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THEME

Ethnobotanical of medicinal plants used against snakebites in the Oued Righ region

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الإهداء

بسم الله الرحمان الرحيم الحمدلله والشكر لله على التوفيق لإتمام هذا العمل اما بعد اهدي تخرجي وفرحتي الى امي حبيبتي التي كانت السند لي في حياتي واهدي أيضا الى ابي الغالي الذي تعب من اجلي للوصول الى هذا المستوى وهذه اللحظة واهدي فرحتي الى عمي احمد الذي كان لي الاب الثاني واهدي الي خالتي سعيدة التي قدمت لي كل الدعم والحب واهدي الي جميع احبتي من اخوتي وخالاتي وصديقاتي واهدي فرحتي الي جميع الأساتذة من مرحلة الابتدائي الي الجامعة وأخيرا وليس اخرا اهدي نجاحي وفرحتي الى نفسي الحبيبة التي تعبت وواجهت كل عائق للوصول الى هدفي

DJOUHINA

الاهداء

بسم الله الرحمان الرحيم الحمدلله حمدا كثيرا والشكرلله اما بعد اهدي تخرجي وفرحتي الى امي التي كانت السند والمسند في حياتي وكانت الداعم الأول في دراستي ولهذا اهدي لها كل فرحتي ونجاحي واهدي ايضا الى ابي الذي ساهم في دراستي بشكل كبير وكان واثق للوصول الى هذا النجاح واهدي نجاحي الى اخوتي احبتي وبالأخص خولة على نصائحها ووقوفها معي في اصعب لحظاتي والتي كان لها دور كبير في نجاحي واهدي نجاحي الي اساتذتي الكرام في مسيرتي الدراسي واهدي هذا النجاح الى نفسي التي واجهت كل الصعوبات من اجل الوصول الى هذا النجاح

RABAB

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Introduction

Introduction

Snakes inhabit diverse habitats including mountains, aquatic environments and deserts. They play pivotal roles in ecosystems by regulating food chains, controlling pests, and serving as sensitive indicators of environmental changes (Pandya et al, 2022). Worldwide, there are over 3,400 different species of snakes (Speybroeck et al., 2016). However, the species richness of the ophidian fauna in the North Sahara is based on information from the literature (Le Berre, 1989; Schleich et al., 1996) and takes into consideration recent taxonomic rearrangements. Those species are belong to the Viperidae family (Mouane et al., 2020). Snake bites are a significant public health concern, particularly in rural areas (Parajuli, 2017). The majority of victims are male, and bites often occur at night (Butt, 2010). The psychological impact of snakebites can be severe, and patient reassurance is an important aspect of treatment (Butt, 2010). The clinical effects of bites can vary, with some causing only local effects while others can be more serious (Ismail, 2010). It is crucial for individuals to have adequate knowledge of first aid for snakebites and to seek timely medical care (Parajuli, 2017).

A considerable number of cases may have remained unreported. The maximum number of cases is reported from rural areas, where farmers are engaged in various farming activities. The modern method of snake-bite treatment requires sophisticated application of anti-venoms, which remain mostly inaccessible to rural people. In addition to transportation difficulties, rural people are unaware of these treatments and facilities. Instead, they rely on local time-tested herbal remedies. Different ethnobotanical studies have been carried out such as in India to gather information about the traditional medicines used to treat snake bites in tribal populations, who depend mostly on forest products for their basic daily needs (Dhanya, 2024). Ethnobotanical and ethnopharmacological research has identified a range of plants with potential for treating snakebite envenomation, a significant public health issue. However, the translation of this knowledge into effective treatments has been limited (Trim et al., 2020). It highlights the potential of herbal medicines in managing snakebite envenomation, particularly in regions with limited access to antivenom (Gupta, 2012). Specific plants are used in traditional medicine for snakebite treatment. In Kenya, there are 14 medicinal plants has been identified and 361 plant species in East. These studies underscore the need for further research to validate the efficacy and safety of these traditional treatments (Mokua, 2021; Omara et al., 2021). Moreover, several studies were conducted in Algeria specially in

Oued Souf region (Atallah and Diab, 2022). However, there were no prior studies on medicinal plants used against snake bites in the Oued Righ region

This work aimed to conduct an ethnobotanical survey in Oued Righ (septentrional Algerian Sahara), which is characterized by its richness and diversity with medicinal plants. A series of surveys was conducted in order to obtain sufficient informations about the therapeutic uses of remedies for treating snake bites. Therefore, we organized our work into 04 chapters:

- The first chapter, entitled " Snakes And Their Venoms": offers an overview of fundamental information concerning snakes.
- The second chapter, entitled " Herbal Medicines Against Snake Bites": delves into the properties and applications of medicinal plants.
- The third chapter, entitled " Methods and materials": detailed methodologies and utilized resources that elucidated.
- The fourth chapter, entitled " Results And Discussion ": is dedicated to the exposition of findings and subsequent discourse.
- Finally, a conclusive section will encapsulate the research outcomes and implications.

The theoretical part

Chapter 01: Snakes and Their Venoms

Chapter 1.- Snakes and their venoms

This chapter provides a definition and classification of snakes, the most important snakes found in Algeria, and specially Oued Righ.

1.-Snakes

Snakes are fascinating creatures with unique adaptations for their specialized lifestyle. Their elongated bodies and lack of legs are complemented by a lack of external and internal ears, and a protective window above the eye (Kristi and Paul, 2001). They have a specialized organ, Jacobson's organ, which helps them smell by capturing gaseous molecules of odors (Kristi and Paul, 2001). Snakes are efficient predators, using a combination of biting, constriction, and venom to kill and swallow their prey (Berkovitz, 2017). Their unique skull and jaw structure, along with their axial system, enable them to swallow prey much larger than their own head (Moon, 2000; Snake, 2012). This ability, combined with their diverse diet and feeding strategies, has contributed to the success of snakes as a group (Cundall, 2000).

Snakes are animals that fluctuate in temperature and are widespread in hot areas. They are the most poisonous animals in the world. Snakes belong to the vertebrate division and the reptile order (Cherifi, 2004). There have been snakes for about 130 million years. Their sizes range from 12 cm (little couleuvres) to 10 m (python, anaconda) (Chaumeton, 2001; Cherifi, 2004; Mattison, 2014). There are over 2500 different species of snakes, of which 540 are venomous (Oussedik, 2007).

2.-Classification of snakes

2.1.-Classification according to order and family

Snakes belong to the vertebrate phylum, to Reptiles class, in squamous order and in Ophidians suborder as in figure 1 (Gruber and Parmentier, 1998); here snakes are divided into two groups**:**

2.1.1.- Scholecophidians Order

Perhaps the most primitive of snakes, they are small in size and have covered bodies. Small shiny scales. It is completely free of toxic devices. It is composed of families**:** Leptotyphlopidaeand Typhlopida (Barré, 2021).

2.1.2- Alethinophidians Order

The alethinophidians (all other snakes, approximately 2,640 species) are more ecologically diverse, and most species feed on relatively large prey. Advanced snakes (approximately 2,470 species) widely use venom to subdue their prey, whereas the remaining alethinophidian

snakes (approximately 170 species), which do not form a single (monophyletic) group, use constriction (secondarily lost by some fossorial species) (Nicolas et al., 2007). Fourteen families make up this infraorder, the main ones of which are: *Acrochordidae*, *Aniliidae*, *Uropeltidae*, *Xenopeltidae*, *Boidae*, *Colubridae*, *Atractaspididae*, *Elapidae*, and *Viperidae*. The last four families include almost all of the venomous snakes in the world (Niamaly, 2021)

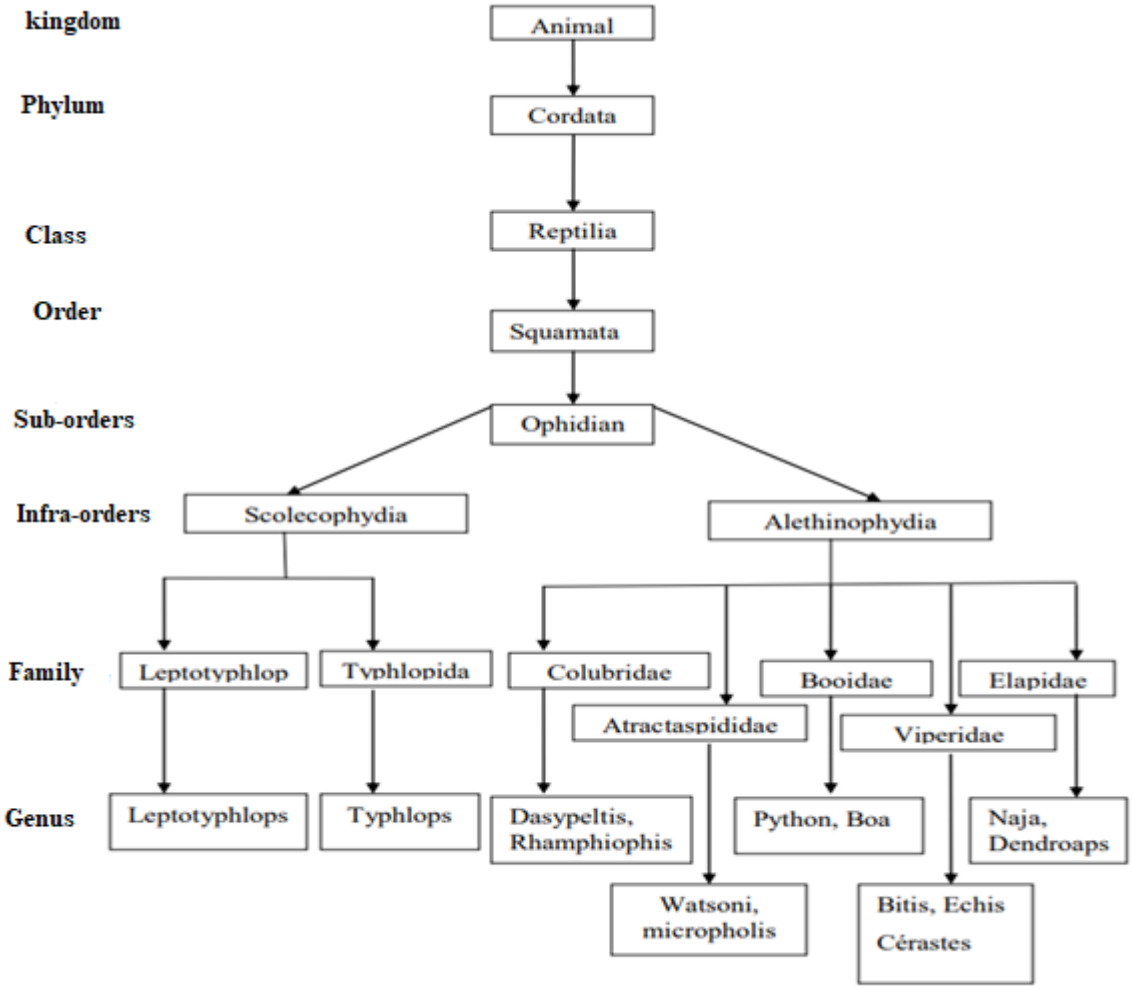

Figure 1-Snake Taxonomy (Barre, 2021)

2.2.-Classification according to the morphology and behaviour

2.2.1.-According to the fangs

There are two types of tusks**:**

2.2.1.1.-Grooved fangs

These fangs have a groove through which the venom ruts (Datta, 2008)

2.2.1.2.-Hollow fangs

The hollow-fangs are like a hypodermic needle through which the venom flows (Datta, 2008)

Table 1. Types of teeth (Das, 2010)

Aglyphous snakes	**Opisthoglyphous snakes**	**Proteroglyphous snakes**	**Solenoglyphous snakes**

2.2.2.-Depends on the teeth

There are four types (Tab. 1)

Each tooth is approximately the same size and shape and does not contain any toxic glands.	They are similar to aglyphous snakes, but they have two large backward-facing teeth at the posterior end of the upper jaw. They possess toxic glands.	They have teeth, for example, the first and second types, but the difference is that they have a significantly enlarged tusk in front of the oral cavity and folds around the venom canal. They also contain venomous glands.	The teeth of snakes are unique. They have long fangs that are usually folded back. Movable hooks are present in front of the maxilla, which contains toxic glands.

2.2.3.-Depending on the way the prey eats

Snakes eat prey in several ways as in figure 2: first which eat their prey by contraction by wrapping the snake around the body, secondly, snakes that kill their prey by stinging them with poison, and the third and last type, which eats their prey while they are alive, and this process is fast **(**Hpley, 1882).

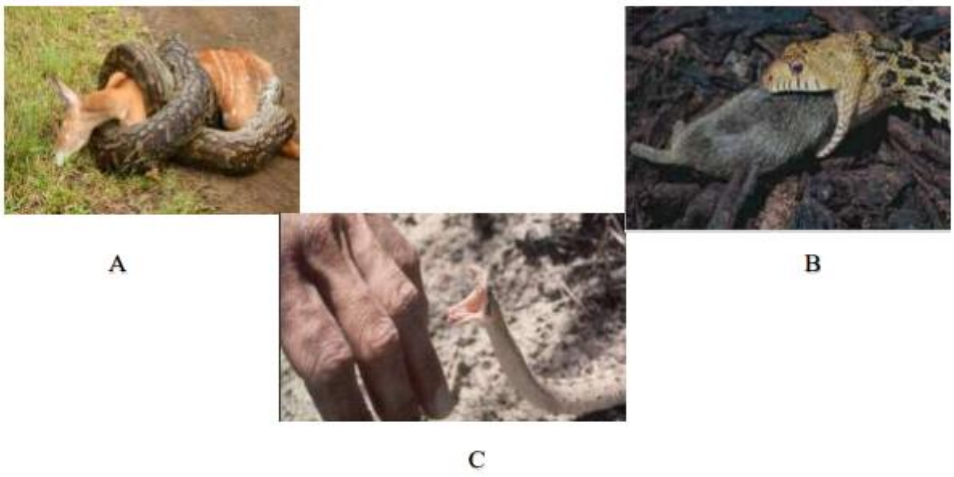

Figure 2-Predation methods for snakes, A: Getting around prey, B: Eat prey, C: Prey bites with poison (Site web 1)

2.2.4.- According to the back standards in the snake

Like **(**Fig 3**)**

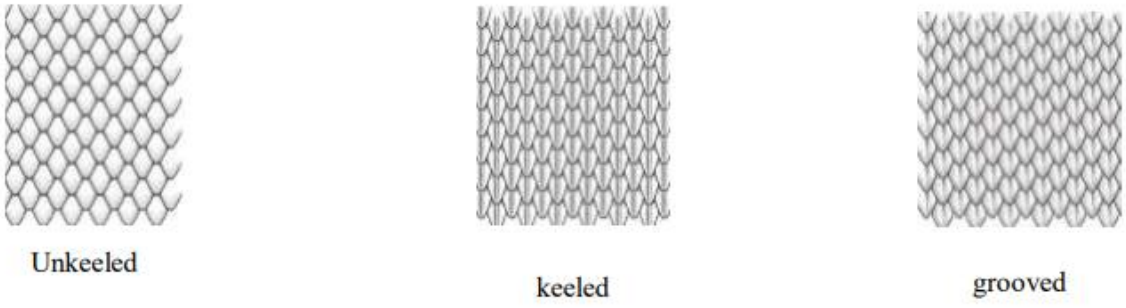

Figure 3-Dorsal scales in Snakes (Speybroeck et al., 2016)

3.- Venomous Apparatus

The venomous system is a complex device that combines a specialized gland that makes toxic secretion and venom and a weakening device called a venomous hook capable of injecting venom into the body of the prey or aggressor. In snakes, this function is particularly complex **(**Chippaux, 2002). Venom would come from a specialization of digestive secretions, perhaps pancreatic, certainly saliva, originally responsible for the digestion of tissues. The role of saliva is twofold: it lubricates food and starts the process digestion. Subsequently, the venoms.would have developed the ability to kill and Immobilize the prey with specialized toxins to facilitate restraint and swallowing made difficult by the absence of limbs **(** Nientao, 2010)

The snakes have different types of venomous structures. These differences seem to be associated with the evolution inof snakes. (Fig. 4) Therefore, the Colubridae are either aglyphs or opisthoglyphs (with the least evolved dentition), Elapidae are proteroglyphs, and the Viperidae are solenoglyphs (the most evolved) (Niamaly, 2021).

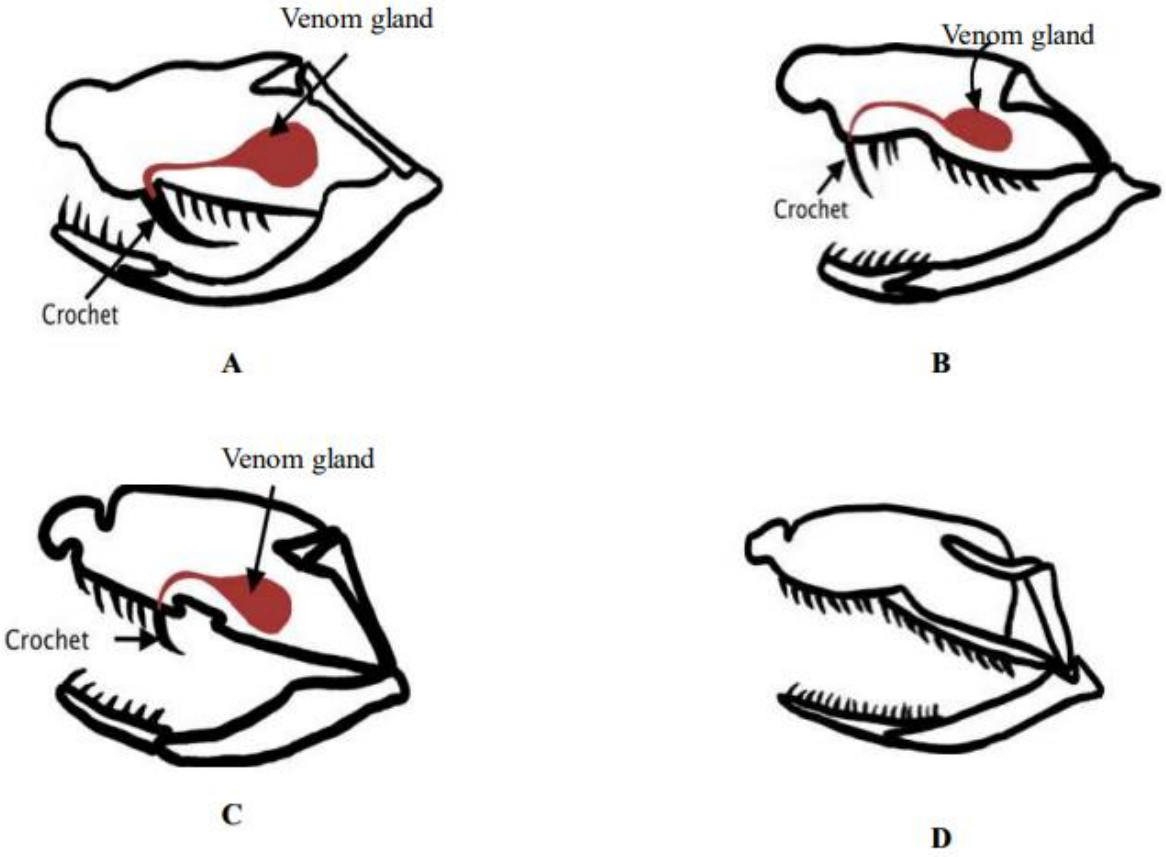

Figure 4- A: Diagram of a venomous device with Solenoglyphteeth (Viperidae), B: Diagram of a venomous device with Proteroglyph teeth, C: Diagram of a venomous device with Opisthoglyphteethe, D: Diagram of a venomous device with Aglyph teeth (Gérald, 2020).

4.- Poisonousand non-venomous snakes

We can distinguish between venomous and non-venomous snakes through anatomical features, which are fangs and venomous glands (Fig 5) , as they are present in venomous snakes and absent in non-venomous snakes (Chaca Niamaly, 2021).

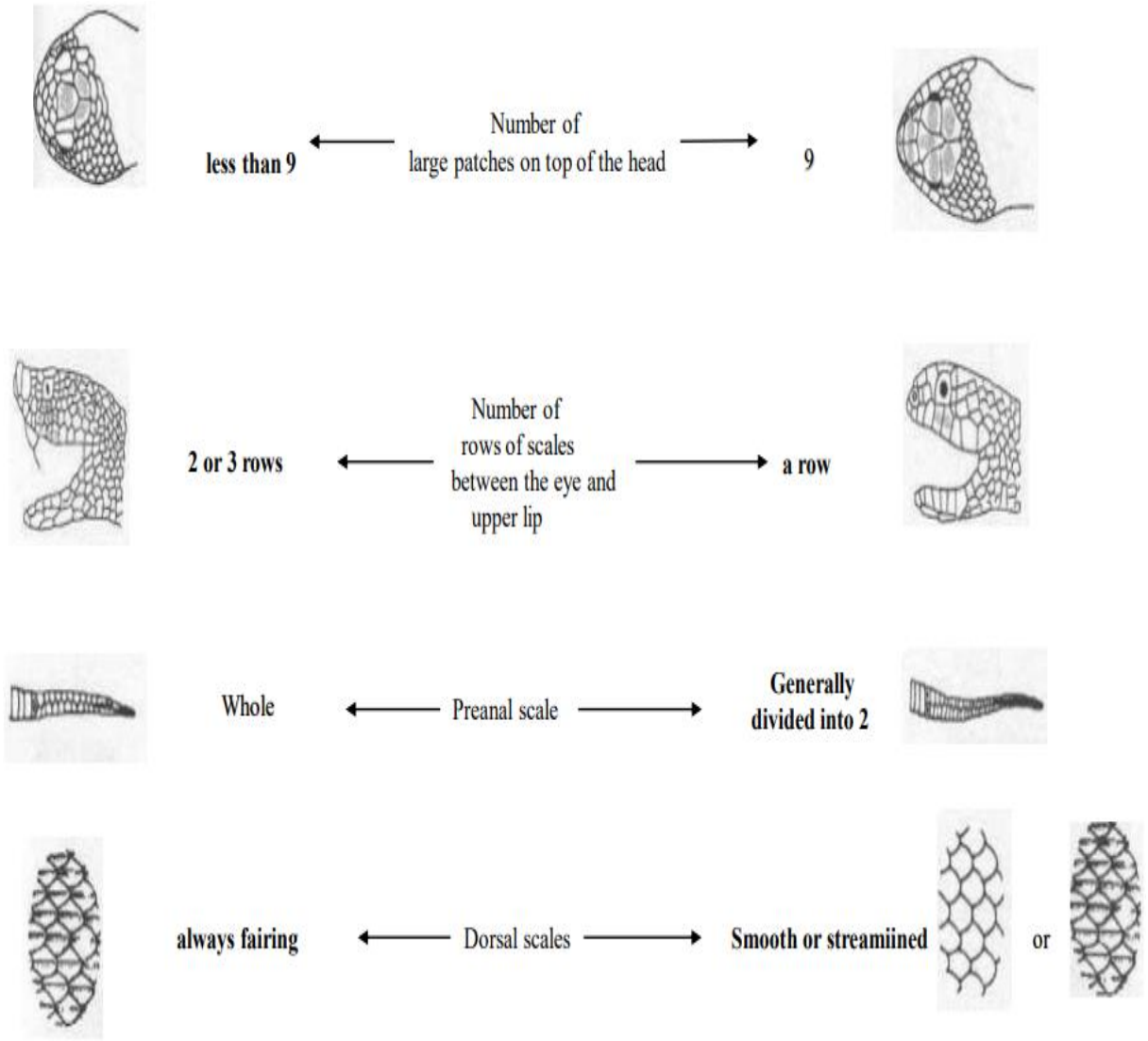

Figure 5- Morphological criteria for rapid identification of venomous (Viperidae) and non-venomous (Colubridae) snakes (El Yassir, 2013)

There are five criteria (Tab.2)

Table 2. Criteria fordifferentiating between venomous and non-venomous snakes (El Yassir, 2013)

	Head	Pupil	Tail	Standards	Hooks
Snake Venomous	Triangular	Vertical	Brief	2 or 3 between the eye and the lip superior	Row Presence
Snake No Venomous	Rounded	Rounded	Long, Tapered	A of scale between the eye and the lip superior	Row Absence

5.- Distribution of snakes

One of the most widely distributed animals in the world, snakes are primarily found in arid regions due to their high diversity. There are about 3400 species of snakes in the world (Speybroeck et al., 2016). They are found throughout the world except the most northern and southern latitudes, where the climate is too cold for them. The presence or absence of reptiles and amphibians in a region is due to an interplay of climate and habitat (Mattison, 2014).

6.- Reproduction

6.1.-The reproductive system of the male snake

The testes in the male reproductive system are oval-shaped and yellowish-cream in color. They are situated at two thirds of the body's length, with the right testis being cranial to the left. The spermatic ducts that run caudally along the intestine and connect each testis to the hemipenis at the base of the tail are called spermatic ducts. The right and left hemipenis of a snake are stored individually and inverted in a hemipenis sac located at the base of the tail (Fig. 6) (Denard, 2006; Jacobson, 2007)

6.2.-Female reproductive system of snakes

The long, thin ovaries that make up the female reproductive system are located in the same position as the male testes, which is the coelom, or two-thirds of the body. The cranial portion of the oviduct dilates to form the infundibulum, which lines the gut caudally. The oviducts on the cloaca open separately, similar to the vagina, without the development of the uterus. The vagina in the cloaca opens through the opening of the genitourinary system or a separate opening in the cloaca (Fig. 6) (Jacobson, 2007).

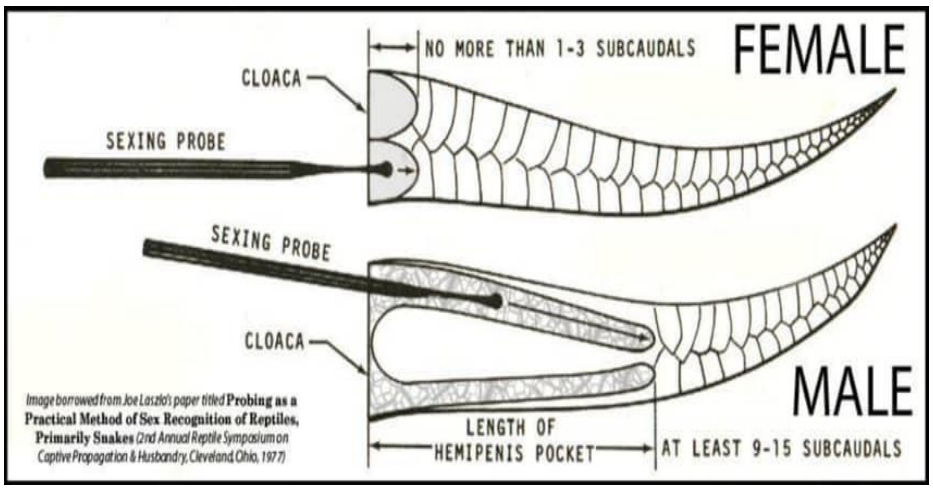

Figure 6- The difference between a male and a female snake sex probe (Laszlo, 1975)

The blunted-tip sexing probe is inserted into the hemipenis sac to determine the sex of snakes. Consequently, the sexing probe can be inserted deeper into a male snake than into a female snake (Fig. 7) (Fitch, 1960).

Pheromones are chemical signals released by the female anal scent gland. The male snake will use its tongue to detect and follow these pheromones (Carpenter, 1980). Combat dancing refers to the behavior of male snakes competing for the attention of a female snake by attempting to push her down. Depending on the correct positioning, one hemipenis will be used by the male to mate with the female. Ejaculation can last for several hours, potentially resulting in delayed fertilization (Vasaruchapong, 2014).

Figure 7-The mating behavior of snakes (Clark et al., 2014)

In two distinct areas of the oviducts in snakes, sperm can be stored: In the posterior funnel, typically in vascular structures (Perkins and Palmer, 1996; Siegel et al., 2011; Rojas, Barros, and Almeida-Santos, 2015), and also in cavitation, crypts, epithelial folds, and the posterior oviduct (Halpert et al., 1982; Almeida-Santos and Salomão, 1997; 2002; Siegel et al., 2011).

Short-term storage involves keeping sperm near the posterior funnel until ovulation, while long-term storage begins with the retention of sperm in the posterior oviduct. Before ovulation, the sperm ascend the oviduct into the posterior infundibulum where they are once again retained until ovulation (Halpert et al., 1982; Schuett, 1992; Siegel et al., 2011). Eggs are laid in dirt piles, wood, decaying plants, stones, or tree trunks (Fig. 8) during late spring or early summer. Snakes are born or hatched in late summer (Jackson and Mirick, 1993).

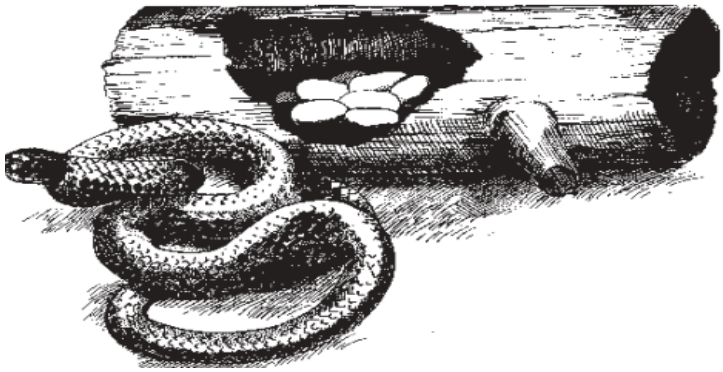

Figure 8-Where snakes lay eggs (Jackson and Mirick, 1993)

7.-Family Viperidae

The vipers and rattlesnakes that belong to the Viperidae family are distinguished by having a venomous apparatus with solenoglyph dentition (movable fangs located in front of the

maxilla). The venom gland produces venom, which is then delivered through an excretory channel that connects the gland to the fang. During a bite, the muscles of the venom gland contract, allowing the injection of venom under pressure (Mebs and Goyffon, 2006). It is reported that this family consists of three species: *Cerastes cerastes*, *Cerastes vipera*, and *Echis leucogaster* (Linnaeus, 1758; Roman, 1972)

7.1.-*Cerastes cerastes*

7.1.1.- Description

Viper of medium size, with a stocky body ending in a short, pointed tail. The head is triangular, wider than that of *Echis carinatus*. The dorsal and head scales are keeled. The suborbital, superciliary and frontal are subpyramidal. Very often, the supraocular scale is horn-shaped, behind each Sil (individuals without horns belong to the mutila variety). There are: 28 to 35 and 26 to 37 dorsal scales across the body; 14 to 18 inter orbitals; 12 to 15 supralabial. The ventral scales of 130 to 165 and 28 to 42 under caudal double, a simple anal. The maximum total length is 73 cm, 50 to 60 cm (Fig. 9). Its most remarkable characteristic consists of horned appendages located above the eyes. The dark coloring of the upper surface is pale sandy yellow, with 30 to 36 darker transverse spots or bands that are more or less well marked, often confluent. The underside is immaculate yellowish white (Le Berre, 1989; Gruber, 1992; Schleich et al., 1996; Nigel and Rob, 2001; Mouane, 2010; Mouane et al., 2020)

7.1.2.- Habitat

This viper is common in a wide variety of environments: Hammada, daya, reg, rocky scree, wadi beds, dunes (Le Berre, 1989), they are found in sand and stone deserts, often with bushy vegetation and sparse vegetation on the ground (Gruber, 1992)

7.1.3.-Distribution

Its distribution area extends over the western part of the Sahara Desert in India. It is found in North Africa, from Morocco to the west of Chott Djérid in Tunisia, but only in the steppe and desert regions. To the south, its limit appears to be the northern part of the Sahelian zone, but it also inhabits the massifs of Hoggar, Tibesti, and Ennedi. Additionally, it is found in Mauritania, Arabia, the Sinai massif, as well as Iraq and the Transjordanian region (Gauthier, 1967).

Figure 9- The viper *Cerastes cerastes* (Mouane et al., 2022).

7.2.- *Cerastes vipera*

7.2.1.-Description

Little viper with a skull that abruptly narrows behind and no horns. The top of the head is where the eyes are located. The tail has a dewclaw at the end and is very short 2 and 3 mm were pointed (Le Berre, 1989). There are 23 to 27 rows of dorsal scales surrounding from the center of the body; 99 to 122 of the ventral series; 16 to 26 under tails (Gruber, 1992); 9 a 13 (Le Berre, 1989) and 9 a 14 scales between the eyes (Schleich et al., 1996). On average, they are 35 centimeters long. 50 cm is the maximum length allowed (Gruber, 1992).

The upper side has 28 alternating dark patches along the body that are mostly black, giving it a sandy yellow or pale brick red tint. Two dark divergent lines are seen in the temporal area less frequently. Often, the tail tip is black. The underside is white with a yellow hue. (Le Berre, 1989) (Fig. 10) **.**

7.2.2.-Habitat

Its habitat is limited to the erg and is not found in any other biotope, including areas with extreme sandiness (Gauthier, 1967). Deep dunes and other regions with considerable siltation are present throughout the Sahara (Trape and Mane, 2006).

7.2.3.-Distribution

Morocco, Algeria (Sahara), and Tunisia (Tozeur and the Algerian-Tunisian desert border, west of Chott Djérid) are the places where it can be found. Additionally, it can also be found in Sinai and Mauritania (Gauthier, 1967).

Figure 10- The *viper Cerastes vipera* (Mouane et al., 2024).

8.- Snake venoms constituents

The majority of snakes have venoms that are complex mixes made up mostly of proteins (90–95%) with a range of biological activity. These components' main job is to contribute to the immobility and/or digesting of the prey by obstructing the nervous system, muscles, or circulatory system a role that hazardous proteins play in this process. The enzymes result in bleeding, acute discomfort, tissue necrosis, and localized capillary damage. The liquid that constitutes snake venom has a thick consistency and is typically yellowish-white in hue. However, the yellow color of the Viperidae venom which is extremely rich in enzymes is caused by the presence of a flavoprotein (L-Amino acid oxidase). The range of its viscosity is 1.5 to 2.5 (Laraba-Djebari, 1984; Chippaux and Goyffon, 1997; Boquet, 1970; Cherifi, 2004).

Chapter 2.-

Herbal Medicines against Snake Bites

Chapiter 2.- Herbal medicines against snake bites

In this chapter, we present the history of medicinal plants in the world and in Algeria. We touched on the definition of both medicinal plants and traditional medicine, the uses of medicinal plants and their global use, and the mechanism of action of medicinal plants in treating snakebites.

1.- History of use of plants

There is proof that for thousands of years, humankind have relied on nature for medicinal purposes, and that plants or plant extracts have served as the foundation for traditional medication. Many parts of the world still practice traditional medicine, which is where medical therapies first came from. Despite the fact that using plants as medications has been practiced for thousands of years (Hassan, 2015)

1.1.- In the world

One of the oldest documents and what is believed to be the oldest documented evidence of the use of medicinal plants dates back to approximately 5,000 years ago. It was inscribed on Sumerian clay tablets, and included dozens of recipes for creating more than 200 distinct plant medicines (Sumner, 2000). Some writings, written on clay, come from ancient Mesopotamia and date to approximately 2600 BC. Tablets written in cuneiform (Scurlock, 2014).

The ‘Ebers Papyrus’ (ca. 1550) was the most important of these recordings and contains over 600 prescription drugs of various plant species (Le Strange, 1977). European medicine is thought to have initiated with Hippocrates (460–377 BC) who compiled over 200 medicinal plants which were classified by physiological action and he is considered the ‘father of medicine (Castiglioni, 1985). Dioscorides, who was a Greek military physician and considered the ‘father of pharmacognosy’, recorded the use of medicinal plants and wrote De Materia Medica in ca. 77 AD, which was used as a reference in Europe for more than a millennium and translated into several languages(Riddle, 1985)

1.2- In Africa

The Egyptians recorded their medicinal knowledge in tomb illustrations and on papyrus dating from the Old Kingdom of Egypt. African traditional medicine has also been practiced for many centuries and it has diverse medical treatments for different diseases (Vossen and Keuthmann, 1986).

Herbs have been studied scientifically, although many local herbal traditions survive, most are passed down from generation to generation (Zevin et al., 1997). In many areas of the

world, and in a very general way, the use of herbal medicines can be classified into two main branches: orally transmitted folk traditions that are passed down from generation to generation and doctrinal or "formal" traditions that are often common today. It is based more on scientific research (Alexander, 2014). Many well-known medical works have recorded a large number of medicinal plants. These works are considered a valuable cultural heritage. Since the majority of traditional medicines are of plant origin, this system was previously called herbal (Yaniv and Bachrach, 2005).

1.3.- In Algeria

Every culture has a story about how medicinal plants were used to treat various ailments. The use of medicinal plants dates back more than a millennium in Algeria (Belkhodja, 2016)

The first written accounts of medicinal plants in Algeria and the Maghreb date back to the ninth century, when Ishâ-Ben-Amran, physician the prince of Kairouan, left behind many teachings on medicine and simple drugs (Baba aissa, 2000). Throughout the French colonial era, botanists managed to classify a significant number of medicinal species. Fourment and Roques published a book in 1942 detailing Algeria's medicinal and aromatic plant species. They mentioned 200 species, the majority of which were described and studied in northern Algeria, and only six species from the Sahara (Belkhodja, 2016).

Data gathered from the National Center of the Trade Register indicates that by the end of 2009, there were 1926 vendors in Algeria with a focus on selling medicinal plants, comprising 1393 sedentary vendors and 533 ambulant vendors. With 199 stores, the capital alone has the most, followed by the wilaya of Sétif (107 stores), Bechar (100 stores), and El Oued (60 stores) (Boumediou and Addoun, 2017)

1.4.- In the Algerian desert

Medicinal plants have been used in Algeria for centuries to treat various diseases. Although Algeria is one of the richest Arab countries with 3,164 plant species, only few ethnobotanical studies have been conducted in the country. In southern Algeria, the Sahara Desert, one of the world's largest indigenous deserts, residents still depend on traditional healers for their health care (Vasisht and Kumar, 2004; Prasad and Tyagi, 2015; Benarba et al., 2015; Benarba, 2016)

2.- Definition of traditional medicine

According to the WHO, "Traditional medicine is the sum total of knowledge, skills and practices that are based on the theories, beliefs and experiences of a and are used to maintain healthy human beings as well as to preventing, diagnosing, treating and curing physical and mental illnesses» In Africa, more than 80% of the population uses traditional medicine and medicinal plants for primary health care (Ait ouakrouch, 2015). Currently, according to WHO estimates, more than 80% of the population world, especially in underdeveloped countries, resort to traditional treatments to meet their health and primary care needs (Boumediou and Addoun, 2017).

3.- Medicinal plants

3.1.-Definition

Medicinal plants are plant medicines, and this is what is meant by the European Pharmacopoeia. They contain medicinal properties, and this is a definition according to the tenth edition of the French Pharmacopoeias (Debuigne, 1974). On the other hand, medicinal plants are those that contain substances that can be they are used for treatment or are precursors in making useful medicines (Abayomi, 2010)

3.2.- The part used in the plant

The medicinal plants are harvested in their natural habitat, if feasible (Leslie, 2004):

- Whole plants: throughout the time of their flowering.
- The leaves: following full development and, if feasible, prior to flowering.
- The flowers and flower stalks: just prior to the full blooming of flowers
- The roots of annual plants: at the conclusion of their growing period, or vegetative phase
- Biennial plants' roots are found toward the conclusion of the first year's vegetative phase and prior to the start of the second
- Perennial plant roots: in the second or third year, before they become too fibrous and hard (lignification)
- The grains and fruits are either fully grown or fully grown when they are Regarding fruits
- Tree bark: in winter or early spring (or during the dry season); shrub bark: after the hot season (or in end of wet season)

3.3.- Preparation method

3.3.1.- Infusions

This is the most straightforward way to prepare. It is kept for tea, which is made by covering the plant(s) with boiling water, leaving the blossoms and leaves for ten to fifteen minutes, and then filtering the liquid. An infusion can be stored in the fridge for up to 48 hours. In theory, it is best to avoid adding sugar to herbal teas. Since certain plants don't taste good, you can add some honey to your herbal tea to make it sweeter (Anne and Nogaret, 2003; Aribi, 2012; Gayet, 2013; Borrle, 2017).

3.3.2.- Decoction

The process of making a decoction is identical to that of an infusion, with the exception that a pan full of cold water is used to hold the plant or a portion of it. Heat everything until it boils. The amount of time that a plant or part of a plant takes to boil varies (10 to 30 minutes).Select tougher, thicker plant components for decoctions. These are the thick roots, bark, stalks, or leaves. Fresh or dried plants might be used (Djerroumi and Nacef, 2004; Nicolas, 2009; Francois, 2014)

3.3.3.- Maceration

This is letting the plants soak for ten or twelve hours in either cold or lukewarm water. The maximum duration of water macerations should be twelve hours to avoid the liquid fermenting and oxidizing. Additionally, plants can be macerated in vinegar, glycerin, alcohol, or another solvent (Anne and Nogaret, 2003; Pierre and Lis, 2007).

3.3.4.- Powders

Can be made by grinding and drying. Because the plant cell is acclimated to water scarcity, the entire plant holds up quite well after desiccation. However, the grinding process may eventually change the stability of the active components. A high-quality powder requires the finest possible grinding, which can be done using a hammer, chisel, or disc. Powders can be blended with meals, dissolved with water, made into extracts, and prepared into capsules (Isrin, 2001; Letard et al., 2015).

3.4.- Methods of use

Table 3. Ways to use plants (Bensalek, 2018).

Method name	Explain the method

Herbal tea	It is a beverage made by macerating, decocting, or infusing plant material into either hot or cold water. It is taken orally
Fumigation	It involves using vapors infused with active ingredients from a given plant to bolster it. Two methods are used: one uses an inhalator, and the other is a retracted teat technique from an empty serviette. Placing the face above the fuming water bowl,holding the plants
Compresses	It is the application of a somewhat pasty plant concoction to the skin for medicinal effects. To get the desired consistency, the plant can be diced, crushed, or combined with flax flour, either way
Baths	They are consistent in adding an infusé, décocté, or macéré to the bath water
Gargle	The medication, which consists of an infusion or as hot a décocté as feasible, is used to rinse the back, throat, pharynx, amygdales, and muqueuses. It is useful for disinfecting or calming, but it should never be used.

3.5.- Uses of medicinal plants

3.5.1.- General use of medicinal plants

The use of plants as medicine is by far the greatest use of the natural world by humans, in terms of the number of species that is addressed. In most medicinal traditions, plants are the primary source of components for medications. The entire number of therapeutic plants on Earth is unknown, and the proportions and quantities of plants vary widely throughout nations and locations (Hamilton, 2004). Worldwide estimates for the number of species utilized for medicinal purposes range from 35,000 to 70,000, or 53,000 (Farnsworth and Soejarto, 1991; Schippmann et al., 2002)

Plants are frequently used to promote health, and this practice is frequently seen as the result of secular accumulation of public knowledge. The usage of traditional medicinal plants remains the primary alternative for treating numerous illnesses for a significant portion of the population, notwithstanding medical breakthroughs. Because of their established therapeutic

efficacy, lower related costs, and the general public's discontent with the official health system, traditional medicinal herbs are actually the sole available therapeutic option for some communities (Cappelleti Nagai et al., 2010; Samuelsson and Bohlin, 2017). In the fight against detrimental physiological changes 85% uses medicinal plants or their derivatives, 80% of the world's population employs conventional primary care methods, according to data from the World Health Organization (WHO)

more than 230 species of angiosperms belonging to about 168 genera and 69 fam- ilies are being utilized for treatment of erectile dysfunc- tion, malnutrition, sickle cell anemia, hernia, venereal diseases (syphilis, HIV, and gonorrhoea), post-partum hemorrhage, snakebites, cancer, menorrhagia, threatened abortion, skin diseases, jaundice, and cough (Omara et al .,2020)

3.5.2.- The use of medicinal plants for snake bites

In order to cure a variety of ailments, including envenomations of animal origin, medicinal plants are a vital component that are the most readily available and easily accessible to local community health systems. These plants are a rich source of chemicals with pharmacological bases and natural inhibitors. Numerous ethnobotanical studies have documented the ability of various therapeutic plants, mostly found in tropical regions of Africa and Asia, to neutralize the venomous qualities of snakes. 1,127 species of antivenomous plants are found throughout 176 families. The most often cited families out of the 176 that were listed were Fabaceae, Asteraceae, Euphorbiaceae, Rubiaceae, Apocynaceae, Lamiaceae, Araceae, Malvaceae, and Acanthaceae. The most commonly utilized portions in antivenom therapies are the leaves and roots, either locally applied or orally (Dossou and Fandohan, 2021).

Medicinal herbs are a valuable source of bioactive chemicals that can be added to traditional serum therapy or used directly to help treat ophidian poisoning. When antisera are not available in emergency situations, plant extracts can be a useful alternative that can be used either alone or in combination with other agents (Pullani and Prabha, 2020)**.** Herbal medicine is being used by indigenous healers all over the world to treat snake envenomations; yet, modern medicine does not truly acknowledge this practice.There aren't many research assessing the pharmacologically effective methods for preventing snake bites **(**Coe and Anderson 2005; Veronese et al., 2005)

3.6.- Mechanisms of action of plants in treating snake bites

People in rural areas, in particular, often rely on traditional healers for alternative treatment due to the lack of proper healthcare facilities. Information drawn from ethnic customs, ancient cultures and herbal remedies. An endless amount of different herbal chemicals with pharmaceutical potential can be found in the plant kingdom. Traditional healers use a wide range of locally available medicinal plants in the form of pastes, tablets, powders, decoctions and juices to treat snakebites (Faruq et al., 2002; Gupta and Peshin, 2012)

The use of medicinal plants to treat ophidian envenomation mainly aims to alleviate the clinical symptoms observed. There are certain plants that have analgesic, anti-inflammatory, anti-edematous, antiseptic and anti-necrotic properties. The anti-inflammatory action is the most frequent and widespread, and is due to secondary metabolites such as flavonoids, coumarins and tri-terpenes. There are plants that act by inhibiting cyclooxygenase or lipoxygenase enzymes, responsible for the conversion of arachidonic acid into prostanoids or leukotrienes. Other plant extracts have antihistamine and anti-serotonic properties. Some plants also have antihemorrhagic effects by activating the coagulation system or dissolving blood clots through their proteolytic properties. Thus, these plants oppose the early stages of thrombosis caused by venom, thus preventing late complications of envenomation by snake bite. Plants have been reported in the literature to contain bioactive compounds, called plant-derived antidotes, which can act in three different ways: through competition, antagonism, and immunological stimulation. For example, certain alkaloids act as competitors of neurotoxins present in snake venom and can bind selectively to muscarinic acetylcholine receptors. This is because snake neurotoxins inhibit muscle contraction in the victim by binding to receptors, resulting in paralysis (Ngboula et al., 2021) Medicinal plants are used by the native medical systems to cure snakebites. A vast array of plants have been found to have antisnake venom properties (Martz, 1992; Houghton and Osibogun, 1993). According to reports, the following mechanisms are used by herbal antivenoms to counteract the deadly venom constituents: protein precipitation/inactivation, enzyme inhibition or inactivation, antioxidant activity, adjuvant action, chelation activity, and combination of these characteristics. Of them, enzyme inhibition and protein precipitation are more widely accepted (Alam and Gomes, 1998; Castro et al., 1999; Hung et al., 2004; Chatterjee et al., 2006; Vale et al., 2008; Gomes et al., 2010)

3.7.- Toxicity of medicinal plants

Medicinal plants can occasionally have undesired side effects. Each plant's undesirable and secondary effects are identified and presented in a clear and understandable manner, But remember that every organism is unique, so stop the treatment if you experience undesirable side effects for which a plant is to blame. To help you identify the plants that most closely match your needs (Iserin et al., 2001). Certain plants may be toxic in high doses, but it would require consuming more than 45 teaspoons a day something we wouldn't even consider (Ozenda, 1991).

Most medicinal plants are made up of dozens of distinct chemicals, some of which are quite complex. Mucilages, polysaccharides, and tannins are examples of plant components that regulate and alter the effects of any "active principles» (Haq, 2004).

It is not possible to replicate the effects of entire plant extracts by giving separated and refined elements of the herbs, according to studies. The biological sciences hold that a plant is larger than the sum of its parts, which is consistent with the medical establishment's innate conservatism. In practice, three groups of herbs can be identified from a safety point of view. Firstly there are some herbs that contain near pharmaceutical concentrations of poisonous constituents which should not be taken internally by unqualified persons Secondly, are the herbs with powerful actions. These herbs are safe under appropriate conditions. Finally, there is an idiosyncratic grouping of herbs, which have been alleged to exhibit specific kinds of toxicity (Haq, 2004).

In overall although medicinal plants are widely used and assumed to be safe, however, they can potentially be toxic. Where poisoning from medicinal plants has been reported, it usually has been due to misidentification of the plants in the form in which they are sold, or incorrectly preparation and administration by inadequately trained personnel (Nasri et al.,2023)

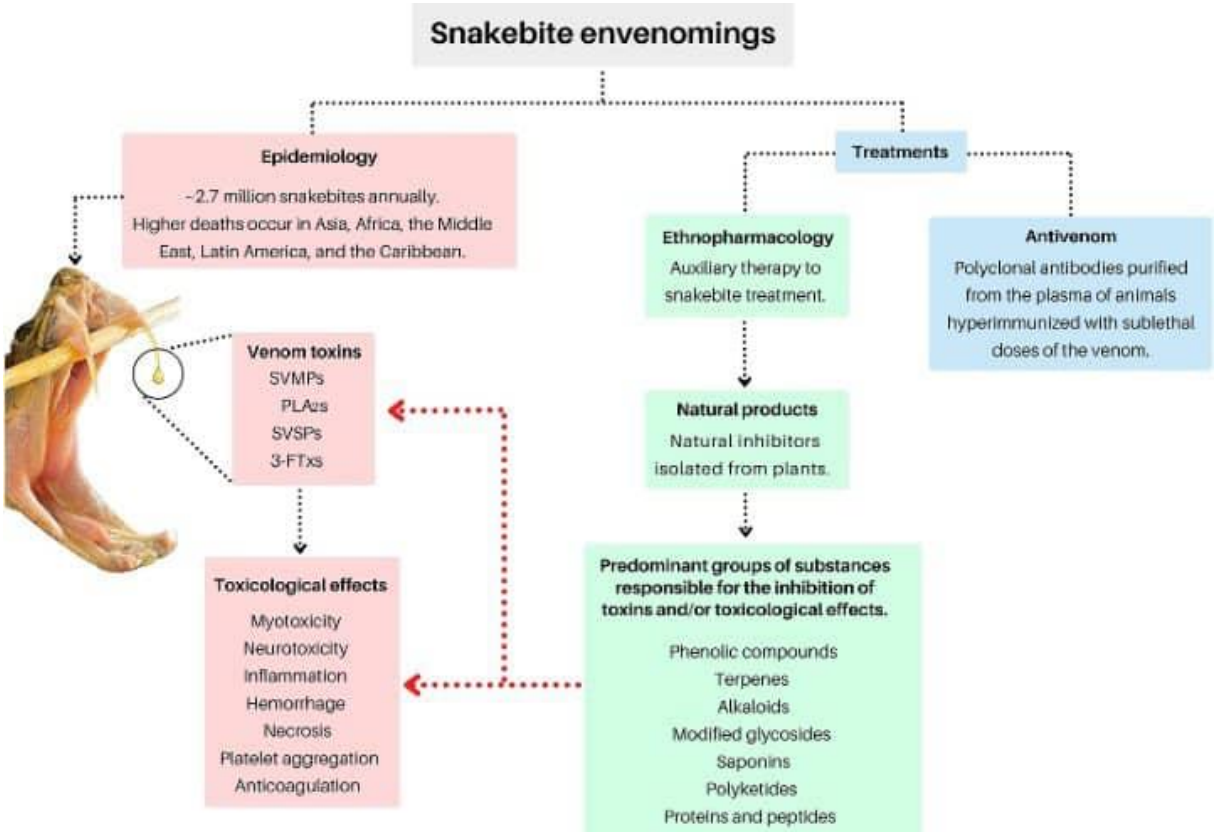

Figure 11- Document on snake poisons and their treatment (Adriao et al., 2022)

Applied part

Chapter 3.-

Materials and Methods

Chaptre3.- Materials and Methods

In this chapter, we will present the study area, the methodology, the most important sources of information, as well as the questionnaire and the methods used to calculate the results.

1.-Type of study

An ethnobotanical study was conducted on herbal plants used in traditional medicine for treating snake bites in the Oued Righ region. A questionnaire sheet was used to collect information about the medicinal plants used for treatment. Multiple tours were conducted in the municipalities of the region, and information and data were collected based on the responses to the questionnaire. The study focused on the general public, vendors, herbalists, and healers. Specifically, individuals with more experience and knowledge about plants, as well as older individuals, were targeted. Each interview lasted around half an hour**.**

2.-Representation of the study area

The Oued Righ region, situated in northern Algeria's Sahara, is a vast expanse of palm groves surrounded by dunes. The Oued Righ valley is part of the larger Lower Sahara basin, covering an area of 600.00 km^2. This region is located in the southeast of the country, specifically in the northeast of the Sahara, on the northern boundary of the large eastern erg and the southern edge of the Aures massif. It is named after Oued Righ region because it runs along the length of a water valley called Oued Righ. In fact, this region is a fossilized Oued, which can be seen on the ground as a linear depression running from north to south, dotted with palm groves. The most important palm groves in the region, from south to north, are Temerna, Djamaa, Meghaier, and Oum Ettiour (Anrh, 2002). The Oued Righ region is located between latitudes 34 and 09 north, and between longitudes 32 and 54 east. Geographically, the Oued Righ region is bordered to the north by Chott Malgheig and to the south by Ouargla. To the east, it is bordered by the Great Oriental Erg, and to the west by a gravel slope and the Wadi Mzab plateau. The region begins from The Ain Al-Safra region near the town of Umm Al-Tuyour in the north and ends in the town of Qouk in the south. The length of the region is about 160 km, while its width ranges between 30 and 40 km (Gouskoo, 1952; Nesson, 1965)

The climate of the Oued Righ Valley is a hot arid desert climate (Köppen climate classification = BWh), characterized by very low precipitation (< 150 mm/year), high temperatures, and low relative humidity. The De Martonne index is and lt; 4 (Mouane et al., 2024), indicating a hyper-arid climate where the Budyko evaporation index is about 100%,

and the climatic net primary production is precipitation-limited. The monthly maximum temperature exceeds 40°C during the mid-hot season (June-July), whereas the lowest minimum temperature is about 3.2°C recorded in January. Monthly precipitation is less than 10 mm, with an annual effective rainfall of 63 mm that falls during 9 days throughout the year. The main agricultural activity in the region is the cultivation of date palm (Phoenix dactylifera) established in oases that have mesic and mild ecological conditions compared to the surrounding hot-arid desert. According to the spontaneous plant species found in palm groves, they include green amaranth (Amaranthus hybridus L.), saltbush (Atriplex dimorphostegia Kar. & Kir.), cheeseweed (Malva parviflora L.), field bindweed (Convolvulus arvensis L.), shrubby seablight (Suaeda fruticosa Forssk. Ex J.F.Gmel.), and scutch grass (Cynodon dactylon (L.) Pers.) (Mouane et al., 2024).

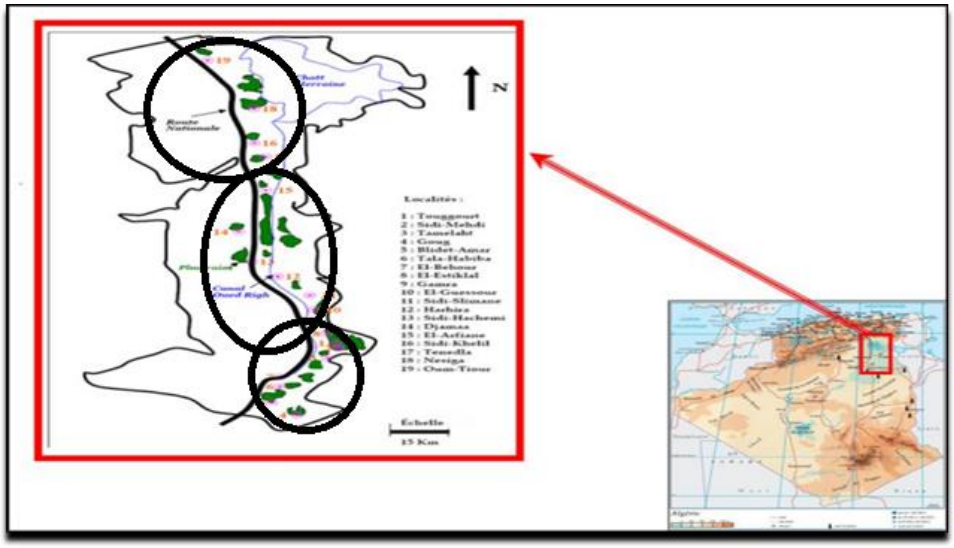

Figure 12- Geographical location of the Oued Righ valley (Hathat, 2021)

3.-Method of work

An ethnobotanical study of the treatment of snakebites was conducted in the Oued Righ area. In our study, we relied on the creation of a questionnaire that helps us to access the required data and information, while the questionnaire contained 45 questions and was divided into three parts, the first part is specific to the information and data of the respondents, namely age, weight, place of height, address, gender, as well as the educational

level, the place where the respondent lives, profession, ethnic origin, whether he was bitten by a snake before or not, and then the snake part, where there is a type and shape of the snake, when he was bitten by a snake, where he was, how old he was, and how long have passed the last bite and the bite area of the body two questions were asked about the medical treatment and its effect, and then comes the part about the plant where we touched on the question about the scientific and common name of the plant and its family name, does the person know the plant or not, and how the plant treatment is used (in the form of compresses, ointment or drink ...**)** How long the treatment lasted (24 hours or 48 hours ...Etc.) and how often the treatment is used (two or three times), as well as who took the treatment information (grandparents or general people ...Etc.) as well as the place of taking the plant, the part used in it, its features, how it is planted, what diseases this plant treats, whether poisonous plants are used in treatment and are taken in a system, whether cupping is used as a treatment, whether the plant is used alone, the rate of satisfaction with treatment, usage warnings and usage tips, where 200 people from the general public were randomly selected to answer the questionnaire. In this study, the questionnaire was distributed to some participants, while others were interviewed in person. Some participants received the questionnaire through social networking sites. The majority of those questioned were residents of the region, either born there or have lived there for a long time. Data and information on the use of medicinal plants in the treatment of snakebites were collected, the period of distribution of the questionnaire and collection of information was from November 21, 2023 to about January 25, 2024.

4.-Information sources

First, a list was created containing the common names of medicinal plants that these people use to treat snakebites. Therefore, a preliminary classification was made in English, based on the Floral Atlas of the Oued Righ Valley, by ecosystem. This classification also contributes to the statistical study of the use of medicinal plants in treating skin injuries and burns in the Oued Souf region. Additionally, there is a stock of medicinal plants in the northern Oued Souf region. This classification was then sent to the expert, Mr. Boukalba mounsef , head of the Forest Department of Talab Al-Arabi, Oued Province, Algeria. Plants were identified using Ozenda, Quezel and Santa (1962), and Quezel and Santa (1963). The plant names and status were revised using the Catalog of Life website and the Plant List website.

Conclusion

Conclusion

Our study presented the results of the ethnobotanical survey conducted in the Oued Righ region about a number of herbal remedies used to treat snake bites. We found 41 plant species belong to 21 families principally, *Citrullus colocynthis* which are belong to the Cucurbitaceae family. The methods of using these plants vary according to personal knowledge, such as their applications as a compresses or ointments, which are the most commonly used methods.

The use of seeds and leaves was very extensive, as women had the most knowledge of medicinal plants, and most of the age group with the most knowledge of plants ranged between 40 and 59 years. The unemployed, the illiterate, and those of Hassani origin, the majority of whom lived in the villages in Al-Meghaier, were the most used and knowledgeable of medicinal plants.

More scientific research is necessary to investigate the plants used for treating snake bites since evidence demonstrates the importance of local knowledge of medicinal plants. However, caution should still be exercised. The meghaier region is the most knowledgeable and widely used area for medicinal plants in Oued Righ. Knowledge of medicinal plants has increased recently after the Corona period due to the unavailability of medicine and people's fear of going to hospitals to avoid contracting the disease.

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Abstract

This work aims to identify an ethnobotanical study in Oued Righ (the Sahara Desert of Algeria), characterized by its rich and diverse medicinal plants. A series of surveys was conducted among local residents in the study area (200 questionnaires) to obtain as much information as possible about the therapeutic uses of medicinal plants in treating snake bites. The results obtained from the residents allowed for the identification of 41 species belonging to 21 plant families. *Citrullus colocynthis* (Cucurbitaceae family) is considered the most widely used plant, with a utilization rate of 15.61%. Additionally, the *Nigella sativa* plant (Ranunculaceae family) was found to be used at a rate of 12.20%. We also discovered the *Artemisia campestris* plant (Asteraceae family), which was used at a rate of 10.24%. These were the species most frequently used in our study, and the seeds were the most commonly used part (26.24%). The plants were prepared in various ways, but the most common method in our study was compresses (50.79%). Most of the plants used were wild (60.96%), and the majority of them were used alone (64.36%). The la rgest proportion of information on plant therapy was obtained from ancestors and the general public, and most of the results from plant therapy were satisfactory (60.33%). Therefore, this study is considered an important source of information that contributes to the knowledge of medicinal plants and their therapeutic use. This study can serve as a database to evaluate this valuable resource with the aim of finding new active ingredients that can be used in pharmacology.

key words: Ethiobotanical study, medicinal plants, traditional medicine, snake bites, oued Righ.

الملخص

يهدف هذا العمل إلى التعرف على دراسة نباتية عرقية في وادي ريغ (صحراء الجزائر الكبرى) التي تتميز بنباتاتها الطبية الغنية والمتنوعة. وأجريت سلسلة من الدراسات الاستقصائية في منطقة الدراسة بين السكان المحليين (200 استبيان) من أجل الحصول على أكبر قدر ممكن من المعلومات حول الاستخدامات العلاجية للنباتات الطبية لعلاج لدغات الثعابين. أتاحت النتائج التي حصل عليها السكان التعرف على 41 نوعا تنتمي إلى 21 عائلة نباتية. تعتبر الحجة (القرعية) النبات الأكثر استخداما بنسبة 15.61 بالمئة وأيضا نبات الحبة السوداء(الحوذان) وهو نبات استخدم بنسبة 12.20بالمئة وجدنا نبات التقفت (النجمية) استخدمت بنسبة 10.24 بالمئة وهذه كانت الأنواع الأكثر استخداما في دراستنا وكان الجزء الأكثر استعمالا البذور 26.24 بالمئة والجزء العلوي والأوراق ويتم تحضير النباتات بطرق كثير لاكن الأكثر شيوع في دراستنا هي الكمادات 50.79 بالمئة واغلب النباتات التي استعملت كانت برية 60.96 بالمئة واغلبها يتم استخدامها بمفردها 64.36 بالمئة وتم اخذ اكثر نسبة من معلومات العلاج بالنباتات من طرف الأجداد وعامة الناس واغلب نتائج العلاج بالنباتات كانت مرضية 60.33 بالمئة ولذلك تعتبر هذه الدراسة مصدراً مهماً للمعلومات التي تساهم في معرفة النباتات الطبية وكيفية استخدام العلاج بالنباتات. يمكن أن تكون هذه الدراسة بمثابة قاعدة بيانات لتقييم هذا المورد القيم بهدف العثور على مكونات نشطة جديدة يمكن استخدامها في علم الصيدلة.

الكلمات المفتاحية: دراسة اثيونباتية، النباتات الطبية، الطب التقليدي، لدغات الافاعي، وادي ريغ.