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ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS USED TO CONTROL DIABETES IN POPULATION OF THE CENTRAL PLATEAU, MOROCCO

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ABSTRACT

The present ethnobotanical study is carried out to identify medicinal plants used in traditional medicine in the treatment of diabetes. It is meant to be carried out in several points distributed in the Moroccan central plateau.

The ethnobotanical survey is based on direct questions from the population. A questionnaire was used, which consisted of two parts: concerns the informant and the plants used in the treatment of disease. The data collected and recorded on the survey forms were then entered and statistically analyzed by the SPSS computer software System Package for Social Sciences, version 11,5).

The survey covered 737 targeted sample including 63.8% females and 36.2% male counterparts. The respondents are aged between 10 and 90 years. Patently, the participants showed a high illiteracy rate (77.5%). Worth noting is that the 737 participants are divided into 563 individuals who practise traditional medicine, and 174 people practice modern medicine. However, ethnobotanical surveys have identified six species used as medicinal plants. These are divided into eight genera and seven families: *Caralluma europea* subs *Marocana*, *Corrigiola telephifolia*, *Tetraclinis articulata*, *Romarinus officinalis*, *Salvia officinalis*, *Artemisia absinthium*, *Asparagus officinalis*, *Ammi majus*. Likewise, the majority of anti-diabetic recipes are prepared as herbal tea. The stems are commonly used in oral therapy.

This study could be a database for further research in the fields of phytochemistry, and pharmacology in order to search for new natural substances. Sustainable exploitation, and conservation strategies must be considered to promote, protect and enhance Moroccan medicinal plants.

Keywords : Diabetes, Central Plateau, Medicinal Plants, Ethnobotanical Survey.

INTRODUCTION

The plant biodiversity of the central plateau is characterized by the presence of medicinal plants with great therapeutic power against several diseases such as diabetes. The latter is a chronic disease that occurs when the pancreas does not make enough insulin or the body does not use the insulin appropriately. Insulin is a hormone that regulates the concentration of sugar in the blood. Hyperglycemia, or high blood sugar levels, is a common effect of uncontrolled diabetes, which over time leads to serious damage to many organ systems, especially the nerves and blood vessels.

According to the World Health Organization (WHO) worldwide, an estimated 422 million adults were living with diabetes in 2014. The number of deaths from diabetes increased by 70% globally between 2000 and 2019, with an 80% increase in the number of deaths among men. In the Eastern Mediterranean, deaths from diabetes have more than doubled and represent the highest percentage increase of all WHO regions (WHO 2020). The numbers reflect the increase in associated risk factors such as overweight and obesity. Over the past decade, the prevalence of diabetes has increased more rapidly in low-and middle-income countries than in high-income countries (WHO, 2016).

The effects of diabetes on the body are manifested in the form of serious complications and other disorders (metabolic, degenerative, infectious, ketoacidosis, cardiovascular and kidney disease) (APEMA *et al.*, 2011). Bearing this in mind, an ethnobotanical survey was carried out in the Moroccan central plateau to explore the medicinal plants used in the traditional treatment of diabetes and to promote them for the sustainable use of renewable resources of plant biodiversity. Still, medicinal plants in the central Moroccan plateau are harvested either for personal use or for regular sale in the markets of urban centers and souks in the region during different seasons of the year. They feed the small local trade carried out by both genders, and provide an acceptable minimum income in many households.

MATERIALS AND METHODS

Study site

The central Meseta, often called the Moroccan central Massif, is limited to the north by the South Rif corridor (Maamora and Meknes Plateau), to the south by the phosphate plateau and by the Middle Atlas to the west (Combe *et al.* 1975).

The territory covered by this study belongs to the Massif Hercynien Central. This massif was defined by Termier (1936) as a vast area of Paleozoic lands ranging from the Cambrian to the Permian. These terrains are folded and schistosed during the Hercynian orogeny, in a series of anticlinoriums and synclinoria of general NE-SW orientation, then fractured and intersected with Hercynian granite intrusions that generate a contact metamorphism. The whole

is leveled by a cycle of erosion before being partially covered in angular discordance by a thin and tabular secondary, tertiary and quaternary cover. Thus, the massif is bordered to the North by the South Rif Mio-Pliocene furrow, to the South and South-West by the erosion limit of the secondary and tertiary outcrops of the phosphate plateau and to the East and South-East by the edge of the Triassic-Liassic plateau of the Middle Atlas.

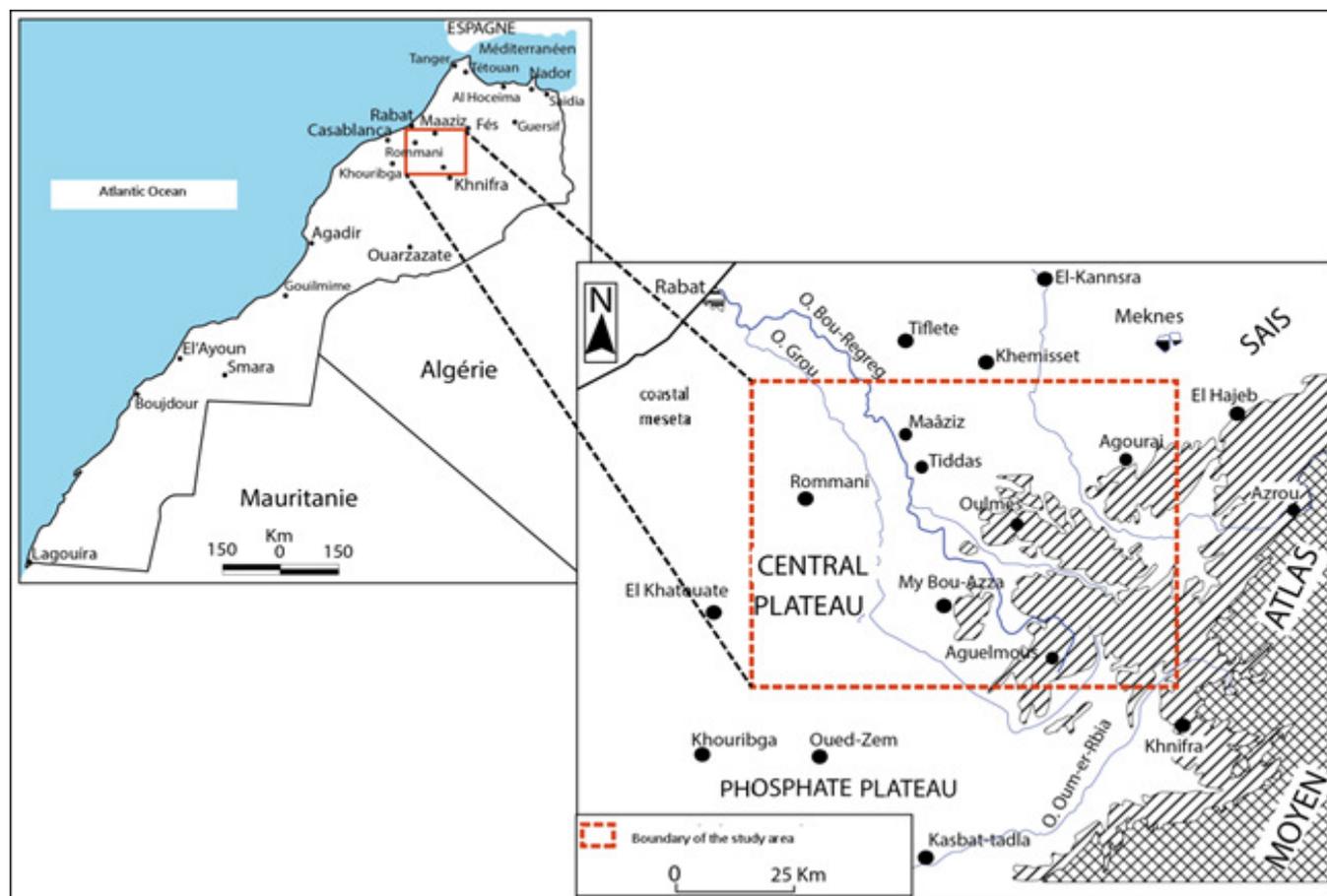


Fig. 1: Geographical location of the study area (Combe *et al.*, 1975) (modified map).

On the geomorphological side, the average altitude of this plateau rises gradually from West to East, from the Atlantic Coast to the Jbel Mtourzguène (near Aguelmous) which rises to 1627 M. This recent rise in the eastern part of this plateau is linked to the Middle Atlas folding (Beaudet, 1969).

The Massif is made up of plateaus, basins and high ridges. These ridges are separated by deep close valleys characterized by their high plant density. Forest areas and the slopes of the great valleys are almost exclusively the domain of the cork oak on siliceous soils, and of Oleaster, Mastic and Tizra on calcareous or clay soils. Also, the holm oak often appears towards the South East, but disappears towards the South. The ridges carry a flora rich in endemic species and the Jujube tree becomes very abundant as it approaches the phosphate plateau (Combe *et al.*, 1975).

Nevertheless, the scarcity of cultivable land makes it a region with a predominant pastoral economy, which results in the existence of a largely non-sedentary population.

Agglomerations of any size are rare and correspond to markets of local interest (Combe *et al.*, 1975).

MATERIALS AND RESEARCH METHODOLOGY

Data Collection

The research method used in the present study is an ethnobotanical survey which is based on direct questions relating to the uses of medicinal plants to treat diabetes in the central plateau using a questionnaire. In this work, 737 individuals were interviewed, 563 of them practise traditional medicine, and 174 practise modern medicine spread across towns, Villages, Douars and Souks in the mentioned region. We contacted all layers of the population, farmers, nomads, shepherds, sedentary people, herbalists.

The identification of materials collected was made in the field and at the botanical laboratory of the Faculty of Sciences of Kénitra. Finally, computer processing was necessary to better analyze the data that were collected during our ethnobotanical surveys. For this, we opted for the

computer software SPSS (System Package for Social Sciences, version 11.5) which allowed us to perform a set of efficient operations in a short time.

Thus, from the sampled variables, in particular gender, academic level, age and family situation and place of residence in relation to the study area, we were able to characterize the population of this Circle. The data collected for each plant includes the local common name, type (wild, cultivated, weed) of plant, uses, part (s) used, method of preparation, period of collection.

The complete floristic list was established after determination and verification of the samples collected thanks to several documents such as:

Hmamouchi (2001). Les plantes médicinales et aromatiques marocaines, utilisation, biologie, écologie, chimie, pharmacologie, toxicologie, lexiques, rabat, Maroc.

Fennane, M., Ibn Tattou, M., Mathez, J., Ouyahya, A., Eloualidi, J., (1999). Flore pratique du Maroc, manuel de détermination des plantes vasculaire, ptéridophyte, gymnospermes, angiosperme (Lauraceae-Neuradaceae), Travaux de l'institut scientifique, série botanique, rabat, Maroc.

Fennane, M., Ibn Tattou, M., Ouyahya, A., Eloualidi, J. (2007). Flore pratique du Maroc, manuel de détermination des plantes vasculaire, angiosperme (Leguminoseae-Lentibulariaceae), travaux de l'institut scientifique, série botanique, rabat, Maroc.

RESULTS AND DISCUSSION

The ethnobotanical information gathered from the population of the central plateau was entered on questionnaire forms then transferred into a database, processed and analyzed to obtain standardized data covering several aspects.

Profile of Respondents

In the sample of 737 people from the population of the central plateau, the female gender predominates with a workforce of 457 or 62%, against 280 men or 38%. According to nationally known statistical data (Kahouadji 1995), it is women who use medicinal plants much more than men. The present study confirms the same results cited in previous works (Mehdioui *et al.*, 2007; Tahri *et al.*, 2012; Belhaj *et al.*, 2020).

The results obtained show that the sample presents four categories of people distributed homogeneously. Subjects between 30 and 50 years old represent 47.77%, followed by subjects aged 50 to 70 years 31.46%, followed by subjects aged 10 to 30 years 11.88%. The subjects whose age is over 70 years represent a percentage of 8.89%.

Regarding the academic level of people using medicinal plants, the results obtained show that the sample is represented by 72.11% of illiterates, followed by 13.80% of people with a primary level. Informants with a secondary level represent 13.14% and academics represent 0.95%.

Our sample is composed of a majority of married people of 89.58%, against 10.42% of single people. They are located in city, hamlet and town with percentages of 39.40% respectively; 31.17% and 29.43%.

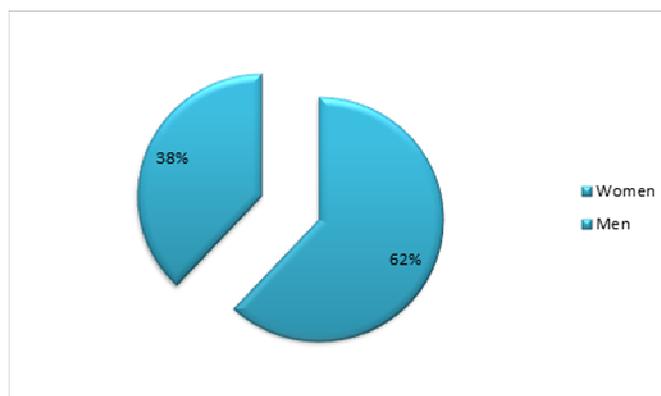


Fig. 2: Distribution of the sample by gender.

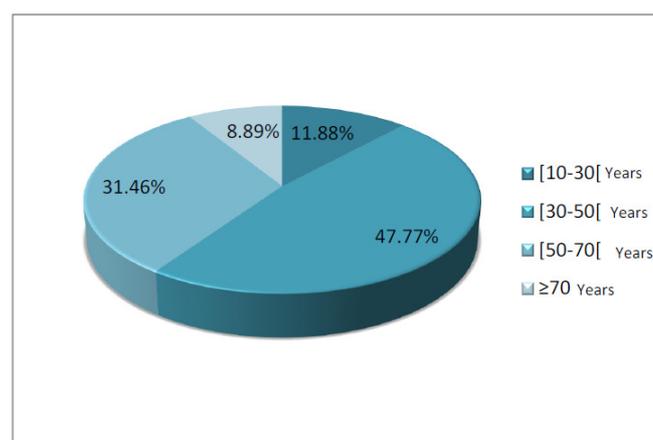


Fig. 3: Distribution of the sample by age.

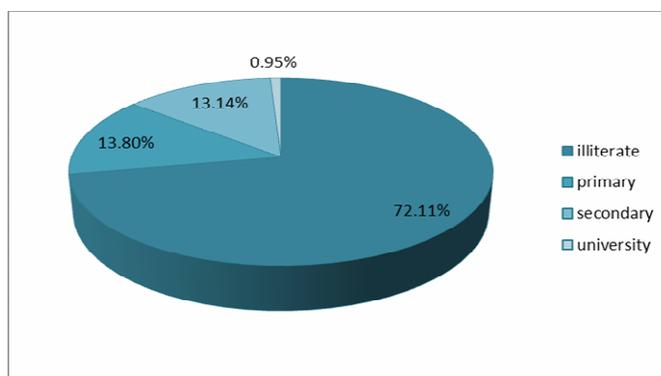


Fig. 4: Distribution of the sample by academic level.

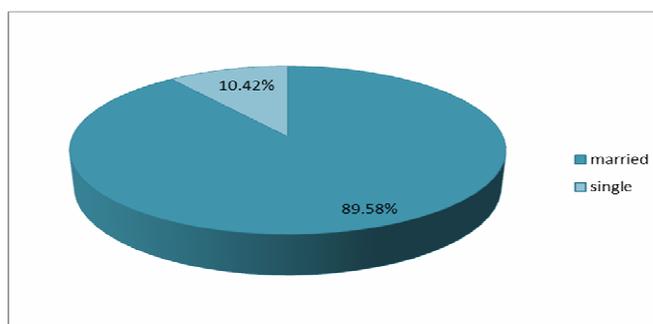


Fig. 5: Distribution of the sample by family situation.

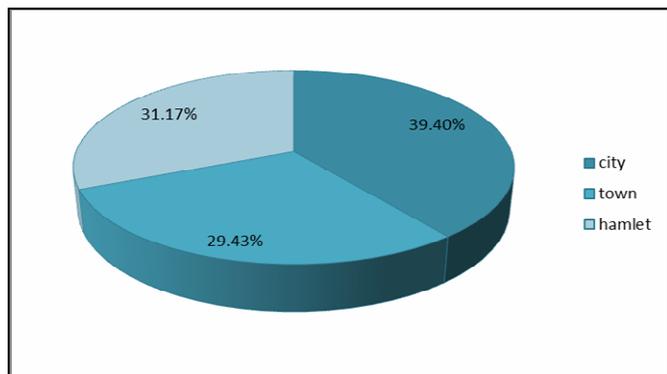


Fig. 6: Distribution of the sample according to habitat

Medicinal Plants used in the Treatment of Diabetes

To carry out this ethnobotanical study, we took into consideration people who use traditional medicine, a total number of 563 individuals. Among this population 78 participants (13.8%) who use MAP to treat diabetes, including 53 women and 25 men. These respondents (herbalists, farmer, sedentary, traditional healer...) informed us about the anti-diabetic medicinal species and the therapeutic and traditional practices of the local population of the region. The study of anti-diabetic medicinal plants resulted in a directory of recipes and dosages of eight plants used in the traditional treatment of diabetes in the central plateau:

Table 1: The most widely used medicinal plants in the treatment of diabetes.

Scientific name	Common name	Family	Frequency
<i>Salvia officinalis</i>	Sage	Lamiaceae	37
<i>Corrigiola telephifolia</i>	Phyllium leaf corrigiole	Caryophyllacées	27
<i>Rosmarinus officinali</i>	Rosemary	Lamiaceae	23
<i>Caralluma europaea</i>	Finger of god	Apocynaceae	21
<i>Tetraclinis articulata</i>	Thuja	Cupressaceae	19
<i>Artemisia absinthium</i>	Absinthe	Asteraceae	18
<i>Asparagus officinalis</i>	Asparagus	Aspargaceae	16
<i>Ammi majus</i>	Khella	Apiaceae	14

Salvia officinalis belongs to the Lamiaceae family, vernacular name: sage. It is used as a condiment in cooking, and tea mint perfumes. Thus, it is used in the treatment of diabetes because it lowers blood sugar levels. The diabetic uses the aerial part as an infusion like tea.

Corrigiola telephifolia belongs to the Caryophyllaceae family, Vernacular name: sarghine. It is a plant endemic to Morocco, it is sold by all herbalists, in the form of whole roots or small dried fragments. The diabetic uses the powdered roots orally.

Caralluma europaea Subs Maroccana belongs to the Capardiaceae family, Vernacular name is daghmous . It is very widespread in the region, used in several treatments. Cut the fresh stems into pieces; mix them in a blender with milk, used as a daily drink for the diabetic one glass every morning. Also, we can take the young stems, dry them, reduce them to powder, and take a spoonful of cool water.

Tetraclinis articulata belongs to the Cupressaceae family, Vernacular name: thya. It is an endemic species of North Africa, constituting real forest massifs. Collect young leaves, wash and boil in water.

Rosmarinus officinalis belongs to the Lamiaceae family, Vernacular name: rosemary. It is used everywhere in Morocco. Harvest the aerial part including the stem and leaves, and rinse them. The diabetic uses it on infusion. Rosemary is known worldwide as an aromatic and medicinal plant with multiple uses ranging from the simple use of traditional medicine to multiple industrial uses (Bhar et al. 2011).

Artemisia absinthium belongs to the Asteraceae family, Vernacular name: wormwood. In Morocco, it is used as a replacement for mint in tea when the weather gets colder. Diabetics use the aerial part dried in boiling water. It is one of the plants whose use becomes dangerous as soon as the therapeutic doses are exceeded. It is never given to children, pregnant, or breastfeeding women.

Asparagus officinalis belongs to the Asparagaceae family, Vernacular name: asparagus. diabetics took the stems by cooking in a steamer, or in water.

Ammi majus L. belongs to the family Apiaceae, Vernacular name: Khella. Diabetics use the whole plant as an oral infusion.

Fig. 7 : The botanical families most used in the treatment of diabetes.

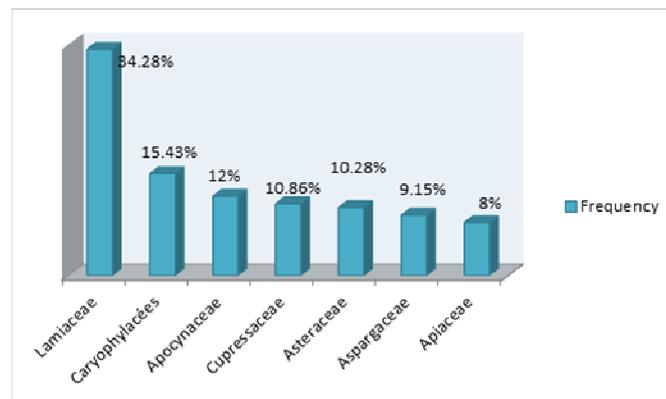
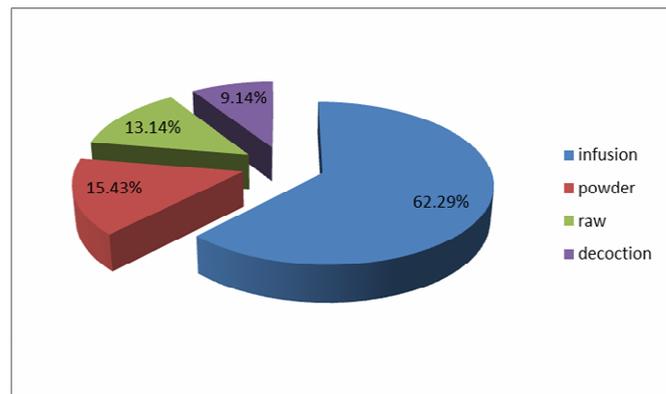


Figure 7 shows a dominance of the Lamiaceae family used in the treatment of diabetes with a percentage of 34.28%.

Parts of the Plant, Pharmaceutical Forms

Figure 8 below shows the percentages of plant organs identified in the central plateau. The stems are the most represented with (29.71%), followed by the aerial part (25.72%), leaves (21.14%), roots (15.43%) and the whole plant with (8%).

Fig. 8: Distribution of the percentages of the different parts of medicinal plants used against diabetes.



Different therapeutic practices are employed by the local population for the treatment of diabetes. Infusion is the most popular method with a percentage of 62.29%. This is followed by the powder preparation with 15.43%. 13.14% of the studied population use raw medicinal plants and decoction with a percentage of 9.14%.

CONCLUSION

This article provides information on the various knowledge acquired on the plants most frequently used by the population of the central plateau. This knowledge was obtained during surveys of herbalists, local users and traditional healers. However, this study could be a database for further research in the fields of Phytochemistry, and Pharmacology with the aim of looking for new natural substances.

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