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## Research Article

### MEDICINAL PLANTS' CATALOG ADOPTED IN THE TREATMENT OF RHEUMATIC DISEASES IN THE CENTRAL MIDDLE ATLAS (MOROCCO)

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#### ABSTRACT

The following ethnobotanical survey which was conducted in the Central Middle Atlas in the years 2013 and 2014 is intended to identify the medicinal plants used in traditional medicine in the treatment of rheumatism. A number of 1560 people were interviewed with a quiz sheet which allowed us to collect information on medicinal plants, traditional healing practices of the local population in particular, the scientific name, the French name, vernacular name, the plants' parts used, the therapeutic indications, recipes and the methods of administration.

The obtained results allowed us to identify 42 medicinal species in this study area. These plant species are divided into 26 families and 38 genera with the predominance of the following families: Lamiaceae (7 species), Asteraceae (4 species). The roots are the most used members (27%) while decoction is the dominant mode of preparation (40%), the administration is either oral (43%) or by local application.

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## INTRODUCTION

Rheumatism concept includes various diseases of the musculoskeletal system which are accompanied by pain and inflammation, the diseases of the supporting tissues and the conjunctival tissue. Rheumatologic diseases count more 300 diseases whose pathologies including bone, muscle and intra- and peri-articular tissues. These articular diseases affect 100 million people worldwide, and 20% of the patients visit the doctor for such ailments (Babulka, 2007). They are very varied at the pathophysiology level while being linked anatomically and associatively with pain and physical disability. They encompass a wide range of acute and chronic conditions including osteoarthritis, rheumatoid arthritis, osteoporosis, fibromyalgia and low back pain. Work can also cause musculoskeletal disorders such as tendinitis, carpal tunnel syndrome, tennis elbow, herniated disc and back pain (CSST, 2004; Hawker et al., 2010).

The rheumatic diseases are a public health problem. Indeed, rheumatism constitutes the main reason for consultation with the general practitioner. Each year, they are a source of

millions of lost working days, thousands of disability pensions. The aging population can only exacerbate this situation (Cherquaoui, 2011). According to the WHO, the articular diseases worldwide represent 50% of chronic diseases affecting people over 60 years. Back pain is the second cause which leads to work stoppage. It is estimated, finally, that 40% of women over 50 years old present a fracture caused by osteoporosis and the number of hip fractures would increase from 1.7 million of annual cases in 1990 to 6.3 million in 2050. The growing number of old people along with the changes in lifestyle (obesity, physical inactivity, urbanization) have been a burden of musculoskeletal disorders on patients since society has increased dramatically (Woolf and Pfleger, 2003). Being real public health problems, they also withheld the United Nations and the attention of the World Health Organization (WHO) which both dedicated the decade 2000-2010 to the bones and the articulations. The purpose was to mobilize all available resources to prevent, diagnose and effectively treat disorders of the musculoskeletal system (Woolf, 2000).

Despite the advances in biology and medicine nowadays, the majority of people in developing countries seriously lack

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access to adequate health care due to low economic systems (Konda *et al.*, 2011; Singh & Singh, 2012; WHO, 2013) this is why plant resources figure prominently in the lives of these populations (Mangambu *et al.*, 2008).

The aromatherapy and herbal medicines are alternative and / or natural complements having their place in the field of rheumatology. Plants and essential oils can replace chemical treatments for benign articular diseases. For the serious diseases, they complement them in order to reduce the use and the serious side effects. They can even improve their tolerance (Cazau-Beyret, 2013).

The plant is the most traditional form of treatment worldwide and it is characterized by its positive effects with fewer serious side effects. The use of traditional medicine is widespread and has an increasing importance in both health and economy. In developing countries, the widespread use of these traditional medicines is both accessible and affordable, particularly for the poorest patients in the world, given the high cost of some drugs and their availability in the market (WHO, 2002).

The development of the natural resources is a issue which is becoming increasingly important in many countries. Therefore the WHO recommends the evaluation of both the safety and the efficacy of herbal medicinal products in order to standardize their use in conventional and integrated systems of care (WHO, 2000).

In Morocco, in view of the peculiarities of our environment, various sociocultural and financial orders can impede the care of rheumatic patients.

The early diagnosis of rheumatic diseases is a major challenge: any delay in the patient's rheumatic consultation beyond three months from the first symptoms may lead to the diagnosis and the treatment delays and may cause permanent damage and may even unfortunately encumber the treatment's response (Cherquaoui, 2011). The Moroccan population has a very rich and very ancient tradition in the field of herbal medicine (Bellakhdar, 1997). In fact, it is a legacy of the Arab-Berber civilization heavily influenced by the Islamic and the Jewish religion which make use of a number of medicinal plants in the treatment of several diseases, which is in its turn an integrated part of Moroccan culture.

The ethnobotanical study has a great importance in the search of new active herbal substances which can answer the problems for which the drugs have not been answered yet. It is in this perspective that the ethnobotanical study of medicinal plants was carried out in the region of Central Middle Atlas, which helps to identify the antirheumatic remedies and to constitute a medicinal plants database to preserve our ancestral knowledge which is essentially based on oral tradition. This knowledge helps, with no doubt, to find good plant resources for a sustainable use of renewable resources of plant biodiversity.

## MATERIAL AND METHODS

### Study area

The Central Middle Atlas region represents the ethnobotanical and floristic study area of the antidiabetic medicinal plants used by its population (Figure 1).

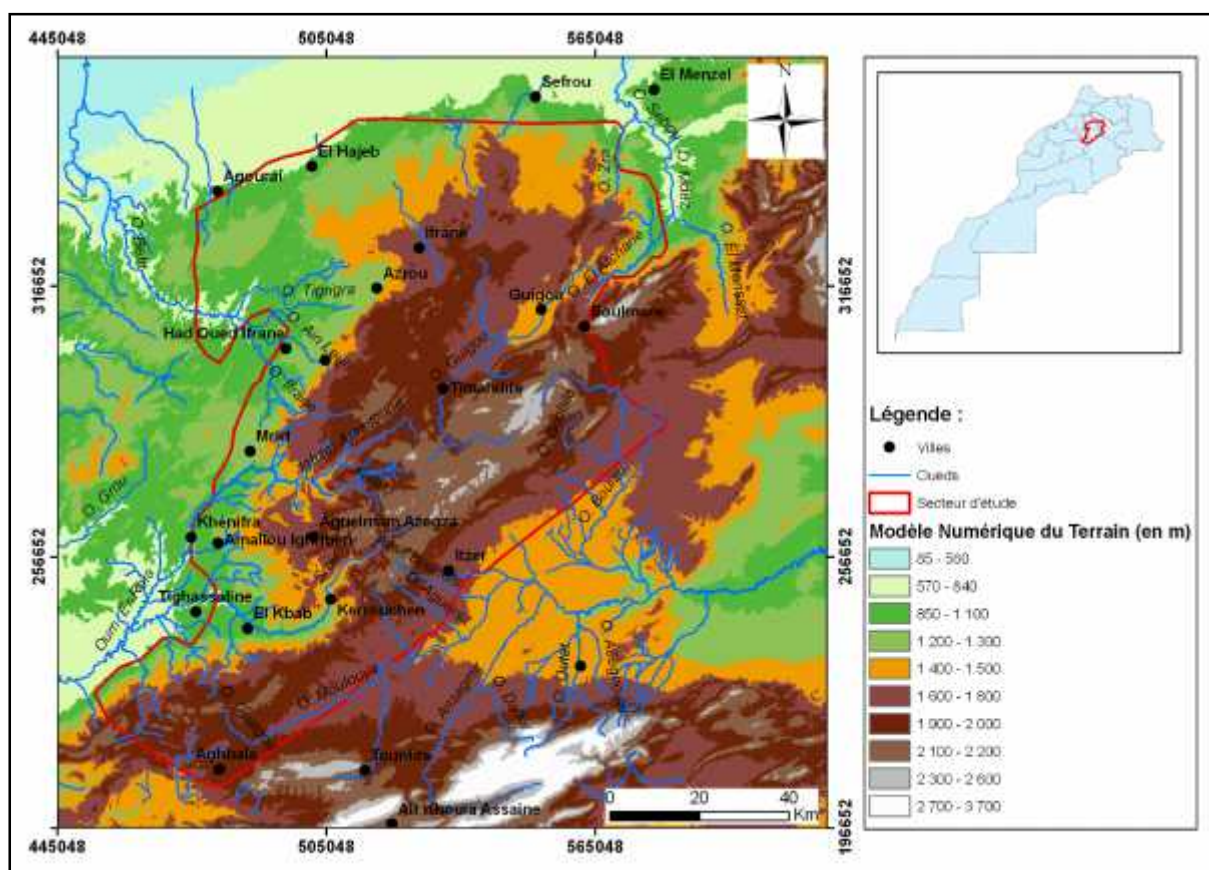


Figure 1 Location of the Central Middle Atlas region.

The Middle Atlas is part of the field of Atlas chains (Michard, 1976). It occupies an intermediate position between the Rif to the north, and the High Atlas to the south. Along an EW section, the Middle Atlas is bordered by the high plateaus of the Oran- Moroccan meseta to the east and the coastal meseta to the west. To the north, it is limited by the plain of Sais (Neogene sediments) and the front of the nappe Rifain. To the northeast, it is limited by the basin of Guercif and to south and southeast; it is limited by the depression of Moulouya (Arboleya *et al.*, 2004).

Globally, the Middle Atlas structure corresponds, on one hand, to large synclinal basins with axes that are parallel to the chain and, on the other hand, to narrow anticlinal ridges, sometimes, intruded with gabbroic rocks (Fedan, 1988). It consists of two structural assemblies that are separated by the North Middle Atlas fault (Arboleya *et al.*, 2004): The tabular Middle Atlas or Middle Atlas plateau to NW and the folded Middle Atlas to SE.

The first it is mainly formed by a Paleozoic basement covered with a large Mesozoic cover, all of it is dotted with scattered volcanic effusions of the quaternary age (Texier & *al.*, 1985; Herbig, 1988). The folded Middle Atlas corresponds to the east part of the chain, it is distinguished from the sub-tabular plateau by the presence of ridges that form reliefs, and those reliefs are pointing toward the chain direction. These anticline ridges, framing the synclinal depressions, continued to function, during the Middle Jurassic, as depocentres and quite thick calcareous marls (Fedan, 1988). The climate in the Middle Atlas is of a mountain Mediterranean type, it is characterized by a wet and cold climate. That unique climate is due to its altitudinal position, its location and exposure to marine influences (Martin, 1981).

The Middle Atlas, known as the key water tower of Morocco, is the mountain range that is the better watered and with the richest wetlands, including natural lakes, rivers and fresh sources, offering varied ecological habitats and fostering a

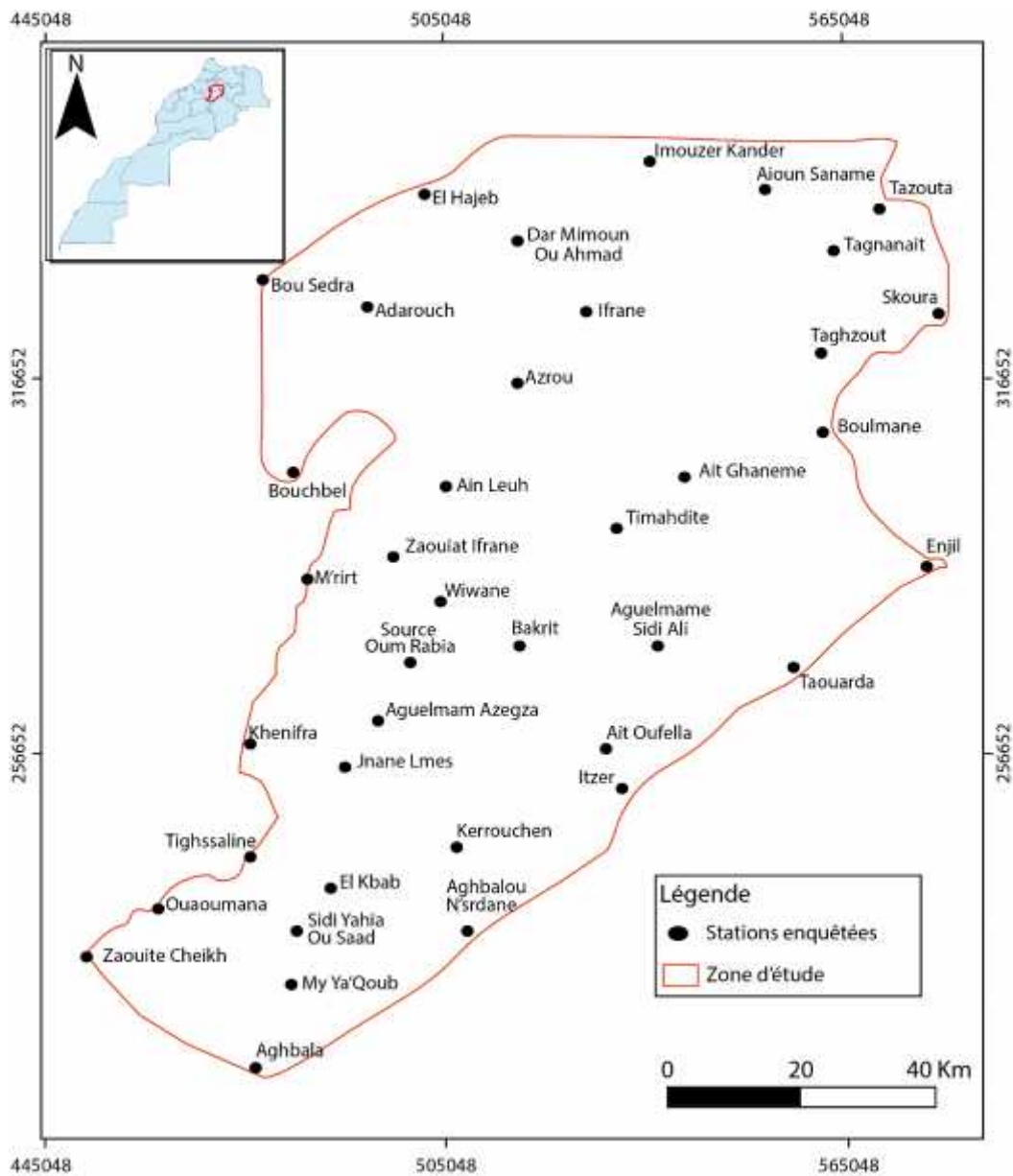


Figure 2 Map of the study area showing the surveyed stations.

great biodiversity (Chillasse & Dakki, 2004). The Middle Atlas is generally very rich in plant species, because of the great diversity of the ecosystems held within this area (forests, grasslands, scrublands, steppes, wetlands, saline soils). The Phytocenoses found there are organized by the following tree species: *Cedrus atlantica* (Atlas cedar), *Quercus faginea* (Zeen oak), *Quercus suber* (cork oak), *Quercus rotundifolia* (green oak), *Tetraclinis articulata* (Barbary thuja), *Juniperus thurifera* (Spanish juniper), *Pinus halepensis* (Aleppo pine), *Pinus pinaster* var. *maghrebiana* (Maghreb maritime pine) and spiny xerophytes.

Two major biogeographic zones are distinguished in the Middle Atlas (Lecompte, 1986):

1. The Area occupied by vegetation that is adapted to the wetter climate conditions. It takes place throughout west and northwest of the Guigou plain, on the limestone cause plateau of the Middle Atlas and their northern foothills.
2. Zones of xeric vegetation of the folded Middle Atlas and its borders (Moulouya and Sebou rivers).

## METHODOLOGY

In order to identify medicinal herbs and gather all information on the therapeutic uses that are practiced by the local population of the Central Middle Atlas region, an ethnobotanical survey was conducted between 2013 and 2014 using a pre-quiz sheet with specific questions about the common name of each species, the used part, methods of preparation, methods of administration and the treated disease. The towns, villages and Douars (small villages) of the surveyed area are determined through the probabilistic stratified sampling techniques (Godron, 1971, 1982).

and Aghbala (Figure 2). By adopting a stratified random sampling, the survey was conducted among 1,560 people, randomly selected from the population of the study area, with a sample of 40 individuals per stratum. This helped to sort the antidiabetic medicinal plants; however, this list enables a monograph of these plants according to the family, the scientific name, the common name and the local therapeutic use.

## RESULTS AND DISCUSSION

Known in traditional medicine as "a disease of the people", rheumatism appears as the most common danger in the population, especially among the elderly. Living in humid conditions, the effect of prolonged cold, the important efforts, changes in the constitution of the blood, and also the bad eating habits are perceived as the causes which are responsible for any rheumatic condition. In herbal medicine journals (Phytomedicine, Phytotherapy Research, Zeitschrift für Phytotherapie, Nouvelle Revue practice phytotherapy, British Journal of Phytotherapy, Fitoterapia), nearly 100 plants for herbal medicine for rheumatism are listed and most authors focus on the effectiveness of plants and their significance in the anti-rheumatic treatment (Babulka, 2007).

Our floristic analysis of this catalog developed during this ethnobotanical study has identified 42 species distributed in 26 botanical families and 38 genera. These species are divided into the following systematic groups: gymnosperms are represented by three families (Cupressaceae, Ephedraceae, and Pinaceae), four kinds (*Juniperus*, *Ephedra*, *Cedrus*, *Pinus*) and four species (*Juniperus oxycedrus*, *Ephedra nebrodensis*, *Cedrus atlantica* and *Pinus halepensis*).

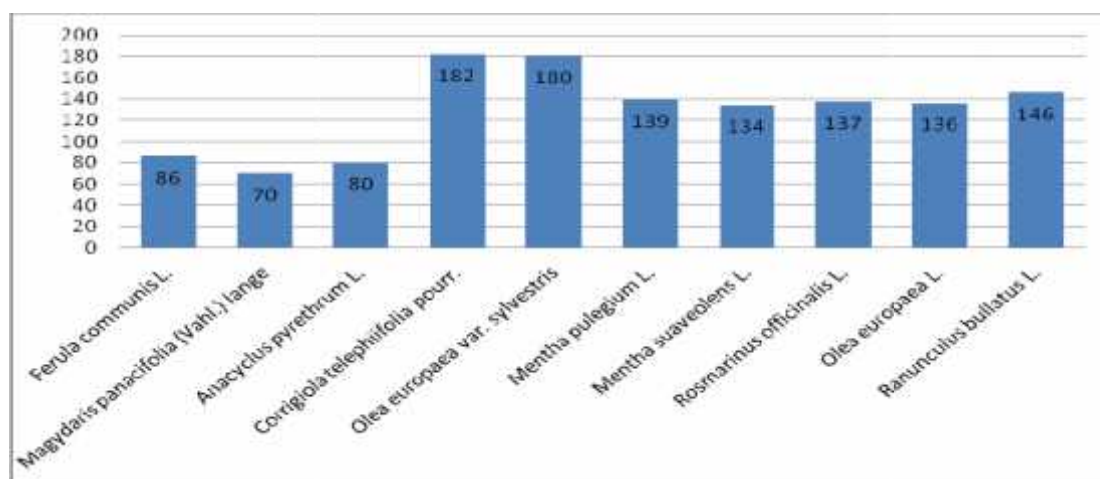


Figure 3 The classification of antirheumatic plants mostly used by the population studied by the number of citations (over 70 citations).

The study area is divided into 39 homogeneous strata: Imouzzer kandar, Aïoun sename, El hajeb, Tazouta, Dar Mimoun Ou Ahmed, Tagnanaït, Bou Sedra, Adarouch, Ifrane, Skoura, Taghzout, Azrou, Boulmane, Bouchbel, Ain Leuh, Aït Ghanem, Timahdite, M'rirt, Zaouit Ifrane, Enjil, Wiwane, Sources Oum Rabia, Bakrit, Aguelmama Sidi Ali, Taoureda, Aguelmam Azegza, Khénifra, Jnane lmes, Aït Oufella, Itzer, Kerouchen, Tighssaline, El Kebab, Ouaoumana, Sidi Yahya Ou Saad, Aghbalou N'serdane, Zaouit Cheikh, Moulay Ya'qoub

Angiosperms include 23 families, 34 genera and 38 species among which these Dicotyledons are dominant with 32 species and Grasses with 6 species. Among the 26 identified families, some are more represented in this region including: Lamiaceae (7 species), Asteraceae (4 species), which are also the richest families in Morocco while families like Anacardiaceae, Apiaceae, Euphorbiaceae, Oleaceae, Pinaceae, Poaceae and Zingiberaceae include 2 in each species. The genus *Mentha* is the most represented with 3 species and *Olea* is represented by



2 species. This reflects the richness and the diversity of the medicinal flora of the Central Middle Atlas characterized by its geographical position, its orography, its edaphic structure, its geology and its climatic conditions.

The most used species in the treatment of musculo-skeletal disorders species are represented in Figure 3.

In our study, the most commonly used plants are: the corrigiole with telephium leaves (*Corrigiola telephiiifolia* Pourr), wild olive (*Olea europaea* var. *sylvestris*.), the bloated Buttercup (*Ranunculus ballatus* L), pennyroyal (*Mentha pulegium* L.), rosemary (*Rosmarinus officinalis* L.), olive (*Olea europaea*), mint with round leaves (*Mentha suaveolens* L.), false fennel (*Ferula communis* L.), anacyclus pyrethrum (*Pyrethrum anacyclus* L.), and magydaris (*Magydaris panacifolia* (Vahl.) Lange).

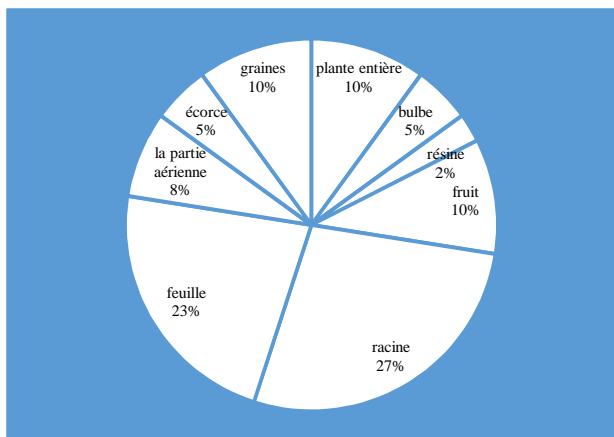
**Table 1** The main plants used in the treatment of rheumatic diseases

Scientific name	Family
<i>Corrigiola telephiiifolia</i> Pourr.	Caryophyllaceae
<i>Olea europaea</i> var. <i>sylvestris</i>	Oleaceae
<i>Ranunculus ballatus</i> L	Ranunculaceae
<i>Mentha pulegium</i> L	Lamiaceae
<i>Rosmarinus officinalis</i> L	Lamiaceae
<i>Olea europaea</i> L.	Oleaceae
<i>Mentha suaveolens</i> L.	Lamiaceae
<i>Ferula communis</i> L.	Apiaceae
<i>Anacyclus pyrethrum</i> L.	Astéraceae
<i>Magydaris panacifolia</i> (Vahl.) Lange	Apiaceae

The table shows that the family Lamiaceae is the most represented and the most used by the population studied in the treatment of rheumatic diseases.

**The used parts**

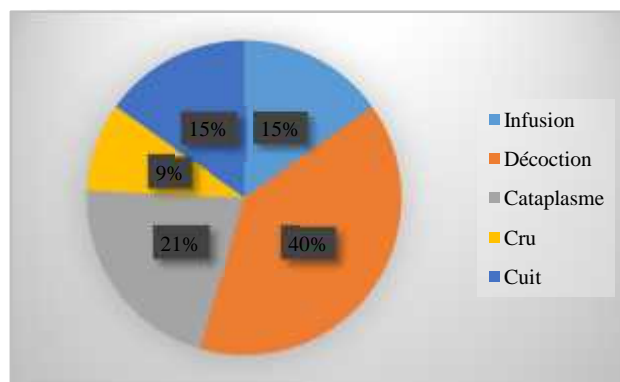
The part of the used plant varies depending on the plant itself.



**Figure 4** Distribution of the percentages of the different parts used in medicinal plants used for the treatment of rheumatic diseases.

The most used parts are the roots (27%) and leaf (23%). The use of leaves is justified by the abundance of the chemical groups within them because they are known as the place of synthesis of plant secondary metabolites (Lumbu et al., 2005; Mangambu et al., 2008; Kumar et Lalramnghinglova, 2011). They produce most of the active ingredients including alkaloids, essences, glycosides, and tannins (Barry, 1999; Pamplona, 2001a).

**Method of preparation**

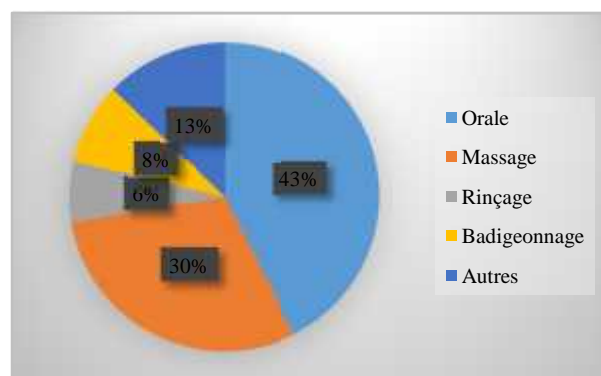


**Figure 5** Distribution of the percentages of preparation methods of medicinal plants used in the central Middle Atlas.

In the Central Middle Atlas, the local population diseases uses decoction plants with a percentage of 40%, followed by preparing a poultice with a percentage of 21% in order to treat rheumatism.

**Administration mode**

The dosage is variable all depending on the plant.



**Figure 6** Percentage distribution of modes of administration of the medicinal plants used in the Central Middle Atlas.

Plants are administered orally with a percentage of 43% maybe to heat the body and to increase blood circulation, followed by the massage mode with a percentage of 30% in order to relax the painful sensations and reducing muscle contractions.

Depending on the nature of the toxic principles, on the preparation mode of remedies and on the manner of administration, toxicity varies from one species to another. In addition, self-medication often leads to overconsumption, prolonged and inadequate doses for the physiological (extreme ages, pregnancy, lactation) and pathological status of the patient (liver, kidney and heart failure, diabetes ....) of patients. According to the results of this study, some plants are used against pain externally due to their toxicity like *Ferula communis* L. *Urginea maritima* (L.) Baker, *Atractylis gummifera* L., *Citrullus colocynthis* (L.) Schrader, *Taxus baccata* L. and *Daphne gnidium* L.

**CONCLUSION**

Rheumatic diseases are a major public health problem. Long underestimated or neglected, they are nevertheless positioned among the chronic diseases the most prevalent.

Catalog of antirhumatistal medicinal plants.

Family	Scientific name of the species	French name	Vernacular name	Parts used	Local medicinal usages
<b>Amaranthaceae</b>	<i>Fredolia aretioides</i> Coss. & Dur.	Chou-fleur de bou hamama.	Sella' / Achennud.	The whole plant	in decoction, used orally as antirhumatistal
<b>Amaryllidaceae</b>	<i>Allium sativum</i> L.	Ail	Toum / Tichert	bulb	in case of back pain (as a suppository).
<b>Anacardiaceae</b>	<i>Pistacia atlantica</i> Desf	Pistachier de l'atlas	Lbtem / Ijj	Resin	The resin triturated with olive oil is recommended in cases of joints pain.
	<i>Pistacia lentiscus</i> L.	Lentisque	Drou	fruits' oil	oil of mastic is used against arthritis
<b>Apiaceae</b>	<i>Ferula communis</i> L.	Faux fenouil.	Uffal /Awli / Klakh / Lboubal.	Root	The root decoction in combination with <i>Citrullus colocynthis</i> , <i>Atractylis gummifera</i> and <i>Daphne gnidium</i> , is used against rheumatic pains by massaging the feet.
	<i>Magydaris panacifolia</i> (Vahl.) Lange	Magydaris.	Frifra.	Root	Root powder mixed with honey are given for joint pain, back pain and cooling in general, Poultrice against back pain, on the knee, against rheumatic inflammation.
<b>Asparagaceae</b>	<i>Urginea maritima</i> (L.) Baker.	Scille.	Îkfil / Bsel idane	bulb	In root liniment (in olive oil), it is used in the treatment of rheumatism, sciatica
	<i>Anacyclus pyrethrum</i> L.	Pyrètre d'afrique	Iguntas / Tagundecht	Root	Infusion of leaves is prescribed for the inflammation of the back. Foot massage in the decoction
<b>Asteraceae</b>	<i>Artemisia herba-alba</i> Asso.	Armoise blanche	Chih / Ifzi / Izri	Leaves	The root powdered root is used against rheumatic diseases.
	<i>Atractylis gummifera</i> L.	Chardon à glu	Addad	Root	The root powdered root is used against rheumatic diseases.
	<i>Stemmacantha acaulis</i>		Tifghwine	Root	Heated leaves in poultices on the knees are used against osteoarthritis
<b>Brassicaceae</b>	<i>Brassica oleracea</i> L.	Chou	Krumb	Leaves	/ The fruit decoction of the fruit is used for these antirheumatic properties; the decoction of the aerial parts is used for foot massage.
<b>Capparaceae</b>	<i>Capparis spinosa</i> L.	Câprier	Kabâr / Taylulut	Aerial part / fruit	Powder is used against joint pain, cooling. It is incorporated in bread, with <i>Mentha suaveolens</i> , <i>Mentha pulegium</i> as a remedy for the same indications. The roots are used to make points of fire in case of rheumatism and joint pain.
<b>Caryophyllaceae</b>	<i>Corrigiola telephiifolia</i> Pourr.	Corrigiole à feuilles de téléphium	Sarghina / Tawsarghine	Root	The fruit divided into two, and heated slightly, is applied under the heels in the case of rheumatic diseases.
<b>Cucurbitaceae</b>	<i>Citrullus colocynthis</i> (L.) Schrader.	Coloquinte	Lhdej / Tafzizte	Fruit	Fruit divided into two, slightly heated and applied under the heels in case of rheumatic diseases.
<b>Cupressaceae</b>	<i>Juniperus oxycedrus</i> L.	Genévrier oxycedre- cadier	Taqqa	Ecorce	Dried leaves, powder, associated with anastatica, with <i>Rosmarinus officinalis</i> , mixed with honey is used against sciatica, against osteoarthritis and back pain.
<b>Ephedraceae</b>	<i>Ephedra nebrodensis</i> Guss.	Ephédra	Timitrte	Leaves	The decoction of the plant is used against rheumatic pain; it also helps in bone ossification with a local application at the fractures.
<b>Euphorbiaceae</b>	<i>Mercurialis annua</i> L.	Mercuriale annuelle.	Harryga malsa.	The whole fresh plant	Incorporated in bread against cooling, as a bath with plants and seeds is used against cooling.
	<i>Ricinus communis</i> L.	Ricin	Lkharwaa / Anguaref	Seeds	The decoction of the plant is recommended as a warming agent and against colds
	<i>Ajuga iva</i> (L.) Schreb.H.	Bugle- Ivette.	Tûf tolba / Chendgoura.	The whole plant	The decoction is used against the chill, rheumatic diseases.
	<i>Lavandula dentata</i> L.	Lavande à feuilles dentées.	Lkhezama lbalidia.		The plant in infusion or in decoction with milk or tea is recommended in case of cooling, abdominal pain.
<b>Lamiaceae</b>	<i>Mentha pulegium</i> L.	Menthe pouliot.	Flyiou	The whole plant	The leaves are applied to the knee against rheumatism.
	<i>Mentha suaveolens</i> L.	Menthe à feuilles rondes.	Timrsade / Timija / Merssita.	Leaves	The infusion plant is used against rheumatism.
	<i>Mentha gatefossei</i> Maire	Mélisse.	Flyiou dial jbel	Aerial part	The stem with leaves in infusion or decoction is recommended in abdominal pain, cooling.
	<i>Origanum compactum</i> Benth.	Origan.	Zaater.	Stem with leaves	Leaves in decoctions or infusions are used against rheumatic diseases.
	<i>Rosmarinus officinalis</i> L.	Romarin	Yazir	Stem with leaves	Maceration of leaf powder in olive oil is used against osteoarthritis.
<b>Lauraceae</b>	<i>Laurus nobilis</i> L.	Laurier-sauce.	Awrak sidna moussa	Leaves	The <i>Eugenia caryophyllata</i> powder associated with <i>Lavendula</i> sp., with <i>Rosmarinus officinalis</i> with <i>Artemesia herba alba</i> , mixed with henna, is used as a poultice for feet and hands against rheumatism. The powdered of <i>Eugenia caryophyllata</i> , mixed with butter (Hayel) or associated with glycerin against the knee pain.
<b>Myrtaceae</b>	<i>Eugenia caryophyllata</i> Thunb.	Girofle.	Qronfel.	Bouton floraux.	

<b>Oleaceae</b>	<i>Olea europaea</i> L.	Olivier	Zitoune	oils	Olive oil associated with <i>Eugenia caryophyllata</i> is used on the joints in pain.
	<i>Olea europaea</i> var. <i>sylvestris</i> (Mill.) Brot.	Olivier sauvage	Azmour / Zabouj	oils	oil is used in cases of rheumatic diseases and joint pains.
<b>Pinaceae</b>	<i>Cedrus atlantica</i> (Endl.) Carr.	Cèdre de l'atlas	L-âr / Atgal.	Ecorce	Bark Tar used locally on fractures, on the joints in case of pain.
	<i>Pinus halepensis</i> Mill.	Pin d'alep	Sanawbar.	Leaves	Putting the legs or taking a shower with water boiled with pine leaves to relieve rheumatic inflammations.
<b>Piperaceae</b>	<i>Piper cubeba</i> L.	Cubèbe	L-kebbaba	seeds	The pulverized seeds associated with the olive oil used in friction in the treatment of back pain. The root powder in association with the <i>Anacyclus pyrethrum</i> , the <i>Corrigiola telephifolia</i> is used against rheumatic diseases with an amount of 2 tablespoons of mixture associated with honey or olive oil in the morning.
<b>Plombaginaceae</b>	<i>Armeria alliacea</i> (Cav) Hoffm	Armeria.	Iwdmi.	Root	The seeds boiled grain is used for broken bones ossification.
<b>Poaceae</b>	<i>Pennisetum typhoides</i> (Burm.) Staph & Hub.	Millet.	Illan.	seeds	Wheat bran used as plasters and promote ossification of bone fractures and against rheumatic pains.
	<i>Triticum durum</i> Desf.	Blé.	Îrden / Gumh.	seeds	
<b>Ranunculaceae</b>	<i>Ranunculus bullatus</i> L.	Renoncule boursouflé.	Wden lhalluf.	Root	roots in decoction is used against back colds
<b>Rutaceae</b>	<i>Ruta montana</i> L.	Rue sauvage.	Ifijel / Iiwrm.	Aerial part	The powdered plant mixed with olive oil is used against rheumatic diseases.
<b>Taxaceae</b>	<i>Taxus baccata</i> L.	If.	Îgen.	Ecorce	Bark Tar yew is used by simple massage, against osteoarthritis, colds members of the body.
<b>Thymelaeaceae</b>	<i>Daphne gnidium</i> L.	Garou.	Âlezzâz.	Root	Foot massage in the decoction
<b>Zingiberaceae</b>	<i>Alpinia officinarum</i> Hance.	Petit Galanga.	Khodenjâl.	Rhizome.	Decoction of the rhizome with rosemary is used against cooling and as warming agent.
	<i>Zingiber officinalis</i> Rosc.	Gingembre	Skenjbir.	Rhizome.	Ginger is used in powder form, in friction against back pain.

Because of their pain and the disability that often accompany them, they are considered as the diseases that have high potential for harm to people's health, since they affect not only those around them but also society as a whole. Even if their hospital morbidity, especially their lethality is lower compared to those of other chronic conditions, the fact remains that they reduce the patients' quality of life. They also affect society by focusing on those who are productive in the labor market, besides being very expensive. Therefore, the management of this disease proves to be a real social problem, especially in developing countries such as Morocco with insufficient resources due to low economic systems. Uses of readily available local resources constitute a real workaround. Therefore, an ethnobotanical study in the Central Middle Atlas region has identified 42 antirheumatic species used by the population of the study area.

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