

Ethnobotanical Study on the Usage of Toxic Plants in Traditional Medicine in the City Center of Tlemcen, Algeria

Nassima Elyebdri, Asma Boumediou, Soumia Addoun

Abstract—Traditional medicine has been part of the Algerian culture for decades. In particular, the city of Tlemcen still retains practices based on phytotherapy to the present day, as this kind of medicine fulfills the needs of its followers among the local population. The toxic plants contain diverse natural substances which supplied a lot of medicine in the pharmaceutical industry. In order to explore new medicinal sources among toxic plants, an ethnobotanical study was carried out on the use of these plants by the population, at Emir Abdelkader Square of the city of Tlemcen, a rather busy place with a high number of traditional health practitioners and herbalists. This is a descriptive and transversal study aimed at estimating the frequency of using toxic plants among the studied population, for a period of 4 months. The information was collected, using self-anonymous questionnaires, and analyzed by the IBM SPSS Statistics software used for statistical analysis. A sample of 200 people, including 120 women and 80 men, were interviewed. The mean age was 41 ± 16 years. Among those questioned, 83.5% used plants; 8% of them used toxic plants and 35% used plants that can be toxic under certain conditions. Some improvements were observed in 88% of the cases where toxic plants were used. 80 medicinal plants, belonging to 36 botanical families, were listed, identified and classified. The most frequent indications for these plants were for respiratory diseases in 64.7% of cases, and for digestive disorders in 51.5% of cases. 11% of these plants are toxic, 26% could be toxic under certain conditions. Among toxic plants, the most common ones are *Berberis vulgaris* with 5.4%, indicated in the treatment of uterine fibroids and thyroid, *Rhamnus alaternus* with 4.8% for hepatic jaundice, *Nerium oleander* with 3% for hemorrhoids, *Ruta chalepensis* with 1.2%, indicated for digestive disorders and dysmenorrhea, and *Viscum album* with 1.2%, indicated for respiratory diseases. The most common plants that could be toxic are *Mentha pulegium* (15.6%), *Eucalyptus globulus* (11.4%), and *Pimpinella anisum* (10.2%). This study revealed interesting results on the use of toxic plants, which are likely to serve as a basis for further ethno-pharmacological investigations in order to get new drug sources.

Keywords—Ethnobotany, phytotherapy, Tlemcen, toxic plants.

Nassima Elyebdri is with Faculty of Medicine: Dr Benzerdjeb Benaouda, Department of Pharmacy, Abou Bekr Belkaïd University, 13000 Tlemcen, Algeria and Organic Chemistry laboratory Natural substances and Analyze (COSNA) Abou Bekr Belkaïd University, POB 119, 13000 Tlemcen, Algeria (phone: +213 0770891908; e-mail: nassoum-ph@hotmail.fr).

Asma Boumediou is with Faculty of Medicine: Dr Benzerdjeb Benaouda, Department of Pharmacy, Abou Bekr Belkaïd University, 13000 Tlemcen, Algeria (phone: +213 0542182919; e-mail: asmabd282@gmail.com).

Soumia Addoun is with Faculty of Medicine: Dr Benzerdjeb Benaouda, Department of Pharmacy, Abou Bekr Belkaïd University, 13000 Tlemcen, Algeria (phone: +213 055776103; e-mail: samou.3ad@gmail.com).

I. INTRODUCTION

OUR contemporary biomedicine is based on the knowledge accumulated throughout centuries [1]. Due to its extraordinary ability to produce original molecules, the plant kingdom today provides the pharmaceutical industry with more than one third of its current medicines [2]. The first research works were oriented towards toxic plants. These investigations have made it possible to isolate, identify and then possibly synthesize or modify certain active molecules [2]. In Algeria, traditional medicine has long been respected and utilized as a source of remedy, thanks to the richness and diversity of its flora, which constitutes a real phyto-genetic reservoir [3]. In big cities, there are chemists, especially to markets, whose stands are visited by a large number of people extending: The diligent connoisseur, who is convinced of the advantages of traditional medicine or the needy patient, which is in the constant research for an accessible treatment [4]. The city of Tlemcen is no exception and still preserves this traditional knowledge that must be explored.

Numerous studies have been carried out in Algeria, and around the world, on the use of toxic plants and their effects [5]-[9], but only a few of them evoked their modern therapeutic virtues. Generally, the focus is on the risks associated with their toxicity. These plants have attracted much interest, and are widely used in traditional medicine.

Objectives

The present study attempts to specify the nature of the plants, supposed to be toxic, and in what proportions they can be used in local traditional medicine. This is part of an ethnobotanical survey conducted with the local population, at the city center of Tlemcen. This was done in order to explore some possible new drug sources among toxic plants. Moreover, today it is necessary to have a clear idea about the plants used, despite their toxicity, in order to study them more deeply in subsequent investigations, and try to assess the impact of their use on the people who directly participated in our study.

II. MATERIAL AND METHODS

A. Type of Study

This is a descriptive and cross-sectional study, with an estimate of the frequency of use of toxic plants by the population studied.

B. Study Period

The study was carried out over a four-month period, i.e. from November 1, 2016 to February 28, 2017.

C. Location of Study

The Wilaya (Province) of Tlemcen is located at the far north-west of Algeria, at a distance of 520 km from the capital city, Algiers. It is bounded to the north by the Mediterranean Sea, to the west by Morocco, to the south by the Wilaya of Naama, and to the east by the Wilayas of Sidi-Bel-Abbes and Ain-Témouchent (Fig. 1) [10], [11].

The study was carried out in downtown Tlemcen, on El Amir Abdelkader Square, opposite the Great Mosque and around the main market of Tlemcen. These two places were chosen because they are part of the oldest places in the city of Tlemcen; they are visited by a large number of people and are characterized by an important grouping of traditional health practitioners and herbalists.

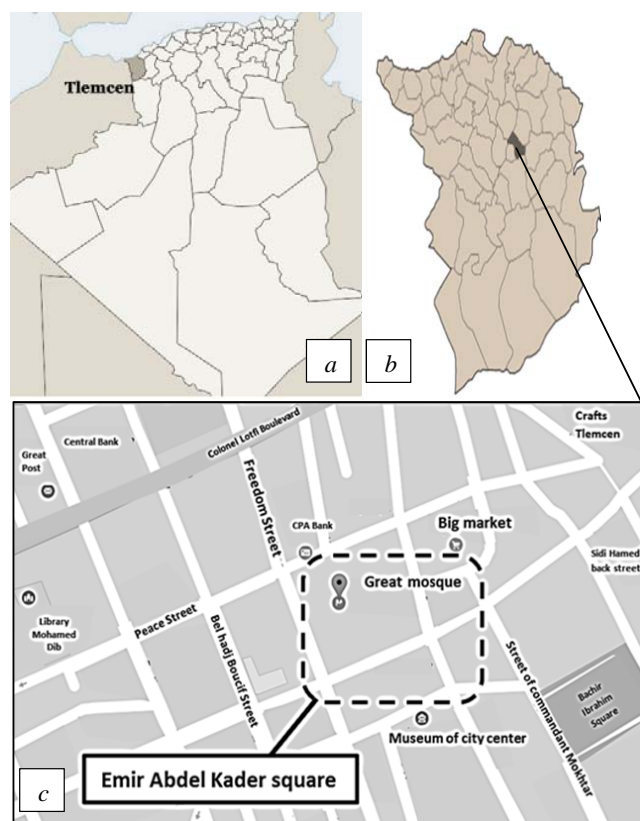


Fig. 1 Location of study region [12], [13] (a) Location of the Wilaya of Tlemcen, in Algeria (b) Location of the city center, of Tlemcen (c) Location of the study area

D. Population Studied

The empirical knowledge on plant medicine is held mainly by the traditional health practitioners [14], who unfortunately secretly preserve their knowledge about these plants and it is often difficult to obtain information from them. For this reason, a sample of individuals using these plants was selected in the town of Tlemcen.

The sample size N was calculated using the Schwartz formula [15]: $N = z^2 p(1 - p)/d$. The city of Tlemcen has a population of 949,135 inhabitants [16], with a confidence level (z) of 99%, a margin of error (d) of 5% and a prevalence (p) of 7%. The study sample included men and women of both sexes, aged 18 years and over, and living in Tlemcen.

E. Data Collection

The data were collected by means of an ethnobotanical survey, in both French and Arabic languages, which consisted of specific questions about the informant (age, sex, habitat, ...) and the medicinal plants he or she uses (Vernacular names, part used, method of preparation and the diseases for which they are indicated...).

Participation in the study is unique; every person must complete the questionnaire only once. It is anonymous and does not give rise to any individual interpretation. The questionnaire is intended for anyone who voluntarily participates in the survey and is committed to answering it sincerely.

The botanical identification of the plants used as well as the selection of the main toxic plants was carried out in the Laboratory of Pharmacognosy at the Faculty of Medicine, University of Tlemcen; it was then supplemented by a review of the literature [17]-[9]-[18].

F. Data Entry and Analysis

The data were entered and analyzed using the statistical analysis software SPSS-IBM.

Descriptive Statistics

The results are expressed as a percentage for qualitative variables (example: use of plants) and as a mean \pm SD (Standard deviation), for quantitative variables (example: age).

Comparative Statistical Study

The statistical analysis of the results was carried out using the Chi-square test, which allows searching for a relationship between two qualitative variables provided that the numbers are greater than or equal to 5. Fisher's exact test is executed and interpreted in the same way as the Chi-square test but does not require any application conditions. The degree of association between two variables was evaluated by the Pearson parametric test; a value of $p < 0.05$ is considered as significant.

The graphical representation was represented with the software Excel.

III. RESULTS

The sample size, $N = 173$, was rounded to 200 people; they were all interviewed during the study period. The sample consisted of 80 men and 120 women.

The age range of our sample is from 18 to 85 years. The mean age is (41 ± 16) years).

Among those interviewed, 83.5% used medicinal plants for their healing capacities (Fig. 2); 8% used toxic plants, 35% used plants that could be toxic under certain conditions (Fig. 3).

Among population studied, 82.50% of women used plants and 14.2% of them used toxic plants. 76% of men used plants and 16.4% of them used toxic plants. The difference is not significant between both sexes ($p = 0.06 > 0.05$).

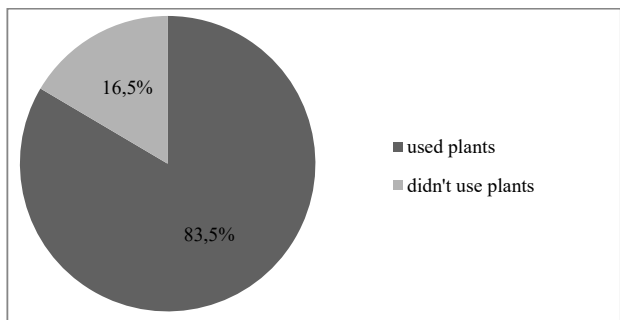


Fig. 2 Percentage of individuals using plants in the study sample

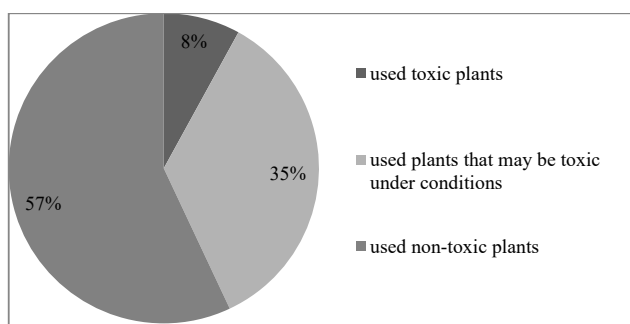


Fig. 3 Percentage of use of toxic, little toxic and non-toxic plants by individuals using plants

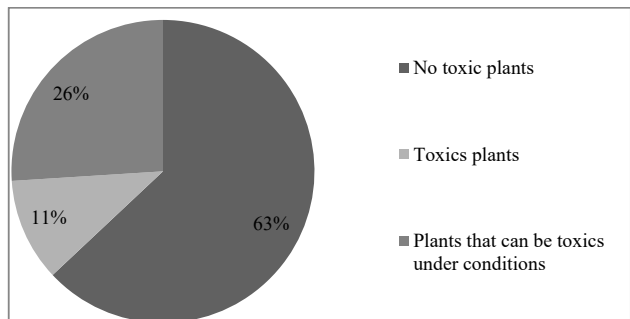


Fig. 4 Percentage of each plant type among the listed plants

60% people from the age range 18-30 years used plants and 1.8% of them used toxic plants. 93% of people from the age range 31-50 years used plants and 13% of them used toxic plants. 96% of people from the age range 51-85 years used plants and 15.20% of the used toxic plants. The difference is significant between the first age bracket and both last one slices ($p = 0.02 < 0.05$).

The survey identified 80 species of medicinal plants belonging to 36 families. The most represented ones are the Apiaceae (12 species), the Lamiaceae (12 species) and the Asteraceae (06 species).

The most frequent indications for the identified plants are

for respiratory diseases in 64.7% of cases, and digestive disorders in 51.5% of cases.

Out of the plants surveyed, 9 (11% of all plants surveyed) were identified as toxic, 21 (26% of all plants surveyed) were identified as non-toxic but potentially toxic under certain conditions (Fig. 4).

The most frequently used toxic plants are *Rhamnus alaternus*, *Berberis vulgaris*, *Nerium oleander*, *Ruta chalepensis*, and *Viscum album* (Fig. 5).

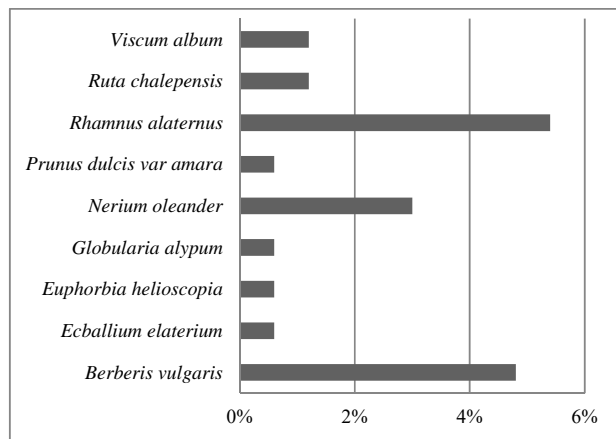


Fig. 5 Frequency of use of each toxic plant by the population studied

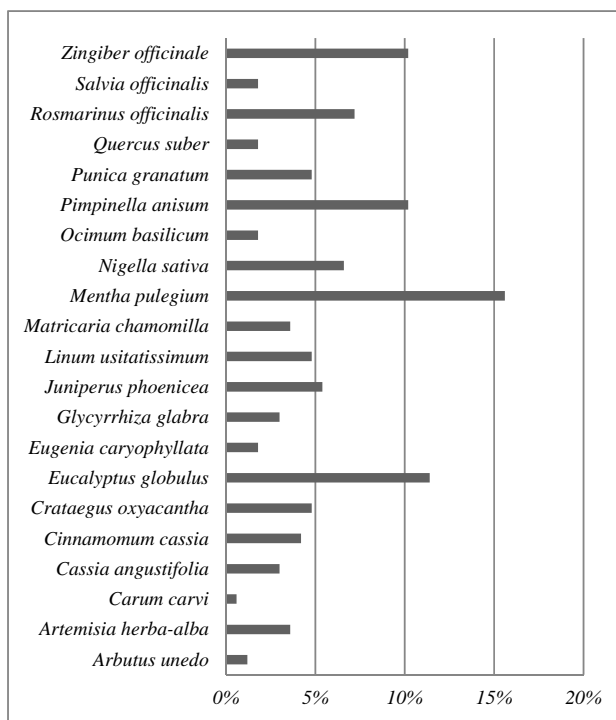


Fig. 6 Frequency of use of each plant among plants that may be toxic under conditions, by the population studied

The most commonly used non-toxic plants, which may be toxic under certain conditions of use, are *Mentha pulegium* (15.6%), *Eucalyptus globulus* (11.4%), *Pimpinella anisum*

(10.2%), *Zingiber officinale* (10.2%), *Rosmarinus officinalis* (7.2%), and *Nigella sativa* (6.6%), as shown in Fig. 6.

Toxic plants, as well as those which may be poisonous under certain conditions, have been reported in two tables, which include the scientific name of each plant, parts used, directions for use and indications (Tables I and II).

88% of people using toxic plants have noticed some improvement. These plants are reported in Table III. 82% of people, using plants that may be poisonous under certain conditions of use, have noted an improvement.

TABLE I
LIST OF TOXIC PLANTS CLASSIFIED ACCORDING TO THE DIRECTIONS FOR USE, INDICATIONS AND USED PARTS

| Identification of plant | Part (s) Used | Instructions for use | Indications |
|---|---------------|------------------------------|---|
| <i>Berberis vulgaris</i> Berberidaceae | Bark | Powder | Internal use: heartburn, thyroid, candidiasis, uterine fibroid. External use: disorders cutaneous, hemorrhoid. |
| <i>Ecballium elaterium</i> Cucurbitaceae | Fruit | Crushing (Two drops in nose) | Internal use: hepatitis. |
| <i>Euphorbia helioscopia</i> Euphorbiaceae | Latex | Direct application | External use: warts, psoriasis. |
| <i>Globularia alypum</i> Plantaginaceae | Leaf | Infusion | Internal use: Dorsal pain. |
| <i>Nerium oleander</i> Apocynaceae | Leaf | Decoction | External use: gingivitis, pharyngitis, psoriasis, varicella, Powder External use: Canker sores, herpes, hemorrhoid. |
| <i>Prunus dulcis var amara</i> Rosaceae | Fruit | Powder | Internal use: male infertility. |
| <i>Rhamnus alaternus</i> Rhamnaceae | Leaf | Infusion | Internal use: jaundice (icterus). |
| <i>Ruta chalepensis</i> Rutaceae | Aerial parts | Infusion | Internal use: gastralgia, dysmenorrhea, Anxiety. |
| <i>Viscum album</i> Loranthaceae | Leaf | Infusion | Internal use: cough, asthma, diabetes. |

TABLE II
LIST OF "NON-TOXIC PLANTS THAT MAY BE POISONOUS UNDER CONDITIONS", ACCORDING TO THE DIRECTIONS FOR USE, INDICATIONS AND USED PARTS

| Identification of plant | Part (s) used | Instructions for use | Indications |
|---|----------------------|------------------------------|---|
| <i>Mentha pulegium</i> Lamiaceae | Leaf Aerial parts | Infusion/ Decoction | Internal use: Flu, urogénitale infection, painful rules, abdominal pain, feminine infertility, feeding |
| <i>Eucalyptus globulus</i> Myrtaceae | Leaf | Decoction | Internal use: Cough, bronchitis, flu. |
| <i>Pimpinella anisum</i> Apiaceae | Fruit | Infusion | Internal use: Stress, insomnia. |
| <i>Zingiber officinale</i> Zingiberaceae | Rhizome | Infusion | Internal use : Flu, cough, sinusitis, asthma, constipation, ballonnement intestinal, obesity, poor blood circulation, pain rheumatic |
| <i>Rosmarinus officinalis</i> Lamiaceae | Leaf | Infusion/ Decoction | Internal use: Disorders liqueurs, hypercholesterol level, cough. |
| <i>Nigella sativa</i> Fabaceae | Seeds | Powder/ Decoction/ Oil | Internal use: Pharyngitises, allergy, hypercholesterol level, goiter, feminine infertility, breast cancer. External use: Hemorrhoids. |

TABLE III
LIST OF TOXIC PLANTS CLASSIFIED ACCORDING TO THEIR INDICATIONS AND THE RESULT OF THEIR USE

| Plants | Indications | Cases | Improvement |
|--------------------------------|---------------------|-------|-------------|
| <i>Berberis vulgaris</i> | Heartburn | 02 | + |
| | Thyroid | 03 | + |
| | | 01 | - |
| | Candidiasis | 01 | + |
| | Uterine fibroid | 01 | + |
| | Cutaneous disorders | 01 | + |
| <i>Ecballium elaterium</i> | Hemorrhoid | 02 | + |
| | Hepatitis | 01 | + |
| <i>Euphorbia helioscopia</i> | Psoriasis | 01 | - |
| | Warts | 01 | + |
| <i>Globularia alypum</i> | Back pain | 01 | + |
| <i>Nerium oleander</i> | Herpes | 01 | + |
| | Psoriasis | 01 | + |
| | Chicken pox | 01 | + |
| <i>Prunus dulcis var amara</i> | Hemorrhoid | 01 | + |
| | Male infertility | 01 | - |
| <i>Rhamnus alaternus</i> | Icterus | 07 | + |
| <i>Ruta chalepensis</i> | Gastralgie | 01 | + |
| | Dysmenorrhea | 01 | + |
| <i>Viscum album</i> | Anxiety | 01 | + |
| | Cough , asthma | 01 | + |
| | Diabetes | 01 | - |

TABLE IV
LIST OF PLANTS USED ACCORDING TO THE SIDE EFFECTS ENGENDERED BY THEIR USE

| Plants used | Side effects | Cases |
|--|---|-------|
| <i>Toxic plants</i> <i>Nerium oleander</i> | Oral paresthesia/ Irritation of the oral mucosa. | 01 |
| <i>Berberis vulgaris</i> | Heart rhythm disorders | 01 |
| <i>Non-toxic plants that may be poisonous under certain conditions</i> <i>Eucalyptus globulus</i> | Sweating Fever | 01 |
| <i>Linum usitatissimum</i> | hemorrhage | 02 |
| <i>Crataegus oxyacantha</i> | Sweating | 01 |
| <i>Cassia angustifolia</i> | Diarrhoea | 01 |
| <i>Mentha pulegium</i> | Sweating | 01 |
| <i>Punica granatum</i> | inflammatory bowel disease (IBD) | 01 |
| <i>Quercus suber</i> | Nausea | 01 |
| <i>Artemisia herba-alba</i> | Abdominal pain/ vomiting | 01 |
| <i>Glycyrrhiza glabra</i> | Asthenia | 01 |
| <i>Rosmarinus officinalis</i> | Heartburn/Sweating, Fever | 02 |

A number of side effects have been observed mainly in people who use non-toxic plants but which may be toxic under certain conditions of use. The plants implicated and their effects are reported in Table IV. However, some side effects were observed in only two cases among individuals using toxic plants. The plants concerned are *Nerium oleander* (Buccal paresthesia, oral mucosal irritation) and *Berberis vulgaris* (Cardiac rhythm disorders), as shown in Table IV.

IV. CONCLUSION

The aim of the present contribution was to identify the

nature of the use of toxic plants by the population of Tlemcen and to obtain as much information as possible about these plants and their indications in order to discover new possible medicinal sources. This should be the subject of further ethnopharmacological studies in the future; the ethnobotanical investigation is the first step in any ethnopharmacological investigation. The survey carried out in this study covered a range of 9 toxic plants and 21 plants that could be toxic under certain conditions of use, used respectively by 8% and 35% of the sample. The survey revealed that the majority of plants are used against respiratory disorders and diseases of the digestive system, which allows us to infer that our population turns to herbal medicine in the case of temporary or transient pathologies. On the other hand, when it comes to chronic diseases, subjects prefer the modern medical treatment. On the other hand, the indications for the toxic plants concerned mainly rare, recurrent diseases, more or less heavy, and considered in some cases as incurable by the conventional medication, for example: hemorrhoids, neurological disorders, uterine fibroid, and male infertility; this explains the low frequency of use of plants.

Most people using toxic plants were satisfied with the results of the traditional treatment, which shows that traditional medicine should be considered seriously as an alternative despite the development of modern medicine.

Toxic plants produced only two cases of adverse effects. It is worth noting that the latter was mainly produced by non-toxic plants which may be toxic under certain conditions of use. This is probably due to the lack of knowledge of the correct preparation method, the correct route of administration, the frequency of daily use, or the dosage of these plants.

The majority of the indications for toxic and little toxic plants identified in this study are in the traditional Maghreb pharmacopoeia except for thyroid and heartburn (*Berberis vulgaris*), as well as for cough and asthma (*Viscum album*).

Apart from *Berberis vulgaris*, *Eucalyptus globulus* and *Nigella sativa*, none of the toxic plants cited in our survey benefited from an ethnopharmacological study for the indications cited. This constitutes an important source of substances to be investigated and indications to be confirmed which must be explored by more elaborate future studies.

REFERENCES

- [1] J. Fleurentin, Des plantes toxiques qui soignent, Ouest France ed., 2011.
- [2] Nathalie Berthaut, Richard Blostin, Phytothérapie : A la découverte des principes actifs, (2012).
- [3] A. Bouzid, R. Chadli, K. Bouzid, Étude ethnobotanique de la plante médicinale *Arbutus unedo* L. dans la région de Sidi Bel Abbès en Algérie occidentale, *Phytothérapie*, (2016) 1-6.
- [4] Hammiche Victoria, Merad Rachida, Azzouz Mohamed, Plantes toxiques à usage médicinal du pourtour méditerranéen, Springer, 2013.
- [5] J. Bruneton, Toxic plants dangerous to humans and animals, Intercept Limited, 1999.
- [6] S. Al-Qura'n, Ethnobotanical survey of folk toxic plants in southern part of Jordan, *Toxicon*, 46 (2005) 119-129.
- [7] A. Maiga, D. Diallo, S. Fane, R. Sanogo, B.S. Paulsen, B. Cisse, A survey of toxic plants on the market in the district of Bamako, Mali: traditional knowledge compared with a literature search of modern pharmacology and toxicology, *Journal of ethnopharmacology*, 96 (2005) 183-193.
- [8] F. Catanese, P. Fernández, J.J. Villalba, R.A. Distel, The physiological consequences of ingesting a toxic plant (*Diplotaxis tenuifolia*) influence subsequent foraging decisions by sheep (*Ovis aries*), *Physiology & behavior*, 167 (2016) 238-247.
- [9] A. Samia, Atlas des risques de la phytothérapie traditionnelle, étude de 57 plantes recommandées par les herboristes, in, (2010).
- [10] F. Ghomari, La médina de Tlemcen : l'héritage de l'histoire Cultural Patrimony, I, (2007) 11-28.
- [11] J.-P. Sérén, Heurs et malheurs d'une vieille capitale in, février 2010.
- [12] <https://www.google.dz/maps/place/La+Grande+Mosqu%C3%A9e/@34.8837463,19z/data=!4m6!3m5!1s0xd78c9bdce879c11:0xfb5ae8793908db89!4b1!8m2!3d34.8837463!4d-1.3105514?hl=fr>, in.
- [13] <https://www.google.dz/maps/place/La+Grande+Mosqu%C3%A9e/@34.8837463,19z/data=!4m6!3m5!1s0xd78c9bdce879c11:0xfb5ae8793908db89!4b1!8m2!3d34.8837463!4d-1.3105514?hl=fr>, in.
- [14] D.D. Ababacar Maigaa, Seydou Fane, Rokia Sanogo, Berit Smestad Paulsen, Boubacar Cisse, A survey of toxic plants on the market in the district of Bamako, Mali: traditional knowledge compared with a literature search of modern pharmacology and toxicology, Volume 96 (4 January 2005).
- [15] Zeggwagh Ali Amine, Lahlou Younes, Bousliman Yassir, Enquête sur les aspects toxicologiques de la phytothérapie utilisée par un herboriste à Fès, Maroc, *The Pan African Medical Journal*, 14 (2013).
- [16] ONS, Office national des statistiques (Algérie), (2008).
- [17] H. Imanshahidi M, Pharmacological and therapeutic effects of *Berberis vulgaris* and its active constituent, berberine, *Phytotherapy research*, 22 (2008).
- [18] B.A. Sihem, Enquête ethnobotanique sur les drogues utilisées dans la médecine traditionnelle à Tlemcen, in, 2013.