Review article

Diseases and traditional medicine in the Central Middle Atlas (Morocco)

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ABSTRACT

Today, despite the development of synthetic chemistry, the use of medicinal plants remains widespread due to their effectiveness in many therapeutic practices. At the same time, poverty and lack of access to modern medical care are driving a large proportion of the world's population to turn to traditional medicines to meet their primary healthcare needs. With the aim of highlighting the medicinal plants of the central Middle Atlas region, we carried out an ethnobotanical and floristic study to identify the medicinal plants used by the local population to treat various illnesses. This study has enabled us to draw up a catalog of 267 medicinal species belonging to 79 botanical families and 211 genera. Analysis of the data showed that each pathology is treated by several plants, but with different frequencies: The results of the study has been presented and discussed in the paper.

Keywords: Central Middle Atlas, disease, ethnobotanical survey, medicinal plant, Morocco.

INTRODUCTION

For a long time, natural remedies, particularly herbal remedies, were the main, if not the only, recourse in medicine. Although the rise of the pharmaceutical industry has enabled modern medicine to effectively treat many formerly fatal diseases, the use of medicinal plants and the remedies derived from them has never been completely abandoned. People continue to turn to traditional medicine, which has preserved the therapeutic traditions inherited from our ancestors. Ethno botanical studies look on how these plants' resources are used for food, medicine, fuel wood, agriculture, housing, crafts, fodder, and religious rituals (Gazala *et al.*, 2023). Today, the use of herbal medicine is experiencing a resurgence of interest in Western countries, particularly to treat imbalances brought on by modern life, from stress to weight problems and cardiovascular disorders (Nguemo Dongock *et al.*, 2018). These plants represent a vast source of biologically active substances (Meliani *et al*., 2023).

The Moroccan population has an ancient and rich tradition of phytotherapy, a heritage of Arab-Berber civilization largely influenced by the Islamic and Jewish religions, which makes the use of a few or several medicinal plants in the treatment of various illnesses an integral part of Moroccan culture. Thus, people have always had a traditionally rich ethnobotanical knowledge due to the cultural and ecological diversity of the environment in which they live. According to Vandebroek *et al.* (2004), this knowledge reflects the richness of the vegetation in which these indigenous peoples live. The medicinal potential of a given flora is greater when it is more diverse. Due to its special geographical location, Morocco occupies a very important place in the Mediterranean basin and is one of the first countries with the richest flora. Its terrestrial flora comprises approximately 7000 inventoried species. The central Middle

Atlas has remarkable forest potential and biodiversity. This ecological heritage is of socio-economic interest, contributing to local development by meeting the needs of the local population (Labhar and Lebaut, 2012). The multiplication of ethnobotanical studies on a national scale enables: to gather more details on medicinal plants, enhance them, and save some knowledge acquired by the local population (Dif *et al*., 2022). With this in mind, an ethnobotanical study of medicinal plants has been carried out in the central Middle Atlas region, with the aim of compiling a written catalogue and ancestral knowledge of medicinal plants, which has been passed down by oral tradition from generation to generation.

Different illnesses treated by medicinal plants in Middle Atlas

Medicinal plants are used for their beneficial properties for human health. However, it is important to remain vigilant, as some plants can be toxic and present health risks. Medicinal and aromatic plants will continue to be potential sources of active, useful chemicals compounds that are used in the cure of various ailments (Rakesh Rathor, 2024). They can be used in a variety of ways, such as decoction, infusion or maceration. Depending on what is needed, one or more parts of these plants, such as the roots, leaves or flowers, can be used (Dutertre, 2011). In our region, they are used to treat a variety of illnesses and symptoms, the most common being digestive tract disorders, metabolic disorders and osteoarticular problems (Hachi *et al*., 2022).

Species most commonly used in the treatment of digestive tract disorders

Origanum compactum ranks first (832 citations), a species widely used in traditional medicine thanks to its properties. The leafy stem, infused or decocted, is recommended for: digestive system problems and as a depurative. However, the very high demand for labelled raw materials (organic, wild, spontaneous, etc.), most of which are destined for export, and the poverty of the local populations, can compromise Morocco's exceptional wealth of biodiversity. One example is rosemary, which is currently under threat from heavy exploitation and irregular climatic conditions (Fechtal, 2000); efforts are still being made to domesticate and regenerate it (Ismaili *et al.,* 2003).

Tetraclinis articulata (421 citations) is used in traditional medicine for its medicinal value against diarrhoea, gastrointestinal pain and colopathy. This species is well documented in traditional medicine for its medicinal value against diarrhoea, abdominal pain, tumours, bronchitis and indigestion (Hmamouchi, 1999; Bellakhdar, 1997).

Chenopodium ambrosioides (402 citations) decoction is used as an antipyretic and aperitif, to treat gastrointestinal disorders, diarrhoea and typhoid, both internally and externally. *Chenopodium ambrosioides* decoction, combined with *Mentha suaveolens* or *Origanum compactum*, is used as a carminative.

Other species such as *Thymus zygis*, *Aretmisia herba-alba*, *Trigonella foenum-graecum*, *Thymus vulgaris*, *Ajuga iva*, *Punica granatum*, *Pistacia lentiscus* and *Mentha suaveolens* are used to treat the digestive tract with varying frequency.

Species most commonly used in the treatment of metabolic disorders

The ethnobotanical study revealed that *Caralluma europaea* (510 citations) is the species most frequently reported by informants for the treatment of metabolic disorders, followed by *Olea europaea* (325 citations), *Artemesia herba-alba* and *Trigonella foenum-graecum* (312 citations), while *Tetraclinis articulata* was cited 216 times). Other notable species include *Nigella sativa* (209 citations), *Allium sativum* (208 citations) and *Olea europaea var. sylvestris* (197 citations). *Origanum compactum* and *Thymus zygis* received 115 and 113 citations respectively. Finally, *Thymus vulgaris* and *Rosmarinus officinalis* shared the same number of mentions 111, while *Alyssum spinosum* was cited 109 times.

Species most commonly used in the treatment of osteoarticular disorders

It was studied that telephiium-leaved corrigiola (*Corrigiola telephiifolia*) was the most commonly used in the treatment of rheumatic diseases (182 citations), followed by wild olive (*Olea europaea var. sylvestris*), buttercup (*Ranunculus ballatus)*, spearmint (*Mentha pulegium*), rosemary (*Rosmarinus officinalis*), olive (*Olea europaea*), round-leaved mint (*Mentha suaveolens*), false fennel (*Ferula communis*), African pyrethrum (*Anacyclus pyrethrum*) and magydaris (*Magydaris panacifolia*) (70 citations). *Corrigiola telephiifolia*, in powder form, is used to relieve joint pain and chills, while the roots are used to make fire tips for rheumatism and joint pain.

Species most commonly used in the treatment of dermal diseases

For dermal diseases, the *Origanum compactum* (89 citations) is best represented in the treatment of skin diseases, followed by *Teucrium polium* and *Allium cepa* (89 citations); *Rosmarinus officinalis, Caralluma europaea*, *Eugenia caryophyllata*, *Plumbago europaea* and *Agave americana L*. (45 citations).

Due to its very high frequency compared with the other species oregano (*Origanum compactum)* appears to be the medicinal species most frequently used in the treatment of skin diseases. It is a species that is very well known among the local population for its therapeutic virtues; its leaves are used in cataplasms to heal wounds and bruises, as an antiseptic and against burns, and used in lotions against hair loss and as an anti-dandruff agent.

Species most commonly used in the treatment of respiratory ailments

For respiratory treatment, *Mentha pulegium* (681 citations) is one of the species most commonly used. It is widely used by infusion, decoction and inhalation to treat colds, flu, bronchitis and coughs. *Rosmarinus officinalis*, (476 citations) *Eucalyptus globules* 359 citations), *Marribium vulgare* (259 citations) and *Lepidium sativum* (169 citations) occupied second place with different percentages in the Midlle Atlas of Morocco.

Mentha pulegium is used to treat more diseases, as an infusion, inhalation or chest poultice, for colds, sore throats, coughs, bronchitis, lung infections and colds of all kinds (Bellakhdar, 1997). It is the plant for winter illnesses.

Species most commonly used in the treatment of cardiovascular diseases

Crataegus laciniata (67 citations) is the most well-known and effective medicinal species for treating cardiovascular disease in the region studied followed by *Allium sativum* 65 citations), *Olea europaea* (56 citations) and *Olea europaea var. sylvestris.* (50 citations). Other notable plants include *Salvia officinalis*, which received 46 citations, and *Nigella sativa* with 45 mentions. *Origanum compactum* and *Hibiscus sabdariffa* were each cited 40 times, while *Mentha suaveolens* received 36 citations. *Mentha pulegium* and *Lavandula dentata* were mentioned 34 times, and *Apium graveolens* was cited 32 times.

Crataegus laciniata enhances myocardial contraction (Gruenwald *et al*., 1998). Hawthorn's procyanidin extracts help to reduce cholesterol levels and reduce the size of atherosclerotic plaques. This action is the result of hawthorn's ability to maintain the integrity of the matrix (collagen) of vessel walls, making them more resistant, which can help prevent the development and progression of atherosclerotic plaque (Rose and Treadway, 1999). Oligomeric procyanidins are responsible for the cardiac actions of Crataegus. They increase the heart's use of oxygen and aid enzyme metabolism (Davies, 2000).

Species most commonly used to treat genitourinary disorders

For genitourinary disorders *Lavandula dentata* (452 citations) is widely used by the population as a decoction to treat ailments of the urinary tract and urogenital disorders. It is also used vaginally to treat infections of the vagina and uterus. *Herniaria hirsuta* (208 citations) is also used in powder or decoction form to remedy anuria, expel kidney stones and treat kidney lithiasis. followed by *Chenopodium ambrosioides*, with 180 citations, and *Artemisia herba-alba* with 146. *Lactuca scariola* and *Anacyclus pyrethrum* have the same number of citations, at 137. *Rosmarinus officinalis* and *Apium graveolens* also share the same total, with 135 citations each. *Crocus sativus* was cited 134 times, while *Ajuga iva* received 129 mentions. *Petroselinum sativum* and *Nigella sativa* also had the same number of citations, at 126. Finally, *Salvia officinalis* and *Melissa officinalis* both recorded 125 citations.

Species most commonly used in the treatment of neurological disorders

Lippia citriodora (270 citations) is the most widely used species, certainly because of its effectiveness against neurological diseases and its wide distribution around homes. Infusions of the plant are used to calm, sedate and induce sleep, and to treat headaches and dizziness. *Matricaria camomilla* (163 citations) is also used to treat neurological disorders. In descending order, we also find the following species: *Lavandula multifida* with 113 citations, *Melissa officinalis* with 89 mentions, and *Tetraclinis articulata* 69 citations. *Salvia officinalis* follows with 60 citations, while *Ocimum basilicum* has 57. *Crataegus laciniata* was cited 56 times, and *Papaver rhoeas* earned 54 mentions.

Wild chamomile is recommended in Morocco as an anxiolytic and central nervous system balancer, of great value in cases of nervous depression (Haddad *et al*., 2003).

Toxic plants varies according to species

Poisoning by plants and traditional pharmacopoeia products is not negligible throughout the world. Their occurrence is the consequence of several factors, including the popular belief that plants are not dangerous because they are natural. According to a study carried out by Morocco's Centre Antipoison et de Pharmacovigilance, intoxications by plants and traditional pharmacopoeia products accounted for 5.1% of all cases of intoxication reported between 1980 and 2008, excluding scopionic stings and envenomations (Rhalem *et al*., 2022). The three main sources of plant intoxication being glue thistle (*Atractylis gummifera*) (10.1%), cannabis (*Cannabis sativa*) (4.6%) and harmel (*Peganum harmala*) (3.6%) (Kamgoui, 2004). The notion of dose is very important. Certain plants used for therapeutic purposes can present risks to human and animal health in large doses. This is the case, for example, with sage, *salvia officinalis*, mugwort and wormwood. All these plants are medicinal in low doses, but highly toxic in high doses (Belghazi and Benbaziz, 2020). The composition of a plant can vary from one specimen to another, depending on the soil, growing conditions, humidity, temperature and sunlight. Similarly, plants of dubious origin should not be used, since pollution factors, harvesting and methods of preservation and storage can alter their properties (Chen *et al.*, 2021). Depending on the nature and the degree of toxicity, the way the remedies are prepared and the way they are administered, toxicity varies according species used. In addition, self-medication often leads to over-consumption and prolonged use, sometimes incompatible with the physiological (extreme ages, pregnancy, breast-feeding) or pathological (hepatic, renal and cardiac insufficiency, diabetes, etc.) condition of patients.

The Table 1 shows the toxic medicinal plants found in our study region:

CONCLUSION

The results of this study shows that each disease is treated by several medicinal plants, either alone or in combination with other plants. *Origanum compactum* is used for

disorders of the digestive tract, followed by *Tetraclinis articulata* and *Chenopodium ambrosioides*. Metabolic disorders are treated mainly with *Caralluma europaea*, followed by *Olea europaea*. Osteoarticular disorders are treated most by *Corrigiola telephiifolia* followed by *Olea europaea var. sylvestris*. For skin disorders, *Origanum compactum* is most commonly used, followed by *Teucrium polium* and *Allium cepa*. For genito-urinary conditions, *Lavandula dentata* is most frequently used, followed by *Herniaria hirsuta*. Respiratory ailments are treated with *Mentha pulegium*, followed by *Rosmarinus officinalis* and *Eucalyptus globulus*. Cardiovascular diseases are treated with *Crataegus laciniata*, followed by *Allium sativum*, *Olea europaea* and *Olea europaea var. sylvestris.* Finally, for neurological diseases, *Lippia citriodora* is used most often, followed by *Matricaria camomilla*.

CONFLICT OF INTEREST STATEMENT

The authors declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Table 1: List of toxic medicinal plants found in the Central Middle Atlas region

Scientific name	Common name Arabic/Tamazight	Toxic part	Symptoms / disorders
Agave americana L. ***	Sabra	Leaves	Skin
Ajuga iva (L.) Schreb. ***	Tûf tolba / Chendgoura	Whole plant	Neurotoxicant
Ammi Sp. ***		Fruit	Skin
Anacyclus pyrethrum L. **	Iguntas / Tagundecht	Root	Digestive, neurotoxicant
Aristolochia baetica L.*	Berztem / Ajrarhi	Root	Digestive, respiratory
Artemesia absinthium L. ***	Chiba	Whole plant	Digestive, neurotoxicant
Artemisia hera-alba Asso. **	Chih / Ifzi / Izri.	Whole plant	Neurotoxicant, abortive
Atractylis gummifera L.*	Addad.	Root	Digestive, neurotoxicant, hepatic
Camelia thea L. ***	Atay.	Leaves	Cardiotoxic, neurotoxicant
Cannabis sativa L. **	Kif	flowers, stems	Digestive, neurotoxicant
Capsicum frutescens L. **	Felfel Hârr /soudania	Fruit	Digestive
Carum carvi L. ***	Karwiya	Fruit	Hepatic, neurotoxicant
Cedrus atlantica (Endl.) Carr. ***	L-ârz / Atgal.	Bark	Neurotoxicant
Chenopodium ambresioides L. ***	Mkhinza.	Leaves	Neurotoxicant
Citrullus colocynthis (L.) Schrad.*	Lhdej / Tafrzizte.	Fruit	Digestive
Colchicum automnale L. **	Bakbuka	Whole plant	Digestive, neurotoxicant
Crataegus laciniata Ucr. ***	Admam	Flowers, seeds	cardiotoxic
Daphne gnidium L.*	Âlezzâz	Leaves, fruit	Neurotoxicant
Delphinium staphysagria L.*	Habbat ras	Seeds	Digestive, cardiotoxic
Echinops spinosus L. ***	Taskra	Root	Neurotoxicant
*Euphorbia sp**	Tikiwt	Latex	Digestive, neurotoxicant
*Ephédra sp****	Timitrte	aerial part	Neurotoxicant
Eucalyptus globulus Labill. ***	Calitous	Leaves	Neurotoxicant, renal toxicity
Ferula assa-feotida L.*	Hantita	Fruit	cardiotoxic
Ferula communis L.*	Uffal / Awli / Klakh / Lboubal.	Whole plant	Hemorrhagic
Ficus carica L. **	Karma / Tazarett	Leaves	Skin
Foeniculum vulgare P. Mill. ***	Nafaa / lbesbas / Amssa.	fruit	Digestive, cardiotoxic, neurotoxicant
Globularia alypum L. ***	A'yen lerneb / Taselgha	Whole plant	Digestive, cardiotoxic, neurotoxicant
Glycirrizha glabra L. ***	Arak sous.	Root	Digestive, cardiotoxic
Juniperus oxycedrus L. ***	Taqqa.	Bark	Skin
Lepidium sativum L. **	Hab rchad	Seeds	Digestive
Linum usitatissimum L.***	Zriaat al kettane	Seeds	Digestive
Mandragora autumnalis Bert.*	Bîd al-ghûl	Root	Digestive, cardiotoxic, neurotoxicant

Marrubium vulgare L. **	Mriwta / Mriwa	Whole plant	Skin
Mentha pulegium L. ***	Fliyou	Whole plant	neurotoxicant, abortive
Mercurialis annua L. **	Harryga malsa	Whole plant	Digestive
Myristica fragrans Houtt. ****	L-gûsa	Seeds	Digestive, neurotoxicant
Nerium oleander L.*	Defla / Allili	Whole plant	Digestive, neurotoxicant, cardiotoxic
Nicotiana tabacum L. **	Tanfiha	Leaves	Respiratory, neurotoxicant, cardiotoxic
Nigella sativa L. **	Sanouj	Seeds	abortive
Papaver rhoeas L. ***	Belaamane	petals	Neurotoxicant
Peganum harmala L. **	Lharmal	Seeds	Digestive, neurotoxicant
Pimpinella anisum L. ***	Habat hlawa	Fruit	Neurotoxicant
Piper cucuba L.F. **	L-kubbaba	Seeds	Digestive
*Quercus Sp****		Whole plant	Digestive
Ranunculus ballatus L.*	Wden l'halluf	Root	Skin, digestive
Ricinus communis L.*	Lkharwaa / Anguaref	Seeds	Digestive, hepatic, cardiotoxic
Rosmarinus officinalis L. ***	Yazir	Whole plant	Neurotoxicant
Ruta montana L. **	Lfijel / Iwrmi	Whole plant	Neurotoxicant, skin
Salvia officinalis L. ***	Salmiya	Whole plant	Neurotoxicant
Satureja calamintha (L.) Scheele. ****	Manta	Whole plant	Skin
Taraxacum obovatum DC. ****	Iwjdem	Leaves, stems, flowers	Skin
Taxus baccata L.*	Îgen	The whole tree, especially the seeds	cardiotoxic
Teucrium polium L. **	Ja'ada	Whole plant	Digestive, hepatic
Urginea maritima (L.) Baker.*	Îkfil / Bsel idane	Bulb	cardiotoxic
Urtica dioïca L. **	Hurriga /Thissarkmaz	Whole plant	Skin
Verbascum sinuatum L.*	Aberdud n-izem	Seeds	Digestive

*: all respondents stated that these plants are toxic.

**: less than 10% of respondents stated that these plants are toxic.

***: toxicity according to literature.