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THEME

Ethnobotanical study of medicinal plants causing
miscarriage in the Oued Souf region

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Abstract

Miscarriage is a relatively common experience but that doesn't make it any easier. The use of plants for abortion is also frequent in Algeria. Our study aimed to identify the medicinal plants used to cause miscarriage in El Oued province. An ethnobotanical survey was undertaken in six municipalities: El Oued center, Reguiba, Hassi Khalifa, Gummar, Debila and Magran. By using semi-structured interviews with 174 women of different ages, the result was analysed using XL version 2013 and the ethnobotanical indices were calculated such as: Relative frequency of citation (RFC), Use value (UV), Informant consensus factor (Fic), Family importance value (FIV) and Rahaman similarity index (RSI). The results showed that the local populations use 55 plants belong to 32 different families for miscarriage purpose; the family that are most cited are Lamiaceae. The highest RFC value was registrated for *Salvia rosmarinus* Spenn. significantly higher use value (UV) among the population of El-Oued. the most used part of the plants was leavs followed by stem, seed and Aerial part, Whole plant, root, Fruit, Flowers, Rhizome, Bulb and Peels and Juice and the most used method of preparation was the decoction, and with another component Vaginal suppository, In equal proportion cataplasm and powder. Women are not professionally inactive recorder the high value with. The people surveyed live in urban.

This survey will help, to identify high valued medicinal plant species in the locality for further drug discovery. Medicinal Plants with high use value should be subjected to comprehensive phytochemical studies for further drug discovery.

Keywords: Medicinal plants, Miscarriage, Ethnobotany, Traditional medicine.

Résumé

L'avortement est une expérience relativement courante, mais cela ne rend pas les choses plus faciles. L'utilisation de plantes pour l'avortement est également fréquente en Algérie. Notre étude visait à identifier les plantes médicinales utilisées pour provoquer des fausses couches dans la province d'El Oued. Une enquête ethnobotanique a été réalisée dans six communes : El Oued, Reguiba, Hassi Khalifa, Gummar, Debila et Magran. A partir d'entretiens semi-structurés auprès de 174 femmes d'âges différents, le résultat a été analysé à l'aide de la version XL 2013 et les indices ethnobotaniques ont été calculés : Fréquence relative de citation (RFC), Valeur d'usage (UV), Facteur de consensus de l'informateur (Fic), Famille valeur d'importance (FIV) et indice de similarité Rahaman (RSI). Les résultats ont montré que les populations locales utilisent 55 plantes appartenant à 32 familles différentes à des fins de fausse couche ; la famille la plus citée est celle des Lamiacées. La valeur RFC la plus élevée a été enregistrée pour *Salvia rosmarinus* Spenn. Valeur d'usage (UV) significativement plus élevée parmi la population d'El-Oued. La partie la plus utilisée des plantes était les feuilles suivi de la tige, de la graine et de la partie aérienne, de la plante entière, de la racine, du fruit, des fleurs, du rhizome, Bulbe et écorces et jus et la méthode de préparation la plus utilisée était la décoction, et avec un autre composant, Suppositoire vaginal, en proportion égale cataplasme et poudre. Les femmes ne sont pas professionnellement inactives avec une valeur élevée de. Les personnes interrogées vivent en milieu urbain.

Cette enquête permettra d'identifier des espèces de plantes médicinales de grande valeur dans la localité en vue de la découverte ultérieure de médicaments. Les plantes médicinales à haute valeur d'usage devraient être soumises à des études phytochimiques approfondies en vue de la découverte ultérieure de médicaments.

Mots clés : Plantes médicinales, Avortement, Ethnobotanique, Médecine traditionnelle.

الملخص

يعد الإجهاض تجربة شائعة نسبيًا، لكن هذا لا يجعل الأمر أسهل. كما أن استخدام النباتات للإجهاض أمر شائع في الجزائر. هدفت دراستنا إلى التعرف على النباتات الطبية المستخدمة في الإجهاض بولاية الواد. تم إجراء مسح عرقي نباتي في ستة دوائر: الوادي، الرقيبة، حاسي خليفة، قمار، الدبيلة والمقرن. باستخدام مقابلات شبه منظمة مع 174 امرأة من مختلف الأعمار، تم تحليل النتيجة باستخدام إصدار XL 2013 وتم حساب المؤشرات العرقية: التكرار النسبي للاستشهاد (RFC)، قيمة الاستخدام (UV)، عامل إجماع المخبر (Fic)، أهمية العائلة (FIV)، ومؤشر تشابه رهمان (RSI).

أظهرت النتائج أن السكان المحليين يستخدمون 55 نبتة تنتمي إلى 32 عائلة مختلفة لغرض الإجهاض. العائلة الأكثر ذكرًا هي الشفوية. تم تسجيل أعلى قيمة RFC لنبات *Salvia Rosmarinus* Spenn قيمة استخدام أعلى بكثير (UV) بين سكان الوادي، وكان الجزء الأكثر استخدامًا من النباتات هو الأوراق يليه الساق، البذور والجزء الهوائي، النبات الكامل، الجذر، الثمار، الأزهار، الجذور أفقية، البصلة والقشور وعصارة الفاكهة وكانت طريقة التحضير الأكثر استخدامًا هي المغلي، ومع مكون آخر، تحميلة مهبلية بنسب متساوية من الكمادات والمسحوق النساء غير النشيطات مهنيًا مسجلات القيمة العالية بنسبة. الأشخاص الذين شملهم الاستطلاع يعيشون في المناطق الحضرية.

سيساعد هذا المسح في تحديد أنواع النباتات الطبية ذات القيمة العالية في المنطقة لمزيد من اكتشاف الأدوية، يجب أن تخضع النباتات الطبية ذات القيمة الاستخدامية العالية لدراسات كيميائية نباتية شاملة لمزيد من اكتشاف الأدوية.

الكلمات المفتاحية: النباتات الطبية - الإجهاض - دراسة عرقية - الطب التقليدي.

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Introduction

Introduction

Mankind has used plants since antiquity to alleviate ailments. The use of plants in folk medication is very old and is currently experiencing an improved attention worldwide.

According to the World Health Organization (WHO) approximately 65-80% of the world's population relies on traditional medicine to meet primary therapeutic needs, due to scarcity and deficiency to access to modern medicine basic medication needs. In terms of economic contribution, global sales of herbal remedy amounted to about US \$ 60 billion in 2000. Algeria has one of the largest diverse and original flora in the Mediterranean. This flora involves around 3139 species (653 endemic) belonging to 150 families, with an endemism rate of about 12.6% Zerrouk et al.(2018).

Traditional medicine sometimes referred to as ethnomedicine, folk medicine, native healing, or complementary and alternative medicine, is the first system of healthcare that has persisted through the generations. Humans have adapted and dealt with a variety of ailments that have threatened their life and survival by using this old form of treatment. Traditional medicine is hence extensive and varied Abdullahi (2011).

For many women, pregnancy is an exciting time when they are planning for the future. Unfortunately, approximately one quarter of all pregnancies end in pregnancy loss. In the past, miscarriage, or spontaneous abortion which is defined as “the spontaneous termination of a pregnancy before the fetus has attained viability” (WHO Technical Report Series, No. 461 cited in WHO, 2006), was the most common type of pregnancy loss. Medically, miscarriage is defined by the World Health Organisation as premature expulsion of an embryo or fetus from the uterus up to 23 weeks of pregnancy and weighing up to 500 grams. However, definitions of miscarriage may vary between countries. In developing countries it is up to 28 weeks of pregnancy, while in some developed countries it is down to 24 weeks. Abortion is a social phenomenon that deserves study and research, as it is linked to three important things: the mother, the fetus, and society Nonglak (2013).

➤ This study aimed to preserve the knowledge and practices for use of medicinal plants for abortion in El Oued Province.

➤ The study aimed to valorise the various plant species used for abortion by the application of ethnobotanical study

The study is divided into two parts, each one is divided into two chapters: in the theoretical part, the first chapter includes a general overview of treatment with medicinal plants, the second chapter is devoted to the study of abortion, and in the experimental part,

the first chapter is devoted to presenting the materials and methods used, while the second chapter presents the results and discussions obtained, and finally the conclusion.

CHAPTER 01

Medicinal plants

1- Definition of medicinal plants

Medicinal plants represent the most ancient form of medication, used for thousands of years in traditional medicine in many countries around the world. The empirical knowledge about their beneficial effects was transmitted over the centuries within human communities Khan (2014).

2- Composition of medicinal plants

Medicinal plants It refers to a plant comprising active ingredients or secondary metabolites that possess biological activity. A whole plant may be medicinally active or plant parts. Herbal medicine. These are medicinal preparations comprising active ingredients obtained from the herbal plant. The product can be made from the whole plant or any part. Preparations from by-product herbal plants such as oils, gums, and other secretions are also considered as herbal medicine. Menstruum. It is a liquid or a suitable solvent chosen for an effective extraction process. Marc. It is an insoluble or inert drug material that is left behind at the end of the extraction process. Micelle. It is the mixture of both the extracted drug material and the solvent of extraction. Primary plant constituents. These are mainly nutritional components of plants such as common sugars, amino acid, proteins, and chlorophyll. These have little or no medicinal properties Abdullahi and Mainul (2020).

3- Definition of Alternative medicine

The world's flowering plant species have been used medicinally. Sometimes the figure of 70,000 medicinal plant species is cited, but this includes many algae, fungi, and micro-organisms that are not really plant as the word is understood by botanists Benjamine (1979).

These days the term Alternative Medicine became very common in western culture, it focus on the idea of using the plants for medicinal purpose. But the current belief that medicines which come in capsules or pills are the only medicines that we can trust and use. Even so most of these pills and capsules we take and use during our daily life came from plants. Medicinal plants frequently used as raw materials for extraction of active ingredients which used in the synthesis of different drugs. Like in case of laxatives, blood thinners, antibiotics and antimalaria medications, contain ingredients from plants Keita et al. (1996).

Algeria is the largest country in the Mediterranean basin, Africa, and the Arab region with a total area of almost 2.4 million km² and 1,600 of coastline. In addition to a diversified climate, Algeria is characterized by a rich flora consisting of 4,000 taxa, 917 genera, and 131 families. Moreover, owing to its ancient history as one of the first cradles of *Homo sapiens* and civilization in the world, Algeria possesses an important and rich cultural diversity. Although several studies have been undertaken to document the local knowledge regarding the use of medicinal plants to treat different diseases Khadidja and Bachir (2021).

4- Characteristics of medicinal plants

Medicinal plants have many characteristics when used as a treatment, as follow:

4-1 Synergic medicine- The ingredients of plants all interact simultaneously, so their uses can complement or damage others or neutralize their possible negative effects Bassam (2016).

4-2 Support of official medicine- In the treatment of complex cases like cancer diseases the components of the plants proved to be very effective Bassam (2016).

4-3 Preventive medicine- It has been proven that the component of the plants also characterize by their ability to prevent the appearance of some diseases. This will help to reduce the use of the chemical remedies which will be used when the disease is already present i.e., reduce the side effect of synthetic treatment Bassam (2016).

5- Classification of medicinal plants

Classification of medicinal plants is organized in different ways depending on the criteria used. In general, medicinal plants are arranged according to their active principles in their storage organs of plants, particularly roots, leaves, flowers, seeds and other parts of plant. These principles are valuable to mankind in the treatment of diseases. Reports on the classification of many plant species yielding vegetable oils used in cosmetics and body and skin care preparations are sporadic or lacking Krishnaiah et al. (2011).

5-1 Classification According to the Usage

The herbs are classified in four parts: medicinal herbs, culinary herbs, aromatic herbs, ornamental herbs Krishnaiah et al. (2011).

5-1-1 Medicinal Herbs

have curative powers and are used in making medicines because of their healing properties like marigold, lemon balm, lavender, johnny-jump-up, feverfew etc.

5-1-2 Culinary Herbs

are probably the mostly used as cooking herbs because of their strong flavours like oregano, parsley, sweet basil, horseradish, thyme etc Krishnaiah et al. (2011).

5-1-3- Aromatic Herbs

have some common uses because of their pleasant smelling flowers or foliage. Oils from aromatic herbs can be used to produce perfumes, toilet water, and various scents. For e.g. mint, rosemary, basil etc Krishnaiah et al. (2011).

5-1-4- Ornamental Herbs

are used for decoration because they have brightly coloured flowers and foliage like lavender, chives, bee balm, lemongrass etc Krishnaiah et al. (2011).

5-2 Classification according to the Active Constituents

According to the active constituents all herbs are divided into five major categories: Aromatic (volatile oils), Astringents (tannins), Bitter (phenol compounds, saponins, and alkaloids), Mucilaginous (polysaccharides), and Nutritive (food stuffs) Yudharaj et al. (2016).

5-2-1 Aromatic herbs

The name is a reflection of the pleasant odour that many of these herbs have. They are used extensively both therapeutically and as flavourings and perfumes.

Aromatic herbs are divided into two subcategories: stimulants and nervines.

Stimulant Herbs increase energy and activities of the body, or its parts or organs, and most often affect the respiratory, digestive, and circulatory systems. E.g. fennel, ginger, garlic, lemongrass Yudharaj et al. (2016).

5-2-2 Astringent Herbs

Tannins in Astringent Herbs have the ability to precipitate proteins, and this "tightens," contracts, or tones living tissue, and helps to halt discharges. They affect the digestive, urinary, and circulatory systems, and large doses are toxic to the liver. They are analgesic, antiseptic, antiabortive, astringent, emmenagogue, hemostatic, and styptic Yudharaj et al. (2016).

5-2-3 Bitter Herbs

Bitter Herbs are named because of the presence of phenols and phenol glycosides, alkaloids, saponins and are divided into four subcategories:

Diuretic Herbs induce loss of fluid from the body through the urinary system. The fluids released help cleanse the vascular system, kidneys, and liver. They are alterative, antibiotic, ant catarrhal, antipyretic, and antiseptic, lithotripter, and blood purifier in nature. asparagus, blessed thistle, burdock, butcher's broom, buchu, chaparral, chickweed, corn silk, dandelion, dog grass, grapevine, and parsley Yudharaj et al. (2016).

5-2-4 Mucilaginous Herbs

Mucilaginous herbs derive their properties from the polysaccharides they contain, which give these herbs a slippery, mild taste that is sweet in water. All plants produce mucilage in some form to store water and glucide as a food reserve. They eliminate the toxins from the intestinal system, help in regulating it and reduce the bowel transit time. They are antibiotic, emollient, vulnerary, and detoxifier in nature. For e.g. althea, aloe, burdock, comfrey, dandelion, Echinacea, fenugreek, kelp, psyllium, slippery elm, dulse, glucomannan from Konjak root, Irish moss, and mullein Yudharaj et al. (2016).

5-2-5 Nutritive Herbs

Wheat germ these herbs derive both their name and their classification from the nutritive value they provide to the diet. They are true foods and provide some medicinal effects as fibber, mucilage, and diuretic action. But most importantly they provide the nutrition of protein, carbohydrates, and fats, plus the vitamins and minerals that are necessary for adequate nutrition. For e.g. rosehips, acerola, apple, asparagus, banana, barley grass, bee pollen, bilberry, broccoli, cabbage, carrot, cauliflower, grapefruit, hibiscus, lemon, oat straw, onion, orange, papaya, pineapple, red clover, spirulina, stevia Yudharaj et al. (2016).

5-3Classification According to their Herbs

Herbs also can be classified as annuals, biennials, and perennials. Annuals bloom one season and then die. Biennials live for two seasons, blooming the second season only. Once established, perennials live over winter and bloom each season. They can last for many years with proper care. Annual herbs complete their life cycle in one year; start them from seed. The annuals have to be seeded each year unless conditions are favorable enough in the garden to seed themselves William (1992).

5-4 Classification according to Nature

Natural products are compounds consisting essentially of carbon derived from natural sources and that generally have very diverse and interesting properties. Some of the most

relevant applications of the Natural Organic Products are using it as Fuels, plastics, fats, soaps, sugars William (1992).

5-4-1- Petroleum

(Petra = stone; Oil = oil) is a naturally formed by liquid mixture of hydrocarbons, which are processed in the petrochemical industry through fractional distillation and cracking to gasoline, natural gas, etc William (1992).

5-4-2- Soap

It is the sodium salt of a fatty acid. Have a party hydrophyllic (dissolves in water) and other lipophyllic (fat dissolves dirt) William (1992).

5-4-3- Sugars

These are natural polyhydroxialdehydes or polyhydroxiketones with different functions: structure, energy storage components of the nucleic acids, etc. They are formed by photosynthesis in plants and are classified into monosaccharides (glucose), disaccharides (sucrose) and polysaccharides (cellulose, starch, etc.) William (1992).

5-4-4- Agro-chemicals

pesticides, plant growth regulators, etc. Modifiers of animal behavior William (1992).

5-4-5- Flavours and perfumes.

Food Additives (flavours, colours, antioxidants, etc) Wright et al. (2007).

5-4-6- Drugs

Product to be administered for curative purposes. Although there are many natural source products that are used as drugs, the synthesis of drugs is well developed and provides a large amount of chemicals that are used as such. For example: sedatives, anti inflammatories, diurethics, antiviral, hepatoprotectors, etc Wright et al. (2007).

5-4-7- Regulators

Like dopamine, used for Parkinson's syndrome (only L-Dopa is active) Antibiotics: chemical products able to inhibit the growth of microorganisms and even destroy them Wright et al. (2007).

5-5 Classification Based on their Physiologic Activity

Approximately one half of the medicines used today are natural products, i.e. alkaloids, antibiotics or synthetic analogs. For that it is usually employed a classification that represents the physiologic activity, such as hormones, vitamins, antibiotics and mycotoxins. Even though the compounds belonging to each group have different structures and biogenetic origins, a narrow relationship is occasionally between those aspects and activity Wright et al. (2007).

6-Origin of medicinal plants

6-1- Wild plants

These plants are difficult or impossible to grow. According to certain importing firms, 60 to 70% of the drugs on the European market are derived from these plants. As for the medicinal value of spontaneous plants, it varies depending on their origin, terrain and growing conditions Atallah and Diab (2021)

6-2- Cultivated plants

Medicinal plants require intensive management. Different species require their own distinct cultivation conditions. The WHO recommends the use of rotation to minimize problems with plant diseases and pests. Cultivation may be traditional or can use conservation agriculture practices, or state of the art agricultural equipment to conserve water and to maintain the organic matter in the soil, for instance with no-till farming systems (World Health Organization, 2003). In many aromatic and medicinal plants, plant characteristics often vary widely with cropping strategy and type of soil, so care is essentially required to obtain satisfactory yields Carrubba and Scalenghe (2012).

7-Medicinal plants preparation and parts used

7-1 Commonly used methods in the preparation of medicinal plants

7-1-1 Maceration

In this process, the whole or coarsely powdered crude plant is placed in a stoppered container with the solvent and allowed to stand at room temperature for a period of at least three days with frequent agitation until the soluble matter has dissolved. The mixture then is strained, the marc (the damp solid material) is pressed, and the combined liquids are clarified by filtration or decantation after standing Majekodunmi (2015) (Fig. 1).



Figure 1. maceration Majekodunmi (2015)

7-1-2- Infusion.

This is an extraction process such as maceration. The drug material is grinded into powder, and then placed inside a clean container. The extraction solvent hot or cold is then poured on top of the drug material, soaked, and kept for a short period of time. This method is suitable for extraction bioactive constituents that are readily soluble. In addition, it is an appropriate method for preparation of fresh extract before use. The solvent to sample ratio is usually 4:1 or 16:1 depending on the intended use Majekodunmi (2015) Ingle et al. (2017)(Fig2).



Figure 2. Infusion of the leaves Atallah and diab (2018).

7-1-3- Digestion

This is an extraction method that involves the use of moderate heat during extraction process. The solvent of extraction is poured into a clean container followed by powdered drug material. The mixture is placed over water bath or in an oven at a temperature about 50o C. Heat was applied throughout the extraction process to decrease the viscosity of extraction solvent and enhance the removal of secondary metabolites. This method is suitable for plant materials that are readily soluble Majekodunmi (2015); Ingle et al. (2017)

7-1-4- Decoction

This is a process that involves continuous hot extraction using specied volume of water as a solvent. A dried, grinded, and powdered plant material is placed into a clean container. Water is then poured and stirred. Heat is then applied throughout the process to hasten the extraction. The process is lasted for a short duration usually about 15min. The ratio of solvent to crude drug is usually 4:1 or 16:1. It is used for extraction of water soluble and heat stable plant material Majekodunmi (2015), Azwanida (2015); Pandey (2014); Ingle et al. (2017) (Fig3).



Figure 3 . Decoction of stems and leaves Atallah and diab (2018).

7-2- Medicinal plant parts used

Healers mostly use fresh specimens from commonly available plants to prepare remedies for their patients his mostly due to the effectiveness of fresh medicinal plant parts in treatment the contents are not lost before use compared to the dried ones. As also referred many authors, traditional healers have harvested leaves, roots, barks, seeds, fruits, stems, flowers, or latex of medicinal plants to prepare their traditional medicines for patient treatments Admasu et al. (2020).

8- Medicinal plants place in the modern pharmacotherapy

Medicinal plants represent the most ancient form of medication, used for thousands of years in traditional medicine in many countries around the world. The empirical knowledge about their beneficial effects was transmitted over the centuries within human communities.

Natural products play a pivotal role as a source of drug compounds and, currently, a number of modern drugs which are derived from traditional herbal medicine are used in modern pharmacotherapy Patwardhan et al. (2008).

The extraction procedure is a crucial step in the study of the bioactive molecules from plant sources. Currently, in addition to more traditional techniques, modern extraction methods are being utilized, such as ultrasound-assisted and supercritical fluid extraction methods Azwanida (2015).

On the other hand, the biological properties of many plant species traditionally utilized together with their bioactive components have been elucidated until now. The more classical bioassay-guided natural drug discovery process and the modern processes, including high-

throughput screening Jamshidi et al.(2018), Harvey and Cree (2010), and even the new reverse pharmacognosy approach Takenaka (2001), allowed the identification of a great number of bioactive phytochemicals Jamshidi et al. (2018).

Nevertheless, medicinal plants still have a hopeful future, as the phytochemical composition and the potential health benefits of many species have not yet been studied or still need to be more deeply investigated Jamshidi et al. (2018).

9- Safety of medicinal plants

Medicinal plants can raise safety concerns and cause adverse effects and even death in extreme cases, whether by the side-effects of their active compounds (substances), by overdose, by inappropriate prescription, or by adulteration (or contamination). Many such effects are well known, while several others remain to be scientifically explored. The Thornapple *Datura stramonium* is used for asthma remedy, because of its content of the alkaloid atropine, but it is as well a powerful and potential fatal hallucinogen. There is no reason whatsoever to presume that as a product comes from nature it is safe: the existence of powerful natural poisons such as nicotine and atropine indicates this to be incorrect. Further, the high standards and quality applied to the conventional medicines do not often apply to the plant medicines, and dose often vary extensively depending on the growth conditions of the plants: for instance, older plants may be far more toxic than young plants Talalay (2001), Vickers (2007), and also plants grown on toxic and contaminated environments usually contain more toxic substances than the plants grown in organic and agricultural safe environment. The extracts of pharmacologically active plants can interact with the conventional drugs, both because they can provide increased dose of related compounds, and because some phytochemicals delay and interfere with the body systems that metabolize drugs in the liver including cytochrome P450 system, causing the drugs to last longer in the body and also have a more powerful and potential cumulative effect Nekvindová and Anzenbacher (2007).

Plant medicines may be dangerous during pregnancy. Since plants usually contain several different substances, plant extracts can have complex effects on human body Born and Barron (2005).

10- Medicinal plants causing miscarriage

Abortifacient plants to avoid during pregnancy Plants known as abortifacient have within their compounds some active ingredients that can favor the onset of contractions, thus triggering an abortion, especially during the first months of pregnancy (Site web1).

For this reason, pregnant women shouldn't usually take medicinal plants, unless they have a prescription and medical advice. Below which abortifacient plants should avoid consuming:

Artemisia absinthium L- *Verbena officinalis* L- *Ruta graveolens* L- *Peumusboldus*- *Achillea millefolium* L- *Glycyrrhiza glabra* L- *Salvia officinalis* L- *Tanacetum vulgare* L- *Menthapulegium* L-*Arnica* L.

Regular consumption of infusions made with these plants can cause some complications, especially during the first trimester of pregnancy (Site web1) (Fig4).



Figure 4 . *Ruta graveolens* L is one of the plants that can cause a miscarriage (Site web 1)

CHAPTER 02

Miscarriage

1.- Fertilization definition

Fertilization is the process by which male and female gametes are fused together, initiating the development of a new organism. The male gamete or 'sperm', and the female gamete, 'egg' or 'ovum' are specialized sex cells, which fuse together to begin the formation of a zygote during a process called sexual reproduction Ariel (2017) (Fig5).

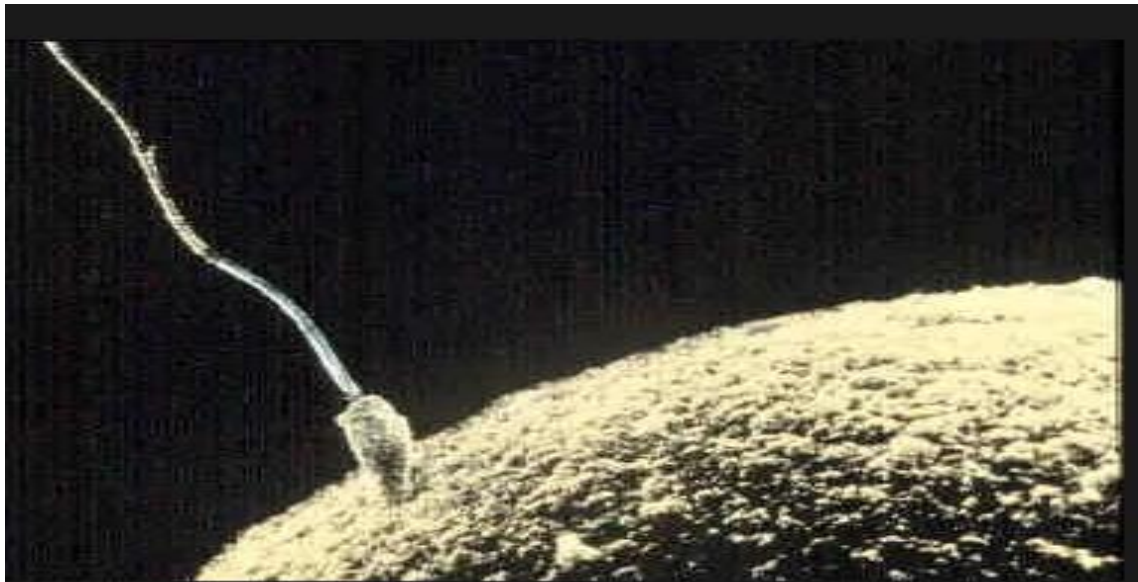


Figure 5. Fertilization (Site web 2)

1.1.- Fertilization process

There are three stages to fertilization which ensure that the appropriate egg and sperm are able to find each other and to warrant that only one sperm enters the egg: chemotaxis, sperm activation/acrosomal reaction and sperm/egg adhesion Ariel (2017).

Ovulation must occur before fertilization can happen; in humans, ovulation occurs once a month during the menstrual cycle. This cycle releases an egg cell from the *ovaries* and the first stage of fertilization begins. In other animals, ovulation can occur in cycles of different length, or is triggered by the occurrence of sexual intercourse Ariel (2017).

In mammals, after ejaculation, the sperm locates the oocyte (the immature egg), through changes in temperature and chemical gradients. Sperm chemotaxis, a type of interaction in which sperm cells are guided to the oocyte to the hormone progesterone, which is secreted by the oocyte, and sperm thermotaxis, which involves the response to changes in temperature, ensure that the sperm are able to locate the oocyte (usually within the ampulla of the fallopian tube. While the sperm is in the reproductive tract, it undergoes *capacitation*, which increases

its movement ability and destabilizes its membrane, preparing it for the acrosome reaction Ariel (2017).

Once the sperm locates the oocyte, it binds to the zona pellucida, which is a thick layer of jelly-like, extra-cellular matrix consisting of glycoproteins, surrounding the egg.

A specialized molecule on the surface of the sperm binds to a ZP3 glycoprotein in the zone pellucida, triggering the acrosome reaction. The acrosome reaction releases hyaluronidase, which digests the hyaluronic acid around the oocyte, allowing the sperm to pass through. Upon successful implantation of a sperm, the cortical granules within the oocyte fuse with the plasma membrane of the cell, and are expelled into the zona pellucida, causing the surface to become hard and impenetrable. This process is called the cortical reaction and is responsible for ensuring that only one sperm cell can enter and fertilize the egg Ariel (2017).

Once the sperm has successfully penetrated the oocyte, the outer coating and the tail of the sperm disintegrates. The oocyte undergoes meiosis to produce the haploid ovum. The two haploid cells, each containing 23 chromosomes, undergo fusion of their genetic material, ultimately creating a diploid cell containing 46 chromosomes, called a zygote. The zygote then begins mitosis, the repeated cellular division necessary for the growth of an organism, forming a blastocyst, which is implanted into the wall of the uterus, beginning the pregnancy Ariel (2017) (Fig6).

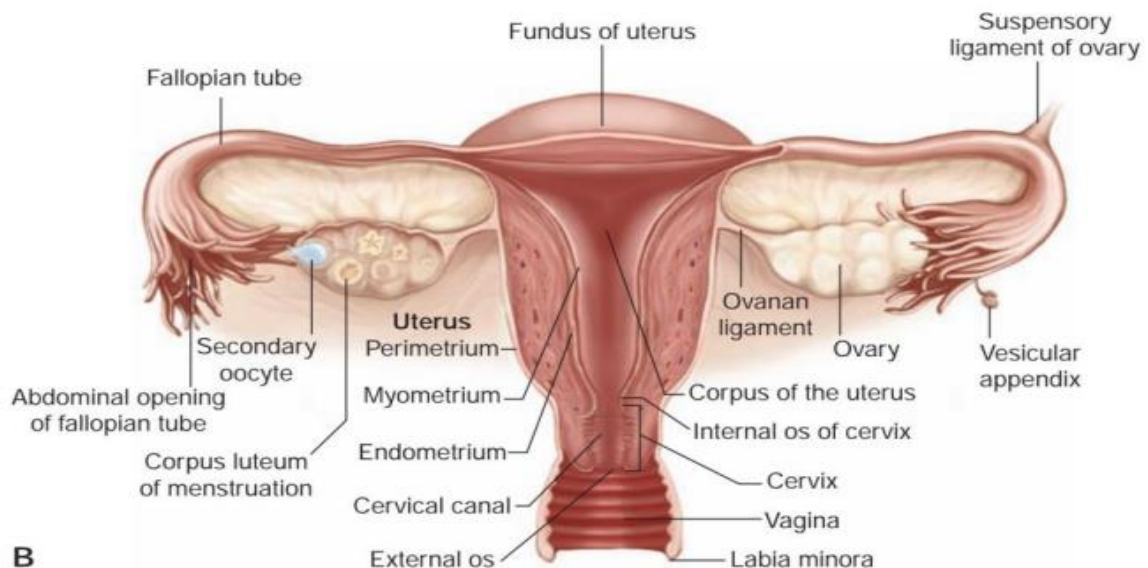


Figure 6 . The female reproductive system mazin hashem et al. (2021)

1.2.- Development of embryo

The development is the embryo, which develops within the amniotic sac, under the lining of the uterus on one side. This stage is characterized by the formation of most internal organs and external body structures. Most organs begin to form about 3 weeks after fertilization, which equals 5 weeks of pregnancy (because doctors date pregnancy from the first day of the woman's last menstrual period, which is typically 2 weeks before fertilization). At this time, the embryo elongates, first suggesting a human shape. Shortly thereafter, the area that will become the brain and spinal cord (neural tube) begins to develop. The heart and major blood vessels begin to develop earlier—by about day 16. The heart begins to pump fluid through blood vessels by day 20, and the first red blood cells appear the next day. Blood vessels continue to develop in the embryo and placenta Artal-Mittelmark (2021).

Almost all organs are completely formed by about 10 weeks after fertilization (which equals 12 weeks of pregnancy). The exceptions are the brain and spinal cord, which continue to form and develop throughout pregnancy. Most malformations (birth defects) occur during the period when organs are forming. During this period, the embryo is most vulnerable to the effects of drugs, radiation, and viruses. Therefore, a pregnant woman should not be given any live-virus vaccinations or take any drugs during this period unless they are considered essential to protect her health Artal-Mittelmark (2021).

2.- Definition of miscarriage

miscarriage is defined as the loss of pregnancy less than 20 weeks gestation. The American College of Obstetricians and Gynecologists (ACOG) estimates it is the most common form of pregnancy loss. It is estimated that as many as 26% of all pregnancies end in miscarriage and up to 10% of clinically recognized pregnancies. Moreover, 80% of early pregnancy loss occurs in the first trimester. The risk of miscarriage decreases after 12 weeks gestation Carla and Valori (2022).

The terms miscarriage and abortion are used interchangeably. The term abortion refers to a termination of a pregnancy either natural or induced. There are several terms that describe different states of pregnancy loss. These terms include threatened, inevitable, complete, and missed abortion. Threatened abortion is the presence of vaginal bleeding in

early pregnancy but on pelvic exam, the cervical os is closed and the transvaginal ultrasound shows a viable fetus. Inevitable abortion is when there is vaginal bleeding but on the pelvic exam, the cervical os is open meaning that the fetus or products of conception are expected to pass through the cervix in the near future. On transvaginal ultrasound, there can be either be a viable fetus or not. Complete abortion is when there is initially vaginal bleeding and passing of products of conception through the cervix. On transvaginal ultrasound, there would be no remaining products of conception in the uterus. A missed abortion refers to when there was vaginal bleeding and perhaps some passage of tissue or products of conception. On pelvic exam, the cervical os would be closed. On transvaginal ultrasound, there would be retained products of conception and there would not be a viable fetus Carla and Valori (2022).

3.- The period during which miscarriage occurs frequently

Miscarriage, also known as early pregnancy loss, typically occurs before 20 weeks of pregnancy. The majority of miscarriages, around 80%, happen in the first trimester before the 12th week of pregnancy. Miscarriages in the second trimester, between 13 and 19 weeks, are less common, happening in about 1 to 5 percent of pregnancies Rebecca (2022).

4.- The reasons for women resorting to abortion

All reasons for abortion are valid, and the decision to end a pregnancy is very personal. Here are some common reasons why people may choose to have an abortion:

4.1.- Financial Circumstances

Around 40% of people seeking abortions mention financial reasons. Some individuals cannot afford to support a child, while others face unemployment or lack insurance or government assistance Hannah (2022).

4.2.- Timing

Approximately 36% of study participants cite timing-related reasons. Some feel they are not emotionally or financially ready to have a baby, while others believe they are too old to become parents Hannah (2022). Other reasons, wants to postpone childbearing, wants no (more) children, cannot afford a baby, having a child will disrupt education or job, risk to maternal health, risk to fetal health Akinrinola et al. (1998).

5.- Statistics the miscarriage

Miscarriage is generally defined as the loss of a pregnancy before viability. An estimated 23 million miscarriages occur every year worldwide, translating to 44 pregnancy losses each minute. The pooled risk of miscarriage is 15.3% (95% CI 12.5–18.7%) of all recognized pregnancies. The population prevalence of women who have had one miscarriage is 10.8% (10.3–11.4%), two miscarriages is 1.9% (1.8–2.1%), and three or more miscarriages is 0.7% (0.5–0.8%) Siobhan et al. (2021).

However, a 2008 World Health Organization report estimates the yearly total of unsafe abortions to be 830,000 in Western Asia, causing 600 annual maternal deaths, and 900,000 in Northern Africa (Maghreb), causing 1,500 annual maternal deaths.⁷ Overall, the report estimates the total number of maternal deaths in Arab countries to be 14,000 in 2007 Iren and Liv (2019).

According to the Algerian Association for Family Planning, there are 8,000 cases of abortion recorded each year in Algeria, of which 200-300 are clandestine. Algeria has remained one of the most restrictive countries in the region as regards abortion. The Penal Code articles 304 to 310, dated 1966 and 1982, criminalise everything from ‘inciting’ someone to have an abortion, e.g. through discourse, posters, publicity, public meetings, groups, or illustrations. Punishment is by various fines and/or imprisonment of anyone involved in the abortion (Site web 3).

6.- Prevalence of miscarriage

The reported amount of clinically recognizable miscarriages in the general population is approximately 10-15% of all pregnancies, with variation according to age and previous miscarriage. The majority of miscarriages occur before the 12th week of pregnancy and late loss between gestational weeks 12 to 22 and it occurs less often. The number of self-reported miscarriages has increased in Sweden because of the availability of new and more sensitive pregnancy tests, with 20% of all multiparous Swedish women reporting that they have experienced at least one miscarriage Caroline (2018).

7.- Causes of miscarriage

7.1.- Genetics

There are several causes of first- and second-trimester miscarriages. Approximately 50% of all miscarriages are due to chromosomal abnormalities. Uterine malformation and cervical insufficiency are other causes of miscarriage Caroline (2018).

7.2.- Misuse of traditional medicine

The misuse of traditional medicine, including herbal medicine, can lead to miscarriages and other pregnancy disorders Aghniya (2020). Specific plants, such as *Carica papaya*, have been found to cause miscarriages in animal studies, although further research is needed to confirm this effect in humans Airaodion et al. (2019). However, some medicinal plants, such as *Corchorus olitorius*, *Sida acuta*, and *Heliotropium indicum*, have been used by tribal people in India to prevent miscarriages, suggesting a potential for these plants to be beneficial in pregnancy Mohapatra (2015). In Malawi, medicinal plants are used for contraception and pregnancy-related cases, including the treatment of miscarriages, but the safety and efficacy of these plants require further investigation Maliwichi-Nyirenda and Maliwichi (2010).

8.- Risk factors for miscarriage

A risk factor is a trait or behavior that increases a person's chance of developing a disease or condition. Risk factors for miscarriage include

8.1.- Age

Studies show that the risk of miscarriage is 12% to 15% for people in their 20s and rises to about 25% for people by age 40. Most age-related miscarriages happen because of a chromosomal abnormality (the fetus has missing or extra chromosomes).

8.2.- Previous miscarriage

Chance of having another miscarriage is 25% (only slightly higher than someone who hasn't had a miscarriage).

8.3.- Health conditions

Certain health conditions like unmanaged diabetes, infections or issues with uterus or cervix increase chance of miscarriage (Site web 4).

9.- Symptoms of miscarriage

The most common symptom of miscarriage is heavy vaginal bleeding with tissue clots and the cervix is open. Other symptoms are abdominal or low back pain and cramps, caused by uterine contractions. However, some women may notice that their pregnancy symptoms, breast tenderness, nausea, vomiting or fatigue, may disappear Ammon et al. (2012) and some women may also have a brownish or red vaginal spotting discharge, and the cervix is closed Gemzell-Danielsson et al. (2007).

10.- Types of miscarriage**10.1.- Threatened Miscarriage**

Clinical definition: There are symptoms of bleeding and/or pain in an ongoing pregnancy. No products of conception have been passed. The cervix is closed upon examination. This describes the presence of vaginal bleeding in early pregnancy when the pregnancy has been found to still be viable. About 25% of all pregnancies threaten to miscarry. Demonstration of fetal heart activity is generally associated with a successful pregnancy rate of 85-97%, depending on the period of gestation, and the woman should be reassured of this. Further ultrasound scans are not routinely needed unless there are further clinical concerns. A dating scan at 12 weeks will pick up the small proportion of women who go on to have a missed miscarriage. Rajmohan and Cheema (2018).

10.2.- Complete miscarriage

Clinical definition-The products of conception have passed, the cervix is closed on examination and there is no bleeding cramping. A complete miscarriage is defined as cessation of vaginal bleeding and an endometrial thickness Rajmohan and Cheema (2018).

10.3.- Incomplete miscarriage

Clinical definition-Some products of conception have passed but some still remain in the uterine cavity. The cervical is open and the patient still has cramps and bleeding. Incomplete miscarriage is defined as vaginal bleeding with the presence of heterogeneous (not uniform in density), irregular tissues (with or without a gestational sac) Rajmohan and Cheema (2018).

10.4.- Missed miscarriage

Clinical definition-No products of conception have been passed. There may be spotting or some pain, but there may be no symptoms Rajmohan and Cheema (2018).

11.- Diagnosis of miscarriage

Diagnoses of miscarriage follow national and international guidelines. A diagnosis is made by a bimanual gynecological examination to assess cervix status and uterine size, usually in combination with transabdominal or transvaginal ultrasonography examination, and serum β -hCG can be analyzed as well. If an intrauterine pregnancy is not detected, β -hCG is again assayed after two to three days to exclude pregnancy complications such as ectopic pregnancy and molar pregnancy. During the ultrasonographic examination, the uterine cavity is checked and endometrial thickness is measured anterior-posterior diameter (AP) - an endometrium of ≤ 15 mm and an empty uterus gives a diagnosis of complete miscarriage, and an endometrium of ≥ 15 mm with remaining products of conception gives a diagnosis of incomplete miscarriage. If an embryo is seen without heart activity its crown-rump length (CRL) and the presence of a yolk sac is noted. If no embryo is seen the gestational sac is measured in three perpendicular directions. Criteria for a miscarriage diagnosis include an empty gestational sac with a mean diameter of ≤ 25 mm. An embryo with $CRL \leq 7$ mm and showing no heart activity after six weeks of pregnancy gives a diagnosis of missed miscarriage. If these criteria are not met, care providers recommend that the women come back after 10-14 days for a new ultrasonographic examination, and if there is still no embryonic heart activity or the gestational sac remains empty a non-viable pregnancy is confirmed, preferably by two care providers competent in ultrasonography. Care providers provide the women with information about the miscarriage progress, bleeding, pain, infections sign and hygiene advice Caroline (2018) .

CHAPTER 03

Materials and methods

1.- Study area

The El-Oued Valley is located in the southeastern part of Algeria, in the wilaya of El-Oued, in a large synclinal basin known as the Lower Sahara due to its low altitude. El-Oued became municipality in 1957 and a province in 1984. It covers an area of 11,738 km², comprising 18 municipalities, with a population of more than half a million, mainly concentrated in large cities (41.41 inhabitants/km²), according to data from Office of National Statistics (2015) Tedjani (2022).

The El-Oued Valley is bordered by Tunisia to the east and the province of Tebessa to the northeast, Biskra and Khenchela to the north and Djelfa and Ouargla to the west and southwest, respectively. The region experiences a hot, dry summer and a mild winter, with low and infrequent precipitation and high evaporation rates. Average maximum temperatures range from 20.76°C in January to 45.31°C in July, while average minimum temperatures vary from 9.62°C in January to 30.18°C in August Tedjani (2022) (Fig7).

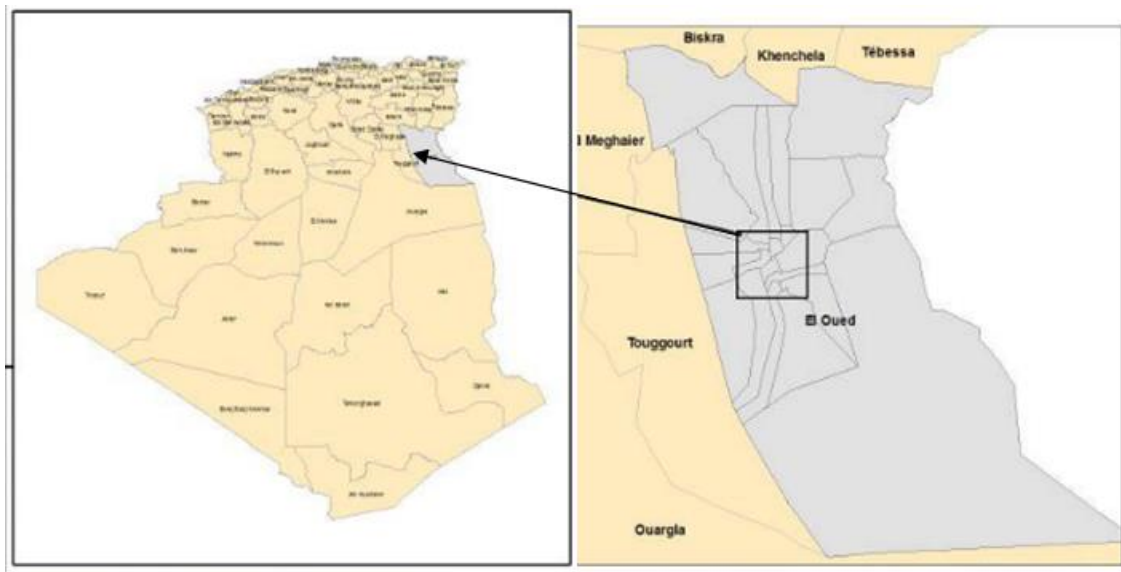


Figure 7 . The geographic location of El Oued C.F.O. (2023)

Table 1. Description of different provinces in El Oued

Region	District	Superficies (Km ²)	Inhabitants	References
El Oued	El Oued	193	176165	Salhi(2016)
	Reguiba	1965.60	42.310	Bahi et al. (2020)
	Hassi Khalifa	1112	38235	Idriss (2023);Hmidi et al. (2016)
	Gummar	1803	65925	Yamina et al. (2018); Salhi (2016)
	Debila	136	58350	Salhi (2016)
	Magran	618	28780	Garmouli et al. (2017) ; Salhi (2016)

The species represent an extreme adaptation to aridity. Because of the great expanse of El Oued, it was studied in six areas according to the administrative division (Table 1). The districts (provinces) chosen in El Oued were: El Oued, Reguiba, Hassi Khalifa, Gummar, Debila and Magran (Table 1). Here we should mention that those choosing province are highly populated municipalities within the Oued Souf province, known for their herbal medicine markets.

2.- Ethnobotanical survey

The ethnobotanical data were collected through face-to-face interview using semi structured questionnaires and free listings (Appendix). Data collection was performed in these municipalities from November 2023 to March 2024. The interviews were conducted with 174 informants. Among these informants, 22 respondents were healers and 62 herbalists. The informants selected are known for their traditional knowledge and use of medicinal plants. Most of the interviewed respondents were either native born or had been living in the region for a long time (20 years or above). This study mainly focused on the use of indigenous medicinal plants by the local population for which causes miscarriage. The questions asked were about the plants used causing miscarriage, which parts of the plants are

used, the methods of preparation and details of administration, dosage and treatment duration. With the help of /some informants, in particular healers and herbalists, the wild medicinal plants of El Oued were collected and identified using Ozenda (2004); Quezel and Santa (1962); Quezel and Santa (1963).

The questionnaire contained 43 parameters divided into 03 sections:

The first section: focusing on the respondent section contains personal information, name, family name, municipality, age, educational level, occupation.

The second section: focusing on plant the common name of the plant, its scientific name, its characteristics, how it is found, where it grows, whether it spreads quickly or not, from whom did you get information about the treatment, do you have prior information about the plant, the part used, the method of use, how many times the treatment is used a day, are the results satisfactory or not, does it have other uses, what other diseases does this plant treat, does it have side effects or not, advice about the plant and finally warnings.

The third section: contains information related to abortion, including the conditions for abortion, the number of miscarriages have had, the age at which first had a miscarriage, the age group most at risk of miscarriage, the causes of miscarriage, how these herbs affect when taken, whether excess weight affects miscarriage, the difference between menstrual blood and miscarriage blood, the symptoms of miscarriage, whether men have anything to do with miscarriage, whether the symptoms of miscarriage differ in the first and last months of pregnancy, the possibility of terminating a pregnancy in advanced stages in exceptional cases, the possibilities that may happen to the mother when a miscarriage does not occur, whether herbal abortion has complications, whether it is necessary to use other herbs to clean the uterus after the abortion, whether you visited the doctor after the abortion, and finally, other benefits specific to this herb. The questionnaire was prepared with slight modifications based on Bouallala et al. (2014).

3.- Statistic analysis

The results of the interviews were analysed using five ethnobotanical indices: relative frequency of citation (RFC), use value (UV), informant consensus factor (FIC), family importance value (FIV) and the Rahaman similarity index (RSI). And the other statistic analyses were carried out using XL version 2007.

3.1.- Relative frequency of citation (RFC)

The relative frequency of citation (RFC) is calculated by dividing the number of informants mentioning a useful species by the total number of informants participating in the survey, without considering the use-categories. This index varies from 0 (when nobody refers to the plant as useful) to 1 (all the informants would mention the use of the species). The following formula is used to calculate RFC:

$$RFC = \frac{FC}{N}$$

Where FC is the frequency of citation and N is the total number of informants Telli et al. (2022).

3.2.- Use value (UV)

The use value of species (UV) is a quantitative method that reveals the importance of species known and used locally. This index is obtained by the following formula:

$$UV_s = \frac{\sum U_{is}}{ns}$$

Where U_{is} is the number of use reports of species s mentioned by each informant (i) and ns is the total number of informants citing a given species Telli et al. (2022).

3.3.- Informant consensus factor (Fic)

To identify the potentially effective medicinal plants, Trotter and Logan developed a method based on the concept of ‘informant consensus’. The Fic is calculated using the following formula:

$$Fic = \frac{n_{resp} - n_t}{n_{resp} - 1}$$

Where n_{resp} is the number of use-reports in each category and n_t is the number of taxa used. The product is between 0 (if plants species are not very well known and used by informants) and 1 (if plants species are very well known and used by informants) Telli et al. (2022).

3.4.- Family importance value (FIV)

Family importance value (FIV) is calculated as a quantitative measure to assess the significance or importance of a plant family within a specific ethnobotanical study Vitalini et al. (2013); Savikin et al. (2013).

The formula for FIV is:

$$FIV = \frac{FC}{N} \times 100$$

FC represents the number of species in the family used in the study and N represents the total number of species used in the study Vitalini et al. (2013); Savikin et al. (2013).

3.5.- Rahaman Similarity Index

Data obtained from the population of six study regions were compared using the Rahaman Similarity index to determine the similarity and difference between these regions in the species used for plants that cause abortion. This index is calculated using the formula:

$$RSI = \frac{nc}{na+nb-nc} \times 100$$

Where A is the number of species of zone A, B the number of species of zone B and C the number of the species common to A and B Rahman et al. (2019).

Conclusion

Conclusion

This study is the first quantitative ethnobotanical work performed in Algerian Septentrional Sahara focusing on the use of medicinal plants causes miscarriage.

Traditional knowledge obtained through interviews with the indigenous population underscores their multifaceted utility, primarily as sources of sustenance for both humans and animals. the leaves part constitutes the most used part, decoction and vaginal suppository are the most practiced forms. The obtained results reveal the use of 55 medicinal plants species (belonging to 32 families) along with various products and by-products such as alt with oil and salt with milk by El Oued local populations. Quantitative ethnopharmacological analyses have demonstrated that *Salvia rosmarinus* Spenn, *Lavandula stoechas* L and *Trigonella Foenum-graecum* L were the most plants used.

Moreover, *Salvia rosmarinus* Spenn has emerged as a versatile plant, it is used in cooking as a food flavoring, widely employed to address various health concerns, Treating digestive problems, Anti-inflammatory and antibacterial, Dandruff and hair loss treatment. Furthermore, there is a need for awareness among the local people of the study area concerning the sustainable use of therapeutic plant species in the period of pregnancy.

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