medicinal plants used in the treatment of

various pathologies. The plant species most cited by the respondents of this study are *Chromolaena odorata* and *Tithonia diversifolia*. *Alchornea cordifolia* and *Euphorbia hirta* are the plants most exploited by the local population among the plants listed on the slopes of the Man mountains. The protection of the plant biodiversity of the Man Mountains is therefore worrying for its strong contribution to the city's health plan.

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