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Faculty of Nature and Life Sciences
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Department of Biology

End of studies' project

With a view to obtaining the Master's Degree

Field: Biological Sciences

Specialty: Plant Biotechnology

Theme

Bibliographic review of the scientific studies carried out on *Artemisia herba-alba* Asso. in Algeria, period 2000-2020

Presented by:

Bourzegue Zineb **Zitouni Fatna**

Jury composed of:

President: Mr. Amraoui Abdellaoui	MAA. Univ. Djelfa
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Academic Year 2020/2021


بسم الله الرحمن الرحيم

Acknowledgments and dedications

Above all, I thank ***Allah***

who helped us and gave us the courage,

and the will to complete this modest work

I would like to express my thanks to ***Mr. Bougoutaia Youcef*** *for having supervised and directed this work.*

I also thank the president of the jury ***Mr. Amraoui Abdellaoui*** *and the members of the jury* ***Mrs. Oualha Dalila*** *and* ***Mr. Bezini El-hadi*** *for having accepted to examine this work.*

I dedicate this work to ***my parents*** *who supported me with their encouragement and who led me to this achievement.*

To my ***brothers*** *and* ***sisters***

To my whole ***Family***

To all those who are dear to me

Bourzegue Zineb

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Zitouni Fatna

ABSTRACT

Artemisia herba alba Asso (white wormwood) is one of the most important plants in Algeria, where many studies have been done about this plant. The objective of the present study is to conduct a database on the scientific studies carried out during the last two decades on this species in Algeria. We collected these studies from the websites Google, Google scholar, scientific journals, Algerian university sites, and the websites of Algerian Theses. We focused our study on Theses, Articles, and Magister Memoirs. The result is one hundred and fourteen (114) scientific studies. We summarized and divided it into five fields according to their objectives. The majority of these studies are about Phytochemistry.

Keywords: *Artemisia herba-alba*, *Asteraceae*, Algeria

RESUME

Artemisia herba alba (l'armoise blanche) est l'une des plantes les plus importantes d'Algérie, où de nombreuses études ont été réalisées sur cette plante. L'objectif de ce projet d'étude est de mettre en place une base de données sur les études scientifiques effectuées sur cette espèce en Algérie. Nous avons collecté ces études sur les sites Google, Google Scholar, des revues scientifiques, des sites universitaires algériens et les sites Web de Thèses Algériennes; Nous avons concentré notre étude sur les thèses, les articles et les mémoires de Magister. Au total, cent quatorze (114) études scientifiques ont été recensées. Les résultats des recherches ont été divisés en cinq domaines en fonction de leurs objectifs. La majorité de ces études portent sur la phytochimie.

Mots-clés : *Artemisia herba-alba*, Asteraceae, Alegria

ملخص

يعتبر نبات الشيح الابيض من اهم النباتات في الجزائر حيث تم اجراء العديد من الدراسات حول هذا النبات. الهدف من هذه الدراسة هو انشاء قاعدة بيانات للدراسات العلمية التي اجريت على هذا النوع في الجزائر. لقد جمعنا هذه الدراسات من مواقع الدراسات العلمية و مواقع المجلات العلمية و مواقع الجامعات الجزائرية و موقع الاطروحات الجزائري .ركزنا في دراستنا على الاطروحات و المقالات و مذكرات الماجسترحيث تحصلنا على مئة و اربعة عشر(114) دراسة علمية. قمنا بتلخيص و تقسيم هذه الدراسات الى خمس مجالات علمية. ترتكز غالبية هذه الدراسات على الكيمياء النباتية.

الكلمات المفتاحية : *Artemisia herba-alba*, Asteraceae, Alegria

ABBRIVIATIONS

AHA: *Artemisia herba alba*

DPPH: 2,2-diphenyl-1-picrylhydrazyl

EO: Essential Oil

GC: Gas Chromatography

HPLC: High-Performance Liquide Chromatography

IC50: Inhibitory Concentration 50%

LD: Lethal Dose

MBC: Minimum Bactericidal Concentration

MFC: Minimum Fungicidal Concentration

MIC: Minimum Inhibitory Concentration

MS: Mass Spectrometry

NMR: Nuclear Megnetic Resonance

TLC: Thin Layer Chromatography

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Introduction

Since humans came into existence, they have been used plants as medicines and food. Ethnobotanists study how people in different areas and different cultures have used plants throughout history. Plants study has become more popular as people around the world have become more interested in the qualities and properties of plants.

The study of plants includes the study of plant anatomy, biochemistry, genetics, molecular biology, physiology, plants classification, evolutionary relationships of plants, the study of fossilized or ancient plants, and ecology of plants and how they live in communities.

The Algerian flora is one of the richest in North Africa **(Miara *et al.*, 2018)**. One of the most important of these plants is *Artemisia herba alba* Asso.

Artemisia herba alba (Asterales, Asteraceae) is an aromatic plant commonly used in traditional medicine as anti-diabetic, anti-bacterial, anti-viral, anti-oxidant, anti-hemorrhagic, anti-pyretic, or anti-spasmodic **(Bouzeraa *et al.*, 2018)**.

Many studies have been done on this plant. The basis of these studies was the natural and traditional background in Algerian popular culture, which was the main objective of these studies is to build a scientific database for the uses of this plant *Artemisia herba alba* (white wormwood).

Our study is a bibliographic synthesis of the scientific studies carried out during the last two decades on the species *Artemisia herba-alba* in Algeria. The objective is to conduct a database on the scientific studies carried out on this species in Algeria.

As methodology followed, we have divided the study into three chapters. The first is a bibliographical summary on *Artemisia herba-alba*. The second concerns the scientific studies carried out on white wormwood in the last two decades in Algeria (articles, theses, Magisters' memoirs); the scientific work has been divided into five fields

according to their objectives. For the majority of the scientific works, we have presented the summary, the material and methods used as well as the results obtained.

For each field, the scientific works have been presented in alphabetical order of the name of the first author of the work. A summary of scientific results has been prepared for each research field.

The third chapter was devoted to the brief presentation of two research projects related to *Artemisia herba alba* in Algeria.

Finally, we ended our work with a conclusion summarizing the results of this project

Chapter I:

Bibliographic synthesis on *Artemisia herba-alba* Asso.

Chapter I: Bibliographic synthesis on *Artemisia herba-alba*

1. Presentation of *Artemisia herba alba*:

Artemisia herba alba Asso commonly known as white wormwood (Arabic name Shih), is a perennial strongly aromatic small shrub (Fig. 01) growing in North Africa (Algeria, Tunisia, and Morocco), Middle East (Sinai, Jordan, Syria, Iraq, and Iran), and South Western Europe (Spain). It belongs to the family Asteraceae **(Nedjimi & Beladel, 2015.).**

Figure 1: *Artemisia herba alba* (white wormwood) (**Henni, 2018**).

2. Nomenclature and Taxonomy:

Artemisia herba alba commonly known as "white wormwood", in Arabic as "Chih" and in Franch as "Armoise blanche" **(Lakehal *et al.*, 2017)**.

Reign: Plantae
Phylum: Magnoliophyta
Class: Magnoliopsida
Order: Asterales
Family: Asteraceae
Genus: Artemisia
Species: *Artemisia herba alba* **(Nia, 2018)**

3. Botanical description:

Artemisia herba alba is a herbaceous plant with woody and branched stems, 30-50 cm, very leafy with a thick stump. The leaves are small, sessile, pubescent and silver-looking. The flowers are grouped in clusters, with very small (3/1.5mm) and ovoid heads. The involucre is interlocking bracts, the external orbicular and pubescent. The floral receptacle is bare with 2 to 5 yellowish flowers per flower head all hermaphrodite **(Mouchem, 2015)**.

4. Biology:

Artemisia herba alba is a low and always green woody plant. Its morphological and physiological characteristics make it a species well adapted to arid climatic conditions. The seasonal dimorphism of its foliage allows it to reduce the sweat surface and thus avoid water loss **(Mouchem, 2015)**.

5. Ecology:

In Algeria, the overall areas of the steppes have been estimated at 20 million hectares (Fig. 02). *Artemisia herba alba* covers three million hectares of these rangelands and its potential as a fodder resource is significant. *Artemisia herba-alba* is well adapted to arid climatic conditions and grows in clayey and compacted soils with low permeability **(Maghni *et al.*,2017).**

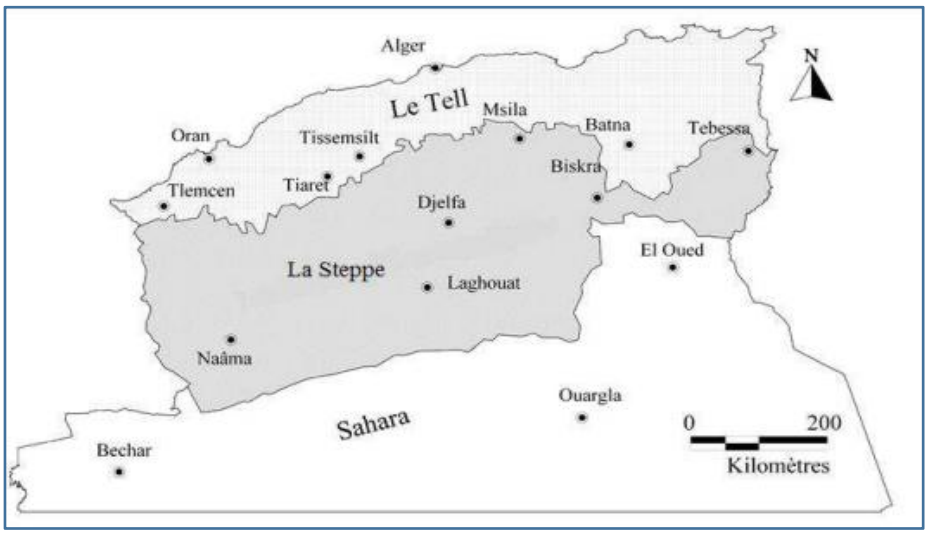

Figure 2 : Situation of the Steppe in Algeria (**Houamel, 2018)**.

6. Biochemical:

The main biochemical compounds of white wormwood are Lactones Sesquiterpenes, Flavonoid Glucosides, and Monoterpenes **(Nia, 2018)**.

7. Therapeutic properties:

Plants of the genus Artemisia (Asteraceae) have been used in medicine traditional by many cultures since ancient times. Herbal teas of these species have been used as analgesic, antibacterial, antiplasmodic, and hemostatic, anthelmintic, anti-diarrheal, and diuretic agents while several extracts and essential oils showed a number of biological activities such as antihyperglycemic, antimicrobial, antioxidant, and anti-inflammatory **(Messai *et al.*, 2008; Mouchem, 2015).**

Chapter II:

The scientific studies of *Artemisia herba alba*

Chapter II: The scientific studies of *Artemisia herba alba*:

The chapter is a summary of one hundred and fourteen scientific studies (27 Theses, 73 Articles, 14 Magister Memoirs) of *Artemisia herba alba* from different Algerian regions during the last two decades obtained from our research. We collected these studies from the websites Google, Google scholar, Scientific journals, Algerian university sites, and the website of Thesis Algeria.

We divided these studies into five fields according to their objectives.

1. Ethnobotanical and Ethnopharmacological studies:

Ethnobotany is the study of the dynamic relationship between plants and people (**Voeks, 2017)**.

Ethnopharmacology is an amalgam of perspectives, primarily those of pharmacology, pharmacognosy, anthropology, and botany. It is the study of indigenous medical systems that connects the ethnography of health and healing with the physiologic relevance of its medical practices **(Elisabetsky & Etkin , 2009).**

We found in this field twenty-one (21) scientific studies, Tow (2) Theses and ninteen (19) Articles), where represent 19% of the total.

1.1. Articles:

Ait-Kaki *et al.*, 2018. Effects of *Artemisia herba alba* or olive leaf (*Olea europaea*) powder supplementation on growth performance, carcass yield, and blood biochemical parameters in broilers:

Abstract

This study was aimed to evaluate the effects of supplementation of white wormwood (*Artemisia herba-alba)* or olive leaf (*Olea europaea*) powder on growth performance, carcass yield, and serum biochemical parameters in broilers in a private farm located in Chemini, Bejaia, Algeria.

Materials and Methods: The olive leaves and *Artemisia herba-alba* were harvested from Bejaia, Algeria. The plant material was dried and transformed to powder using a cereal mill. the final products were analyzed at the Laboratory of Forage Analysis (Department of Agricultural and Environmental Analyses, Province of Liege, Belgium). The parameters measured were dry matter (DM), crude protein (CP), crude fiber (CF), crude ash (CA), and selected macro and micro minerals. The experiment was carried out for a rearing period of 42 days in a private farm located in Chemini, Bejaia, Algeria. A total of 60, 1-day-old Ross 308 male chicks (commercial strain) were divided into three groups consisted of 10 chicks, in each of two replications. The chicks in Group 1 were fed with a standard commercial diet (SCD); Group 2 received the same SCD with 2% supplementation of *Artemisia herba-alb* powder, and Group 3 received the same SCD with 2% supplementation of *Olea europaea* powder. The chicks were housed under identical conditions and provided lighting 16 h/day using fluorescent lights controlled by timers until the end of the experiment. Growth performance was measured with body weights every 2 weeks, daily feed intake, feed conversion ratio (FCR), and carcass yield at the end of 42 days of rearing. Blood samples were collected to analyze serum glucose, cholesterol, triglycerides, urea, and total protein levels.

Results showed that, at 42 days of rearing, supplementation of *O. europaea* and *A. herba-alba* significantly increased ($p<0.001$) mean body weight (2230.10±26.38 g and 2117.42±26.38 g, respectively, vs. 2336.66±27.88 g in chicks of Group 1), but there was no significant difference ($p\geq0.05$) among the three diets for FCR or percentage carcass yield. Among the serum biochemical parameters, glucose was significantly affected ($p<0.01$) by supplementation of olive leaf powder (1.90 g/L: Group 3), compared to the SCD (2.24 g/L: Group 1) or wormwood powder (2.05 g/L: Group 2). Moreover, the supplementation of olive leaf powder in Group 3 broilers significantly affected ($p<0.05$) the serum cholesterol level (0.95 g/L), compared to the control diet (1.13 g/L). There was no significant difference ($p\geq0.05$) for the other selected serum biochemical concentrations, namely triglycerides, urea, and total protein. The analytical composition of white wormwood or olive leaf powder indicated that crude protein (CP), crude fiber (CF), and crude ash (CA) contents were higher in *A. herba-alba* compared with *O. europaea*.

The supplementation of Artemisia or olive leaf powder into the diet for broilers improved body weight by about 5% or 10%, respectively, at slaughter with moderate changes in blood biochemical parameters.

Azzi *et al.*, 2012. Ethnopharmacological survey of medicinal plants used in the traditional treatment of diabetes mellitus in the North Western and South Western Algeria:

Abstract

The aim of this study is to document the plants used for the management of diabetes mellitus in targeted areas represented by four provinces located in the west of Algeria repartee in a trough north-south axis.

Materials and Methods: An ethnobotanical study was conducted from October 2009 to June 2011, using questionnaire. Ethnobotanic information was obtained from 470 patients suffering from type 1 or type 2 diabetes mellitus. Interview was performed in hospital, pharmacy, and associations helping diabetics. All patients interviewed had been informed about the objective of the study.

The results indicated that only 28.30% of patients interviewed used medicinal plants as treatment alone or in association with the conventional treatment of diabetes. 60 medicinal plants belonging to 32 families were cited, of which the most cited were: *Trigonella foenum-graecum* (56 citations), *Rosmarinus officinalis* (27 citations), *Citrullus colocynthis* (22 citations), *Tetraclinis articulata* (21 citations), *Artemesia herba alba* (20 citations), *Origanum compactum* (16 citations) and *Punica granatum* (16 citations). The plants families' which contained the most commonly used species and their antidiabetic effects were: *Asteraceae* (8 species), *Lamiaceae* (8 species) and *Apiaceae* (4 species). Among these medicinal plants, five plants were known to be toxic: *Nerium oleander, C. colocynthis, Zygophyllum album, Nigella sativa* and *Peganum harmala.*

Bouasla A. & Bouasla I., 2017. Ethnobotanocal survey of medicinal plants in Northeastern of Algeria:

Abstract

The objective of this study is a contribution to the census of the plants used by the local population of Skikda in order to identify the plant species of this region and to document their traditional uses.

Materials and Methods: The survey was carried out during the year (2015-2016), with 89 people through face to face interviews, using pre-prepared questionnaire. The form contains: sociodemographic profile of each respondent (sex, age, educational level and monthly income), local name of medicinal species used, uses, used parts and methods of preparations. Data were organized andive stat analyzed by descriptistics.
Results: The survey identified 90 species belonging to 42 botanical families. Of the 42 botanical families listed, three are clearly dominant: Lamiaceae (9 species), Apiaceae (8 species), and Asteraceae (7 species). The analysis of the obtained results showed that the frequency of use of medicinal plants is related to the age, sex, educational level and monthly income of our respondents. It was recorded that the majority of remedies are prepared in the form of a decoctate from the leaves of the different species, in order to treat a wide range of diseases especially those of the digestive tract. It should be noted that some listed species are suffering from surexploitation which can subjects to the disappearance of the most vulnerable species. It will be urgent and essential to adopt a sustainable management strategy to avoid the degradation of biodiversity of the region.

Boudjelal *et al.*, 2015. Antidiabetic Effects of Aqueous infusions of *Artemisia herba alba* and *Ajuga iva* in Alloscan-Induced Diabetic Rats:

Abstract

The aim of this work is to give scientific significance to local folk medicine, by studied the composition of aqueous infusions from *Artemisia herba alba* and *Ajuga iva* and their effects on blood glucose levels in alloxan-induced diabetes mellitus in rats.

Materials and Methods: *Artemisia herba alba* and *Ajuga iva* were collected in the M'sila region, Algeria, in May 2011, The aqueous extracts were prepared by the infusion method and were then filtered. The extracts were evaporated in a vacuum to give dark brownish syrups as residues, which were kept at 4 °C under a nitrogen atmosphere until use. The aqueous extracts from *Artemisia herba alba* and *Ajuga iva* were analyzed by a hyphenated technique, HPLC/UV‑ vis-DAD/ESI‑ MS. Rats were randomly divided into nine groups, with each group consisting of six animals. Group I: normal control (rats treated with distilled water); group II: diabetic control (rats treated with distilled water); group III: diabetic rats treated with glibenclamide (5 mg/kg b.w.); groups IV-VI: diabetic rats treated with *Artemisia herba alba* aqueous

infusions (100, 200, and 300 mg/kg b.w.); groups VII-IX: diabetic rats treated with *Ajuga iva* aqueous infusions (100, 200, and 300 mg/kg b.w.). The drug preparations were given orally to rats of each group twice daily for 15 days. Within groups, comparisons were performed by analysis of variance using the ANOVA test obtained with GraphPad Prism 5 software. Significant differences between the control and experimental groups were assessed by Tukey's test.

Results: Compositional analysis of the aqueous infusions revealed the presence of several polyphenols as main components. *Artemisia herba alba* extract was characterized by mono- and di-cinnamoylquinic acids, with 5-caffeoylquinic (chlorogenic) acid being the main compound, followed by 3,5-dicaffeoylquinic acid. Vicenin-2 (apigenin 6,8-di-C-glucoside) appeared to be the most abundant among flavonoids. *Ajuga iva* showed the exclusive presence of flavonoids, with the flavanone naringin present in relatively high levels together with several flavone derivatives. The highest percentage decrease of glycaemia levels was observed for the treatments with 300 mg/kg b.w. of *Artemisia* and *Ajuga* infusions (− 73.88% and − 72.69%, respectively), which was greater than the reference drug (− 65.90%). These results showed a great efficiency at lowering the blood glucose levels of *Artemisia herba alba* and *Ajuga iva* infusions, confirming its use by local people as an antidiabetic plant.

Hamza *et al.*, 2010. Prevention of type 2 diabetes induced by high fat diet in the C 57 BL/6J mouse by two medicinal plants used in traditional treatment of diabetes in the east of Algeria:

Abstract

Aim of the study: The preventive effect of the hydro-alcoholic extracts of *Artemisia herba-alba Asso* , and *Centaurium erythraea Rafn* , two medicinal plants used in traditional treatment of diabetes in the north-eastern Algeria, were evaluated in animal models of type 2 diabetic induced with a standardised high fat diet (HFD).

Materials and methods: Plant extracts were administered orally by gavage at a dose of 2 g/kg bodyweight daily for 20 weeks to male C57BL/6J mice fed HFD. Animals were weighed and plasma glucose measured weekly and insulin at the end of study using standard ELISA methods.

Results: In mice fed a high fat diet, *Artemisia herba-alba Asso* and *Centaurium erythraea Rafn* signifificantly inhibited the increased blood glucose, triglyceride,

insulin and insulin resistance seen in untreated mice, to levels that were not signifificantly different from those found in mice fed a standard diet. In contrast, body weight and calorie intake were not different between treated and untreated animals fed the HFD.Administration of *Artemisia herba-alba Asso* extract improved glucose levels with markedly decreased insulin resistance (8-fold lower than the HFD controls). *Artemisia herba-alba Asso* seemed to have the pharmacological effect of restoring sensitivity to insulin and therefore, reducing the insulin resistance that is associated with type 2 diabetes and the same result was found for *Centaurium erythraea Rafn*.

Conclusion: *Artemisia herba-alba Asso* had been shown to have a hypoglycaemic effect in diabetes but this is the first demonstration of a preventive effect of *Artemisia herba-alba Asso* and *Centaurium erythraea Rafn* on HFD-induced diabetes

Hamza *et al.*, 2010. Treatment of high fat diet induced type 2 diabetes in C 57 BL/6J mice by two medicinal plants used in traditional treatment of diabetes is the east of Algeria:

Abstract

Aim of the study: Hydro-alcoholic extracts of *Centaurium erythraea Rafn*, Gentianaceae and *Artemisia herba-alba Asso*, Asteraceae, medicinal plants used in traditional treatment of diabetes in northeastern Algeria, were tested in established type 2 diabetes induced with a standardized high fat diet (HFD) in mice.

Materials and methods: After confirmation of diabetes (17th week), plant extracts were administered orally by gavage at a dose of 2 g/kg daily for 18 weeks to male C57BL/6J mice fed HFD. Animals were weighed, food intake and plasma glucose measured weekly, insulin and lipid profile at study end.

Results of this study clearly indicate that *Centaurium erythraea* Rafn and *Artemisia herba-alba* Asso extract can reduce type 2 diabetes in mice fed a high fat diet. This is the first report on the antihyperglycaemic, antihypercholesterolemic and antihypertriglyceridemic action of hydro-alcoholic extract of *Artemisia herba-alba Asso* and *Centaurium erythraea Rafn* on this model of diabetes. These results confirm the previous results found in a preventive model of diabetes, but in a treatment model of established model, analogous to the treatment of human patients with diabetes.

Hamza *et al.*, 2015. Effet of *Centaurium erythraea Rafn*, *Artemisia herba alba Asso.* And *Trigonella foenum-graecum L.* on liver fat accumulation in C 57 BL/6J mice with high-fat diet-induced type 2 diabetes:

Abstract

Aim of the study: Describe the additional effects of diet and treatment on liver and tissue histology and lipid deposits in the HFD diabetic mice.

Materials and methods: Male C57BL/6J mice were fed with HFD to induce type 2 Diabetes. Groups of mice were given plant extracts orally at 2 g/kg/bodyweight daily for 20 weeks during establishment of diabetes, or for 18 weeks after confifirmation of diabetes at the 17th week. Liver and other tissue samples were stained with Oil Red O.

Results: Liver steatosis was confifirmed with HFD. *Centaurium erythraea Rafn*, *Artemisia herba alba Asso.* and *Trigonella foenum-graecum L.* extracts improved liver steatosis by the end of the preventive (20 weeks) and curative periods (35 weeks). This was most marked for *Centaurium erythraea Rafn* extract (po0.05), less so with *Trigonella foenum-graecum L.* and *Artemisia herba alba* Asso.. No steatosis was found in other tissues.

Conclusion: CE extract had a clear hepatoprotective effect in this mouse model of diet-induced type 2 diabetes. *Artemisia herba alba Asso.* and *Trigonella foenum-graecum L.* had a minimal or no signifificant effect on steatosis. Beyond its effect as an antidiabetic agent, *Centaurium erythraea Rafn* may also be promising to prevent or treat non-alcoholic liver steatosis.

Hamza *et al.*, 2019. A review of Algerian medicinal plants used in the treatment of diabetes:

Abstract

The objective of the study was first to identify ethnobotanical studies that might inform on the plants used to treat diabetes in various areas of Algeria, and in a second part, identify the papers reporting on the pharmacological evaluation of these plants in experimental or human diabetes.

Material and methods: Systematic review of ethnobotanical papers published in the medical literature, from literature databases (Pubmed, Web of Science), as well as Google, for English, French and Arabic -language publication, and a manual search of local libraries and bookshops, as well as the university repository of PhD and master's

theses. The reference lists of the papers retrieved were also examined for further papers.

Results: Many plants are cited in the ethnobotanical surveys, but only very few pharmacological studies were found. In the ethnobotanical surveys, 171 plants were reported, from 58 families of which the most often cited were Asteraceae, Lamiaceae and Apiaceae. The plants with the best evidence of use and activity are: *Anabasis articulata* (Forssk.) Moq., *Trigonella foenum-graecum* L., *Centaurium erythraea Rafn*, *Artemisia herba-alba* Asso, *Marrubium vulgare* L., *Agathophora alopecuroides* (Delile) *Fenzl ex Bunge*, *Anabasis articulata* (Forssk.) Moq., *Hammada elegans* (Bunge) Botsch., *Helianthemum kahiricum* Delile, *Salsola baryosma* (Schult.) Dandy, *Salsola vermiculata* L., *Olea europaea* L.

Conclusion: Traditional herbal medicines are still very much used in Algeria to control diabetes. However they are generally poorly characterized and none have been properly tested in man. There is a need for systematic evaluation of the more commonly used plants to confirm their antidiabetic activity, identify possible mechanimss of action, and recommend best use.

Kadi *et al.*, 2017. Synergistic antinociceptive activity of combined aqueous extracts of *Artemisia compestris* and *Artemisia herba alba* in several acute pain models:

Abstract

This study was carried out to evaluate the antinociceptive properties of both *Artemisia herba-alba* and *Artemisia campestris* individually and enhancing their combination effects using several models of pain in experimental animals.

The results of this study demonstrated that co-administration of *A. campestris* and *A. herba-alba* decoctions had exerted a synergistic analgesic effect in different models of acute nociception. For the obtained data, no clinical signs of toxicity were detected during the experiments, which means that plants decoctions were relatively safe for animals, and DL 50 values were greater than 2000 mg/kg b-w for both plants. Additionally, binary combination forms exhibited a great improvement in intensity and amplitude of antinociceptive activity in comparison with both plants used individually by a relative interference with the opioid system. The results suggested the central and peripheral analgesic properties and confirmed the folkloric medicinal use of these plants in pain symptom.

Kalifa *et al.*, 2020. An Ethnobotanical survey and quantitative study of Indegenous Medicinal Plants used in the Algerian semi-arid region:

Abstract

The aim of this ethnobotanical survey in the region of El Bayadh situated in the semi-arid part of Algeria was to identify the main medicinal plants used by the local inhabitants to treat different diseases and to collect all the data on their therapeutic characteristics.

Materials and Methods: One hundred informants of different ages were interviewed for this study (69 women and 31 men). Both quantitative and qualitative information were collected through open semi-structured face-to-face interviews with the local people. Data were organized andive stat analyzed by descriptistics. The ethnobotanical data were analyzed using various important quantitative indices calculated for each of the recorded medicinal plant species like use value (UV), relative frequency of citation (RFC), relative importance index (RII), informants' agreement ratio (IAR), informant consensus factor (ICF), fidelity level (FL), and family importance value index (FIV). In addition, a correlation analysis was performed to check the level of association between RFC and both UV and RII.

The results: It was reported that 44 useful plant species, belonging to 26 botanical families were used in the treatment of various diseases. The Asteraceae family was the most common family (6 species, 13.64%, FIV = 0.94) of all the medicinal plants recorded in this study. Leaves were the most commonly used plant part, accounting for 50.77% of the plants reported. Eighty-three diseases were identified and grouped into eleven categories, dominated by diseases of the nervous system and sensory organs (ICF = 0.94), which were treated with local medicinal plants. There is a clear dominance of *Artemisia herba alba* Asso. (Chih) in the three important ethnobotanical indices (UV, RFC, and RII).We found in this study five plant species having maximum fidelity level (100%) where they were used to treat only one disease. The Pearson correlation coefficient between RFC and UV (0.986**), and between RFC and RII (0.713**) showed highly positive significant association between RFC and both UV and RI of plant use in the study area. We deduce that herbal medicine is used in selfmedication of the local population; however, we also draw attention to the fact that the incoherent and limitless use of the medicinal flora constitutes a potential risk contributing to the degradation of the plant biodiversity of the area of study. These results may complement the database of the national medicinal flora and

support research in phytochemistry and pharmacology to discover new drugs and approve ethnomedicinal knowledge.

Miara *et al.*, 2018. Ethnobotanical Survey of medicinal plants used by nomadic peoples in the Algerian steppe:

Abstract

This work aims to document the phytotherapeutical knowledge and practice of the nomadic community of the Algerian steppe, and compare it with neighbouring sedentary populations and Mediterranean historical texts. Through this, the study strives to evaluate processes of transmission of knowledge among this population, for whom written sources have been largely unavailable.

Material and Methods: Ethnobotanical surveys were carried out during two years (2015-2017). In total, 73 informants from nomadic populations were interviewed in several steppe regions including areas in the administrative departments of Tiaret, Saida, Naama, Djelfa and M'sila. Structured interviews about medicinal plant knowledge were combined with guided tours with the informants. Prior informed consent was always obtained. The surveys allowed for the collection of sociodemographic data and traditional knowledge about medicinal plants and their uses. Informant Consensus Factor (FIC) was calculated to evaluate agreement among informants. Results were compared to existing literature to evaluate similarities between this nomadic medicinal flora, that of neighbouring communities and historical texts and identify new plant citations and uses.

Results: Among Algerian nomadic communities, herbal remedies are used mostly by women and elders, who are often illiterate. We identified 97 taxa of medicinal plants belonging to 42 botanical families, importantly Lamiaceae, Asteraceae and Apiaceae, like in neighbouring communities. The most common plant parts and method of preparation are also shared with neighbouring populations. New uses are described for 25 known medicinal taxa, and nine species with undocumented medicinal uses in recent literature have been reported. However, some of these have been reported in Mediterranean *materia medica*. In total, 60% of the medicinal plant diversity used by Algerian nomads are well-known plants of the Mediterranean ethnopharmacological heritage. The most frequently cited medicinal species by nomads are: *Mentha spicata* L. (62 citations), *Artemisia herba-alba* (60 citations) and *Juniperus phoenicea* L. (46 citations). These plants are commonly used and uses among nomadic populations are

also known amongst other populations. Other species also have high citation numbers are: *Artemisia campestris* (42 citations), *Rosmarinus officinalis* L. (40 citations), *Peganum harmala* and *Allium sativum* L. (32 citations each) and *Teucrium polium* L. with 30 citations.

Miara *et al.*, 2019. Ethnoveterinary remedies used in Algerian steppe, Exploring the relationship with traditional human herbal medicine:

Abstract

This study aims to document the plants and other materials used in ethnoveterinary medicine among nomadic herders in the Algerian steppe. We calculate the overlap with remedies used for human health and evaluate some of the possible drivers of similarities between the two interlinked medical systems.

Methods: The field study was conducted in spring 2018 with 2019 local knowledge holders in five provinces in the central part of the Algerian steppe. Forty-six camps and ten weekly animal markets were visited. After obtaining prior informed consent, data was collected through structured interviews. Anonymous sociodemographic in formation was collected along with veterinary use data. Plant specimens were acquired, identified and deposited in the Botanical Laboratory Herbarium of the University of Tiaret. Ethnobotanical information was structured in use reports and therapeutic applications organised into 13 simple categories. Plants used in ethnoveterinary medicine were compared to those used in human health care using a Chi square test, and ethnoveterinary use was predicted using a generalised linear model with use for human care and plant family as predictive variables. Logistic regressions were also used to test if any specifific medicinal application predicts shared use in human and veterinary medicine.

Results: Sixty-six plant species from 32 botanical families and ten non-vegetable remedies were documented. Plants from the Lamiaceae, Asteraceae, Fabaceae and Apiaceae families were most commonly used. The plants most often cited by interviewees are all harvested from the wild (*Echinops spinosissimus Turra*, *Atriplex halimus L., Artemisia campestris L., Juniperus phoenicea L.* and *Peganum harmala L.*). Leaves are the most commonly used plant part and decoction is the most common preparation method. There are important similarities between remedies used to treat humans and other animals: two thirds of the remedies used in ethnoveterinary medicine are also used in human health care, and these represent half of the human

health treatments. Use for human health and plant family both predict the use of a medicinal plant in veterinary medicine, but no correlation is found regarding specifific therapeutic applications.

Conclusions: Traditional veterinary knowledge is still key to sheep and goat herders in the Algerian steppe, but a knowledge transmission gap seems to exist between older and younger generations, and ethnoveterinary practices may disappear in the near future. Treatments for human and animal care overlap to a large extent, and a causal relationship possibly exists for, at least, some of them. However, overall a smaller number of remedies

Messaoudene *et al.*, 2011. Ex vivo effects of flavonoids extracted from *Artemisia herba alba* on cytokines and nitric oxide production in Algerian patients with Adamantiades-Behçet's disease:

Abstract

The present work was aimed to investigate the effect of the flavonoïds extracted from the medicinal plant *Artemisia herba alba* on the production of IL-12 and IL-4 and we examined nitric oxide production as a marker of the inflammatory response in the PBMC of patients with Adamantiades-Behçet's disease (ABD). *Artemisia herba alba* may represent an alternative therapy for Algerian patients with ABD.

Materials and Methods: Samples from Twenty patients (8 men and 12 women) were obtained from the ophthalmology and internal medicine service, Bab El Oued Hospital, and Algiers Medicinal University Hospital (Mustapha Bacha), respectively. Patients with ABD (females and males) were tested during the clinically active stage. The mean age of the active stage was 38.43 years (20-58 years) and the mean duration of the disease was 7.69 years (1-18 years). The flowering aerial parts of *Artemisia herba alba* were collected from Djalfa region, Algeria. 20 g of the pulverized plant material were macerated for 24hours in methano-containing water (7:3). The filtrate was evaporated at 40°C to get completely rid of the solvent mixture. The solid extract was then submitted three times to 50 ml n-butanol to collect the flavonoïds mixture. The solution was filtrated and evaporated at 40°C and then dissolved in water. The extracts were kept frozen (-20°C) until used. The modulatory effects of flavonoïds extracted from *Artemisia herba alba* on cytokines and nitric oxide production by peripheral blood mononuclear cells isolated from Algerian ABD patients and healthy

controls were respectively measured by means of ELISA assays and Griess modified method.

The results showed that the Th-1 cytokines (IL-12) and nitric oxide are involved in the pathogenesis of ABD. flavonoïds significantly reduce the production of interleukin-12, the key effector of T helper 1 (Th1) cells, and nitric oxide in a dose-dependent manner in Adamantiades-Behçet's disease. In contrast, the production of IL-4, the key marker of Th2 cells was increased.

Conclusion: This study suggests that in vitro supplementation with flavonoïds extracted from *Artemisia herba alba* could have potential immunomodulatory effects characterized by a down-regulation and up-regulation of Th1 and Th2 cytokines, respectively. Moreover, flavonoïds may prevent nitric oxide-induced damages.

Ouelbani *et al.*, 2016. Ethnobotanical investigations on plants used in folk medicine in the regions of Constantine and Mila (Northeast of Algeria):

Abstract

This study is aimed at contributing to safeguard world cultural heritage and document ethnomedicinal uses of plants in Algeria and the Mediterranean basin; data on the national and global uses in the world were obtained to extract new potential species for further phytochemical and clinical investigations.

Materials and methods: The survey was carried out in two cities in the northeast of Algeria: Constantine and Mila. It was based on semi-structured interviews of 79 local informants. Data were analyzed using quantitative indices, namely, informant consensus factor, fidelity level (FL), use value (UV), and relative frequency citation (RFC), to evaluate the reliability and richness of herbal knowledge in the region.

Results: The interviewed persons used 102 plant species belonging to 90 genera and distributed among 53 families, represented mainly by Lamiaceae, Apiaceae, and Asteraceae (30%, 13%, and 10%, respectively), which were used to treat 14 ailment categories. The category of most frequent ailments (16%) was digestive disorders. The highest RFC was found for *Origanum glandulosum Desf*. with regard to the fidelity level, a higher FL was found for Tilia cordata Mill. (100%), followed by *Artemisia herba alba* Asso. with an FL of 95.74 % and *Punica granatum L.* with an FL of 93.09 %) to treat gastrointestinal system diseases, and Aloe sp L. with an FL of 96.67% for skin diseases. The highest UV was found for *Origanum glandulosum Desf.*

(2.280). Moreover, new medicinal uses were recorded for the first time in Algeria and Mediterranean regions.

Conclusion: The present study has highlighted the rich herbal knowledge about newfound medicinal plants and their new uses in the Mediterranean region, which could be useful not only in facilitating other studies such as phytochemical and pharmacological investigations and upgrading the sources of biomolecules beneficial to people but also in reopening discussion on pharmacovigilance in herbal medicine as an imperative requirement for local authorities.

Ould El Hadj *et al.*, 2003. Place des plantes spontanees dans la medicine traditionnelle de la région de Ouargla (Sahra Septentrional EST):

Abstract

The aims of this study are to investigate and identified the spontaneous medicinal plants in Ouargla region.

Materials and Methods: This study is based on two points: in the first phase, a survey was undertaken from the local population's knowledge about the use of spontaneous medicinal plants; subsequently, the plants were identified and sampled.

Results: An investigation made it possible to inventory 37 species of which 27 could be sampled on the ground. The most important families are Asteraceae (13,51%), Poaceae (10,81%), Chenopodiaceae (8,10 %), and Lamiaceae (8,10%). The dominant diseases are digestive pathology (26,38%), various pains (15,27), dermatoses (13,88 %), bronchopulmonary pathology, and affections intern with 12,50% each one, female pathology, and the punctures of a scorpion with 9,72 % each one. The oral administration, which gathers the majority of the modes of preparation: infusion, maceration, decoction, herb tea, powder intern, is recommended. The parts used, are respectively the sheets, the stems, the fruits, the roots, and the inflorescences.

Réggami *et al.*, 2019. *Artemisia herba alba* aqueous extract improves insulin sensitivity and hepatic streatosis in rodent model of fructose induced metabolic syndrome:

Abstract

The aim of this study is to investigate the ability of the aqueous extract from the leaves of *Artemisia herba-alba* Asso. to improve insulin sensitivity, dyslipidemia, oxidative stress, and hepatic steatosis in fructose-induced MetS rodent model.

Materials and Methods: *Artemisia herba-alba* Asso. was collected in Oultem region (M'sila Province, central part of northern Algeria). The aerial part was dried and was powdered, then used according to the traditional method for obtained the aqueous extract of *A. herba-alba* . The rats were divided into seven groups (six animals/ each group) as given below: NC: Normal control group. N + AH3: Normal group administered with 400 mg/kg b.w. of *A. herba-alba* extract (AH). FC: Fructose-drinking control group. F + AH1: Fructose-drinking group treated with 100 mg/kg b.w. of *A. herba-alba* extract. F + AH2: Fructose-drinking group treated with 200 mg/kg b.w. of *A. herba-alba* extract . F + AH3: Fructose-drinking group treated with 400 mg/kg b.w. of *A. herba-alba* extract. F + MT: Fructose-drinking group treated with 300 mg/kg b.w. of the Metformin (the positive control). *A. herba-alba* extract was administrated to treated groups by gavage for the last six weeks of the experiment.
The results: Liquid fructose (10% w/v) intake did not vary total animal body weight, whereas, it produced moderate hyperglycemia associated with metabolic and histological alterations. Treating MetS rats with *A. herba-alba* extract improved insulin sensitivity, alleviated atherogenic dyslipidemia, and decreased lipid deposition in their hepatic tissues. Additionally, *A. herba-alba* extract was found to raise GSH level and antioxidant enzymes (GPx, GST, and CAT) activities in rat livers homogenates. The results here reported demonstrated, for the first time, that *A. herba-alba* have therapeutic proprieties against fructose-induced MetS in rodent model.

Sekiou *et al.*, 2018. Mitigating effects of antioxidant properties of *Artemisia herba alba* aqueous extract on hyperlipidemia and oxidative damage in alloxan-induced diabetic rats:

Abstract

The aim of this study is to investigate the antidiabetic, anti-hyperlipidemic, and antioxidant activities of *Artemisia herba alba* aqueous extract leaf in alloxan-induced diabetic rats.

Materials and Methods: The aerial part of *Artemisia herba alba* from Djebel Ettarf, Oum el-Bouaghi, Algeria was collected in April 2016. The *Artemisia herba alba* aqueous extract (AHA) was prepared by the maceration and was extracted by filtration by filter paper (Whatman No. 1). The mixture was then removed from the filtrate by evaporation at (40 °C) in an oven, allowing to obtain a freeze-dried residue in which the overall mass is 56.35 g. The obtained residue was stored at (4 °C). The

flavonoid assay was based on a colorimetric test using the AlCl3 method and the phenolic content was determined by Folin–Ciocalteu test. The rats were randomly divided into four groups of seven animals each: Group I: normal control (NC) received saline solution at9% given by intraperitoneal way. Group II: Diabetic control (DC) was treated with 150 mg alloxane/[kg body weight (b.w.)] administered by intraperitoneal way. Group III: NC + AHA have received saline solution and treated with 400 mg AHA/(kg b.w). Group IV: DC + AHA were treated with alloxane and AHA.

The results obtained was shown that alloxan induces perturbations of the antioxidant defense system with an oxidative stress state. However, the *Artemisia herba alba* aqueous extract was proven to be effective to fight this epidemic. Additionally, the aqueous extract of *Artemisia herba alba* was found to have important antioxidant properties, allowing it to reduce the harmful effects of free radicals that are highly generated during diabetes. Hence, it can be concluded that the aqueous extract of *Artemisia herba alba* has hypoglycemic, hypolipidemic, and antioxidant properties.

Sekiou *et al.*, 2020. Nephroprotective effect of *Artemisia herba alba* aqueous extract in alloxan-induced diabetic rats:

Abstract

The objective of this study was to evaluate the inflfluence of the alloxan administration on metabolic and renal changes associated with oxidative stress. In this research, the main assumption was that the renal and metabolic alterations induced by alloxan could be moderated by supplementation of *Artemisia herba-alba* aqueous extract.

Material and methods: Wistar rats were divided into four groups of seven rats each: Group I: Normal control received saline solution at 9‰ given by intraperitoneal way; Group II: Diabetic control received alloxan (150 mg/kg b.w) intraperitoneally; Group III: Normal control received saline solution at 9‰ and treated orally by *Artemisia herba-alba* aqueous extract (400 mg/kg/b.w); Group IV: Diabetic control received alloxan solution (150 mg/kg b.w) intraperitoneally and treated by aqueous extract of *Artemisia herba-alba* (400 mg/kg/b.w/day) orally after one week of alloxan administration. After 30 days, blood and tissue samples were collected for biochemical and histopathological analysis, respectively. Glomerular damage markers, including creatinine, serum urea, urine creatinine and urine urea levels were estimated.

Creatinine clearance was also assessed. Oxidative stress parameters were assessed in the kidney homogenate.

Results and conclusion: Alloxan-exposure resulted in significant increase in blood glucose and serum level of glomerular damage markers. The antioxidant enzyme activities were significantly downregulated associated with an increase in malondialdehyde level over the baseline values. *Artemisia herba alba* aqueous extract supplementation significantly improved the studied parameters. In concluding, the results obtained suggests that *Artemisia herbs-alba* aqueous extract supplementation reduces alloxan-induced free radical generation, potentiates the antioxidant defense system and alleviates renal sensitivity to oxidative stress.

Sidaoui *et al.*, 2018. Pathogenicity and biological control of Bayoud disease by Trichoderma longibrachiatum and *Artemisia herba alba* essential oil:

Abstract

The objective of this work is to study the pathogenicity of *Fusarium oxysporum* f. sp. *albedinis* (Foa) collected in different regions of southern Algeria, using two methods of biological control, firstly by its interaction with the antagonist *T. longibrachiatum* and secondly by application of *Artemisia herba-alba* essential oil and checking their potential inhibitory effect.

Materials and Methods: The 23 isolates of pathogenic fungi and antagonism used in this study were isolated 20 isolates from the spine were taken at the average crown of palms showing symptoms of Bayoud, and three isolates of *Fusarium sp*. The essential oil was extracted by hydrodistillation of the aerial parts of *Artemisia herba alba*, collected from the locality of Bouilef in Batna province, east of Algeria. Seeds of dates Deglet Nour variety from Biskra and Ghardaïa were sterilized and were placed in Petri dishes glass, padded with cotton, soused with sterile distilled water, and placed in a stove at 38°C for two days, after, the temperature was lowered to 28°C for one to two weeks. Germinated seeds were transferred in transparent bags containing sterile mold and placed in a greenhouse under uncontrolled conditions. Inoculation was carried out after three months at the two-leaf stage and was used 25 seedlings for each isolate. Antagonism between Foa and *T. longibrachiatum* was studied by deposited two opposite explants of 0.5 cm diameter disc of the pathogen and the *T.longibrachiatum* in Petri dishes containing 15 ml of PSA medium. The controls are constituted only by the pathogen. The distance between discs was approximately six

cm. Antifungal activity of *Artemisia herba-alba* essential oil was determined by the Minimum Inhibitory Concentration (MIC) and the Minimum Fungicidal Concentration (MFC).

The results showed the aggressiveness of Foa against date palm seedlings, with varying mortality rates; and this explains the absence of correlation between the geographical origin and the pathogenicity of the isolates. In vitro, antagonistic effect of Trichoderma longibrachiatum against three isolates of Foa revealed that the latest has inhibited mycelial growth of the pathogen by more than 60%, compared to the control and this after an incubation period of six days at 27 ±2°C. Biological control with essential oil of *Artemisia herba-alba* yielded important results with a minimum inhibitory concentration (MIC) ranging from 2.5 to 5 µl/ml and a minimum fungicidal concentration (MFC) of 80 µl/ml.

1.2. Theses:

Mansour, 2015. Evaluation de l'effet anti inffammatoire de trois plantes médicinales : *Artemisia absinthium L.* , *Artemisia herba-alba Asso* et *Hypericum scarboides* . étude in vivo:

Abstract

The objective of this study is to evaluate the anti-inflammatory effect of three medicinal plants: *Artemisia absinthium L.*, *Artemisia herba-alba Asso*, and *Hypericum scarboides*.

Materials and methods: The anti-inflammatory activity was tested of the aqueous leaf extracts of 2 species of Artemisia (*A.absinthium* and *A. herba alba*) and methanol extracts of Hypericum scarbroid aerial parts in mice weighting 25±5g. The aqueous extract of *Artemisia absinthium* leaves, the aqueous extract of *Artemisia herba allba* leaves and the ethanolic extract of *Hypercum scarboides* by testing their toxicity at doses of 150 and 300 and 200 mg/kg body weight, respectively, and diclofenac (50 mg/kg), in oral administration on the model of acute edema of the mouse's paw induced by carrageenan. The mouse-paw volume was measured each hour for 6 hours, after injection of carrageenin. In the control group, the carrageenin increases the development of edema of the mouse-paw.

The results: The Diclofenac (50 mg/kg), paw volume was reduced significantly until 2,24 ± 0,49% at the 6th hour. At a dose of 150 mg/kg of body weight, the aqueous

extracts of *A. absinthium* and the aqueous extracts of *A. herba alba* inhibited significantly the development of edema specially after 6 hours (4,02±0,49% and 1,08±0,47 %, on *A.absinthium* group and *A. herba alba* group, respectively). Similar results were observed with the aqueous extract of *A. absinthium* and the aqueous extracts of *A.herba alba* at the dose of 300 mg/kg of body weight. The methanol extract of aerial parts of *Hypericum scarbroides* in a dose of 200 mg/kg showed significant antiinflammatory activity (78,03±15,54% and 40,44±16,36) at 1 and 3h post medication, respectively. In diclofenac models treated animals at (50 mg/kg) this activity was by 31 ±11,52, 0,80±0,09 and 9,39±1,99 % at 1, 3 and 6h, respectively, when compared to control group. Histological examination of sections treated by diclofenac and aqueous extract of *Artemisia absinthium* and *Artemisia herba alba* (150 and 300 mg/kg bw) confirms that these treatments have anti-inflammatory activity. In addition, at the dose of 300 mg/kg bw, the inflammatory infiltrate disappears almost completely. The chemical composition of *Hypericum scarboides* reveals the presence of hyperoside and isoquercitrin. Moreover, the test of the anti-inflammatory activity shows a percentage of inhibition of inflammatory edema reduced after treatment with the ethanolic extract of *H. scabroides* (200 mg/kg bw). The obtained results of the present investigation revealed that the aqueous leaf extracts of the two species of Artemisia (*A.absinthium* and *A. herba alba*) and the methanol extract of *Hypericum scarbroides* have significant anti-inflammatory activity.

Messai, 2015. Utilisation de l'armoise et de l'eau de riz en traitement adjuvant de la coccidioe chez le poulet de chair:

Abstract

The aim of this study is to demonstrate the anticoccidial effect of *Artemisia herba-alba* Asso, and antidiarrheal-rehydrating rice water during a cecal coccidian infection with *Eimeria tenella*.

Materials and methods: The aerial parts of *Artemisia herba alba* were harvested in April, May, and June 2011 from the T'Kout region (commune of the Aurès in the Wilaya of Batna, located 95 km southeast of Batna and 71 km northwest of the Wilaya of Biskra). After drying in the shade for 07 days, the aerial parts were finely cut (1 to 1.5mm) using a chisel to be mixed with the feed. The dried aerial parts of the white wormwood were incorporated at the rate of 5% in the feed distributed to the lots

concerned. The rice water was prepared by the boil of 50g of polished rice in 1 liter of water for 15 minutes. After cooling, it is added 2 liters of water.

The results: The incorporation of the plant in the diet (5%) has prevented mortality, reduced shedding oocysts, reduced severity of *Eimeria tenella* lesions, and prevented the collapse of hematological and biochemical parameters (hematocrit, hemoglobin rate) during experimental infection with Eimeria tenella. A direct result of the infestation is the appearance of severe diarrhea, bleeding in the case of *Eimeria tenella*, causing marked homeostatic and nutritional disturbances. Rice water, widely used for its antidiarrheal properties, has been used as adjuvant therapy in this coccidial infection. In combination with anticoccidials, it improved growth performance in the treated animals, improve lesion score, and also prevented the collapse of hematological and biochemical parameters. *Artemisia herba alba* Asso, with its anticoccidial effects, and rice water with its antidiarrheal and moisturizing effects deserve to be the subject of further studies to better exploit their properties.

1.3. Summary of results:

Ethnobotany and ethnopharmacological surveys were conducted on the plants used in traditional medicine from different regions in Algeria during the last two decades, especially in the last ten years by conducted investigations with the inhabitants of these areas regarded medicinal plants and how they were used (**Kalifa *et al.*, 2020; Miara *et al.*, 2018; Ouelbani *et al.*, 2016**)

Traditional herbal medicines are still very much used in Algeria. The results suggested the central and peripheral analgesic properties and confirmed the folkloric medicinal use of these plants in pain symptoms.

The Asteraceae family was the most common family, *Artemisia herba alba* (white wormwood) is one of the most used plants in this family. it was used in traditional treatment especially in diabetes.

Anti-diabetes properties of *Artemisia herba alba* were carried by many studies (**Boudjelal *et al.*, 2015; Hamza *et al.*, 2010, 2015**), the results showed good therapeutic ability for this plant.

The results of these researches may form the database of the national medicinal flora and support research in phytochemistry and pharmacology to discover new drugs and approve ethnomedicinal knowledge.

2. Kariological and cytogenetic studies:

Karyological and cytogenetic data are fundamental for characterising genome organisation, which is key for systematic, evolutionary, and conservation approaches to plant studies (**Levin, 2002)**.

We found in this field five (5) scientific works; Tow (2) Theses, Three (3) Articles where represent 4% of the total.

2.1. Articles:

Bougoutaia *et al.*, 2014. Etude caryologique et moléculaire de deux population algérienne d'*Artemisia herba alba* Asso. (Astraceae):

Abstract

This study is aimed at Caryological and molecular characterization of *Artemisia herba-alba* Asso. (Asteraceae) from two Algerian localities.

Materials and methods: The samples were collected in February 2013 in the Taadmit and Oued Sedar areas of the Algerian semi-arid steppe.was made the chromosomal enumeration after the preparation of the samples by the photonic microscope at 100x magnifications.DNA extraction was performed using the CTAB method plus some modifications.

Results: Chromosomal enumeration performed on both populations revealed a chromosomal number 2n = 36. The analysis of the genetic material by the use of the ISSR genetic marker carried out on 18 individuals of the origin of Oued Sedar indicates that the species is characterized by a significant molecular polymorphism.

Bougoutaia *et al.*, 2016. Genome size, chromosome number, and rDNA organisation in Algerian population of *Artemisia herba alba* (Asteraceae), a basic plant for animal feeding facing overgrazing erosing:

Abstract

The objective of this study is to perform a karyological and cytogenetic investigation of a representative set of Algerian populations of *Artemisia herba alba*, to provide a comprehensive picture of its genome organization, which could serve as the basis for further genetic studies and for the conservation and management of this species.

Materials and Methods: A karyological study based on 22 populations together with a cytogenetic characterization of Algerian *Artemisia herba alba* has been performed for the first time, through genome size and chromosome number determination. Fluorescence in situ hybridization (FISH) was also used to assess the rDNA loci number and distribution in the two ploidy levels detected.

Results: The studied accessions are diploid ($2n = 2x = 18$ chromosomes, 6 populations) or tetraploid ($2n = 4x = 36$ chromosomes, 15 populations). One population, occupying a more or less central geographic position among the studied area, presented both cytotypes. Genome size reflects well the two ploidy levels, with no evidence of downsizing with polyploidy. The karyotypes are rather symmetric (2A Stebbins' class). FISH analyses detected four signals (2 loci) in diploid and eight signals (4 loci) in tetraploid cytotypes for both ribosomal DNA genes, which present an L-type (linked) organisation, i.e. with loci from both rDNA genes colocalised.

The presence of two ploidy levels suggests a genomic dynamism and even a possible differentiation underlying the morphological uniformity and despite of the dramatic decrease experienced by this plant in Algeria in terms of surface coverage.

Bougoutaia *et al.*, 2020. Phylogeographical and cytogeographical history of *Artemisia herba alba* (Asteraceae) in the Iberian Peninsula and North Africa: mirrored intricate patterns on both sides of the Mediterranean Sea:

Abstract

The aim of this study is to obtain a deeper and detailed knowledge of the natural history of *Artemisia herba alba* as a key species of dry steppes from the Iberian Peninsula and North Africa and that's by applying a multidisciplinary approach combining spatial genetic and cytogenetic analyses with ENM.

Materials and Methods: Forty populations of *Artemisia herba alba* were sampled, covering the main distribution range of the species on the Iberian Peninsula (12 populations) and in North Africa (28 populations). Leaf material from five to ten plants per population was collected and stored fresh for genome size assessment by flow cytometry and dried in silica gel for DNA sequencing procedures. Species

distribution modeling was performed under present and past climatic scenarios, and calculated environmental differences between cytotypes.

Results: Sequencing data indicate a complex phylogeographical structure showing similar haplotype diversity patterns on both sides of the Strait of Gibraltar and no clear signals of genetic refugia. According to cytogeographical results, were inferred multiple polyploidization events, which probably took place on the Iberian Peninsula and in North Africa independently. Environmental niche modeling suggested stable potential distributions of *Artemisia herba alba* on both sides of the Mediterranean Sea under present and past Last Glacial Maximum conditions, which could be related to the intricate spatial genetic and cytogenetic patterns shown by the species. Finally, environmental modeling comparison among cytotypes revealed that the niche of tetraploids is narrower and nested in that of diploids, a result that could indicate environmental specialization and could potentially explain recurrent establishment success of tetraploids.

2.2. Theses:

Abderrabi, 2018. Etude de la variabilité génétique et de potentialité d'adaptation chez *Artemisia herba alba* dans la steppe de l'ouest algérien:

Abstract

The aim of this work is to study the genetic variability characterizing the white wormwood (*Artemisia herba-alba*) and its relation with the distribution and the adaptation of the species, as well as an estimation of the rates of variations of this variability in connection with variations of the medium.

Materials and methods: The study was based on an anatomical characterization of the leaf and its relation with certain morphological, micro-morphological, and genetic parameters in populations of white wormwood (*Artemisia herba-alba Asso*) from the two regions of western Algeria. (Tiaret, Sidi Bel Abbes).

The results obtained showed that this species is defined by a high level of polymorphism linked to the morphological, quantitative, and qualitative parameters of the cauline and reproductive parts. The results indicated that this species and in these areas is characterized by a large variability of the structure of the leaf and is distinguished by the presence of water parenchyma. The increase in the thickness of this parenchyma of the water reserve favors the abundance of the chlorophyll

parenchyma, the increase of the density of the stomata, and the reduction of the aerial vegetative mass.

Bougoutaia, 2018. Etude du complexe *Artemisia herba-alba* Asso d'algérie par des approches phuridisciplimaires cytogénétique classique , cytogénétique moléculaire ,phylogénie et phylogéographie:

Abstract

The aim of this thesis work is to procedure a genetic characterization by classical and molecular cytogenetic approaches and phylogeny and phylogeography of different populations of *Artemisia herba-alba* (white wormwood) covering the whole range of this taxon in Algeria.

At the end of this study, two chromosome numbers 2n = 2x = 18 and 2n = 4x = 36 in the Algerian white wormwood species were revealed, with the coexistence of two cytotypes in the same population in two populations, occupying a more or less central geographic position in the study area. The diploid cytotype 2*n* = 2*x* = 18 was detected for the first time in Algeria. Four signals (2 *loci*) were detected by FISH in diploid cytotypes and eight (4 *loci*) in tetraploid cytotypes for both ribosomal DNA genes. Both genes are colocalized on the same chromosomal site, and therefore have an L (linked) organization. The genome size reflects both ploidy levels, with a relative reduction of nuclear DNA amount in the polyploid cytotypes. The minimum temperature of January "tm" seems to be the determining factor in the spatial distribution of the two cytotypes. The phylogenetic and phylogeographic studies using cpDNA sequences in 17 populations of *Artemisia herba-alba* showed a low level of genetic diversity. However, there is enough variation on the cpDNA for a phylogeographic signal to be detected. The Central-East region was the most diverse. The origin of *Artemisia herba-alba* in Hoggar is probably derived from populations in the southern boundary of the study area through late Miocene biological corridors between Mediterranean and central Saharan ecosystems. The mountains of the Central Sahara have thus become crucial biogeographic refuges for this taxon.

2.3. Summary of results:

Karyological and cytogenetic studies of *Artemisia herba alba* were few, compared to other studies; which included five studies (**Bougoutaia *et al*.(2014, 2016, 2020); Abderrabi, 2018; Bougoutaia, 2018**).

Among the objectives of these studies are to perform a karyological and cytogenetic investigation of a representative set of Algerian populations of *Artemisia herba alba*, to provide a comprehensive picture of its genome organization, and to obtain a deeper and detailed knowledge of the natural history of *Artemisia herba alba* as a key species of dry steppes from the Iberian Peninsula and North Africa and that's by applying a multidisciplinary approach combining spatial genetic and cytogenetic analyses with ENM.

Chromosomal enumeration revealed a chromosomal number 2n = 36. The analysis of the genetic material by the use of the ISSR genetic marker carried out on 18 individuals of the origin of Oued Sedar indicates that the species is characterized by a significant molecular polymorphism (**Bougoutaia *et al.*, 2014**).

The results showed that the studied accessions are diploid (2n = 2x = 18 chromosomes, 6 populations) or tetraploid (2n = 4x = 36 chromosomes, 15 populations). One population, occupying a more or less central geographic position among the studied area, presented both cytotypes. Genome size reflects well the two ploidy levels, with no evidence of downsizing with polyploidy. The karyotypes are rather symmetric (2A Stebbins' class). FISH analyses detected four signals (2 loci) in diploid and eight signals (4 loci) in tetraploid cytotypes for both ribosomal DNA genes, which present an L-type (linked) organisation, i.e. with loci from both rDNA genes colocalised.
The presence of two ploidy levels suggests a genomic dynamism and even a possible differentiation underlying the morphological uniformity and despite of the dramatic decrease experienced by this plant in Algeria in terms of surface coverage.

3. Phytochemistry studies:

Phytochemistry is defined as the science responsible for the study of the compounds contained in plants. The study of such compounds includes their chemical structures, metabolism (biosynthesis and degradation), natural distribution, biological function,

extraction, and qualitative-quantitative evaluation **(Mendoza & Escamilla-Silva, 2018).**

We found in this field sixty-four scientific works; 16 Theses, 41 Articles, 8 Magister Memoirs, where represent 57% of the total.

3.1. Articles:

Agouillal *et al.*, 2018. Coupling Ultrasound with Enzyme- Assisted Extraction of Essential Oil from Algerian *Artemisia herba alba* Asso.:

Abstract

In considering the large use of *Artemisia herba alba Asso,* The aim of this work intended to enrich data about coupling ultrasound with enzymatic technologies prior to the Essential Oil extraction and the effect on its composition and bioactivities.

Materials and Methods: the composition of the essetial oil (EO) of *Artemisia herba alba Asso*, extracted by Hydro-Distillation (HD) and by coupling Ultrasound with Enzyme-Assisted Extraction (UE-AE) prior to HD from the plant's aerial parts were analyzed by GC-MS. Antimicrobial activities were determined by disc diffusion method. The evaluation of in vitro antioxidant activity of HD-EO and UE-EO was carried out by the 2,2-Diphenyl-1-picrylhydazyl (DPPH) free radical scavenging assay.

Results: Antibacterial, antifungal and antioxidant of the obtained EOs were evaluated. The yield of EO extraction after pretreatment of the wormwood leaves by coupling ultrasound with enzymes was in the range of 1.56% ± 0.07 compared to 1.01% ± 0.08 in HD process; also, the total time necessary to complete EO extraction is 180 min for HD and 120 min for UE-AE. GC-MS profiling of the EOs showed changes in chemo type obtained by HD from camphor/ 1.8-cineole/ α-thujone/ chrysamthenone to a new chemotype in the case of UE-AE: camphor/ α-thujone/ 1.8-cineole/ filifolone. Then, an increasing of filifolone, α-thujone, 3-octyne and cis-limonene oxide characterize the UE-EO. The antifungal activity of the EO has slightly increased when extrated by UE-AE, however, both antibacterial and antioxidant activities were interestingly increased.

Amraoui *et al.*, 2015. Contrôle de l'activité antifongique d'huiles essentielle d'*Artemisia herba alba* sur quelques moisissures d'altération les graines des céréales:

Abstract

The objective of the study is to evaluate the antifungal activity of essential oil of the aromatic plant *Artemisia Herba alba*.

Materials and methods: Essential oil extraction was carried out by hydro-distillation. The tested plant gives an essential oil yield of 1.05%. The oil in different concentrations (0.05%, 0.25%, 0.5%) were added to the PDA medium and then poured into petri dishes. Each of them is inoculated using a mycelial explant about 9 mm in diameter, from a fungus culture, one week old.

The efficacy of each concentration studied is estimated by calculating the percentage of growth inhibition of four *Fusarium* species, tested with a minimum CMI inhibitor concentration of 0.25% for three strains. The MIC of *F.langsethiae* is 0.05%.

The results of the use of essential oils of *Artemisia herba alba* show good antifungal activity and acceptable results in stopping the development of the pathogen.

Arabia *et al.*, 2017. Antimicrobial activity of aqueous extracts from four plants on bacterial isolates from periodontitis patients:

Abstract

The aim of this study was to investigate current natural products that are non-toxic or with a low toxicity in order to develop phytotherapy as an alternative method in oral medicine. This work also compares bactericidal effects of these plant extracts to those obtained from known antibiotics in the same conditions experimented in vitro.

Materials and Methods: Four aqueous extracts were extracted for different plants: *Artemisia herba-alba*, *Opuntia ficus-indica*, *Camellia sinensis* and *Phlomis crinita*. the extracts were evaluated againsttwo bacterial strains: *Porphyromonas gingivalis* and *Prevotella intermedia*, which are implicated in periodontal diseases. The disc and agar diffusion methods were used to investigate the antibacterial activity of plants extracts.

Results: These plant extracts demonstrated powerful bacterial activity against these Gram-negative strains.The minimum inhibitory concentration values of the four plant extracts varied between 0.03 and 590.82 mg/ml for the microbes. Another assay using

commercial antibiotics and antibacterials as positive controls was also conducted. Values obtained after statistical analysis of inhibition diameters of all plant extracts demonstrated that for *P. gingivalis*, the aqueous extracts of *A. herba-alba* and *O. ficus-indica* were most effective, followed by those of *C. sinensis* and *P. crinita*. For *P. intermedia*, aqueous extractsof *O. ficus-indica* and *C. sinensis* appeared to be more efficient with significantly different ($P > 0.05$) inhibition diameters, followed by those of *O. ficus-indica* and *P. crinita*. Conclusion: The studied plant extracts are powerful compared to synthetic antibiotics, these natural products are a little toxic or non-toxic and can be used in the long-term treatment.

Begaa & Messaoudi, 2018. Toxicological Aspect of some sclected medicinal plant samples collected from Djelfa, Algeria Region:

Abstract

The aim of this work is to contribute by using nuclear analytical techniques, to determine concentrations of some toxic chemical elements (As, Br, Ce, Co, Cr, and Sb) in eight aromatic plants that are largely used in traditional Algerian medicine such as *Artemisia herba-alba Asso*., *Artemisia compestris L*., *Laurus nobilis L*., *Origanum vulgare L*., *Mentha spicata L*., *Rosmarinus officinalis L*., *Mentha pulegium L*., and *Pistacia lentiscus L.*. The selection of plants studied for this work corresponds perfectly to the scientific needs because these samples are widely used by the Algerian population in their health treatments.

Materials and Methods: The plant samples were collected during the year 2012 from the steppe zone of Djelfa province ,Algeria. The samples were washed , were dried for 3 weeks at room temperature, then were ground to a fine powder; three samples of each plant weighing about 120 mg were stored in precleaned polyethylene capped bottles. Instrumental neutron activation analysis (INAA) method was used to determine the concentration of six toxic chemical elements (As, Br, Ce, Co, Cr, and Sb) on the samples.

Results: The levels of toxic elements were compared to their daily total intake; Arsenic was present in all plant species examined, with a concentration ranging from 0.18 to 5.44 μg/g . Bromine was also detected in all the medicinal plant species, with high concentrations, compared to arsenic except in the case of Laurus nobilis that has the highest concentration of arsenic. Cerium, cobalt, chromium, and antimony were presented in all plant species. The exactitude of the results was assessed by analyzing

the certified reference material of SRM-NIST 1573a and CRM GB07605 (GSV4). These data analysis for this medicinal plants can be useful for therapeutics and pharmaceutical purposes.

Begaa *et al.*, 2020. Statistical approach and neutron activation analysis for determining essential and toxic elements in two kinds of Algerian:

Abstract

The aims of this study are to investigate and evaluate both essential and toxic chemical elements presented in *Artemisia campestris L.* and *Artemisia herba-alba.*

Materials and Methods: Two types of Artemisia plant, *A. campestris L*. and *A. herba alba Asso*., were collected in June 2013 from different locations in Djelfa province, Algeria. The samples were washed, were dried for 3 weeks at room temperature, then were ground to a fine powder, and were stored in precleaned polyethylene capped bottles. The samples were subjected to an instrumental neutron activation analysis (INAA) in order to determine their essential and toxic elements.

The results: Twenty-one chemical elements were identified , these elements could be divided into three main groups: essential chemical element group includes K, Ca, Fe, Na, Co, and Cr; non-essential chemical element group includes La, Sm, Ba, Ce, Cs, Eu, Hf, Rb, Sc, Sr, and Yb; and, last, the potential toxic elements group contained Br > As > Sb which presented in a descending content pattern. On the other hand, the tolerable daily intake (TDI) of the studied plants for an adult person per day was within the tolerance limits imposed by the World Health Organization (WHO). Hence, these findings might therefore be used to offer scientific basis for an optimum usage of the studied plants and so enriches the database of medicinal herbs.

Belhattab *et al.*, 2012. Essential oil from *Artemisia herba alba Asso* grown wild in Algeria: variability assessment and comparison with an update literature survey:

Abstract

The aim of this study is to evaluate the chemical composition of the essential oils isolated from *A. herba-alba* collected at different locations in Algeria and to compare these data with an updated survey on the chemical variability of this species essential oils.

Materials and Methods: The aerial parts of *A. herba-alba* were collected during the flowering (July, 2008) and vegetative phase of the plant (October and November,

2008) at different localities in Algeria (Benifouda; Bougaa; Boussaada and Boutaleb). Plant material was dried in the dark, at room temperature. The essential oils of *A. herba-alba* were isolated by hydrodistillation, using a Clevenger-type apparatus and were analyzed by GC/MS techniques.

The results: The essential oils yield ranged between 0.2% and 0.9% (v/d.w.). Fifty components were identifified in *A. herba-alba* oils. Monoterpenes (78–89%) and particularly oxygen-containing monoterpenes (72–80%) dominated all oils. Sesquiterpenes ranged from 2–11%. Camphor (17–33%), α-Thujone (7–28%) and chrysanthenone (4–19%) were the major oil components. Despite the similarity in main components, three types of oils could be defifined, (a) α-Thujone ; camphor (23–28;17–28% from Bougaa and Boussaada plants oils), (b) camphor ; chrysanthenone (33;12% from Benifouda plant oil) and (c) α-Thujone ; camphor ; chrysanthenone (24;19;19% from Boutaleb plant oil). The chemical variability of essential oils from Algerian *A. herba-alba* emphasizes the importance of evaluating individual plant samples.

Benarab *et al.*, 2020. Allelopathic activity of essential oil extracts from *Artemisia herba alba* Asso. On seed and seedling germination of weed and wheat crops:

Abstract

The aim of this research is the assessment of the effect of allelopathic potential of essential oil extracts from *Artemisia herba-alba Asso*., on seed germination of some weed species and two Algerian wheat varieties.

Materials and Methods: The Aerial parts (leaves and flower) of *A. herba-alba*, were collected in May 2016 from El-Rasfa region in Setif, Algeria. All plant material was air-dried in shade at room temperature for 15 days and then were subjected to hydrodistillation, using Clevenger type apparatus. The obtained essential oils were preserved in sealed vials at 4°C. Oil yield was calculated (w/w) on the basis of the total amount of fresh plant material. The extracted essential oil was used in the analysis of its composition by chromatography. Mature seeds from adult weed plants and seeds from Algerian wheat were collected from Sétif. After collection, seeds were cleaned, kept in paper bags, and dry-stored at room temperature until germination tests were performed. The solutions of essential oil dissolved in distilled ethanol were prepared at four concentration levels and control (0.2, 0.4, 0.6, and 0.8 µl/1ml of oil/ethanol). Seeds surfaces were sterilized, and ten disinfected seeds were placed into

each petri dish. One milliliter of each solution was added to each dish and then left 15 minutes for ethanol evaporation. Five milliliters of distilled water were also added to each dish and kept in darkness in an incubator at 25°C±1°C. All the dishes were sealed with parafilm to avoid evaporation. After a period of 8 days, the percentage of germination was calculated and early seedling growth was measured.

The results: The yield obtained is 1.19%, and 36 compounds had been identified. The main components are: camphor (28.58%), cis-thujone (22.03%), eucalyptol (11.65%) and trans-thujone (7.03%). The results of bioassays show that essential oil extracts have a significant effect on seed germination and seedling growth of the major weed tested and two wheat varieties. In conclusion, this study shows that *Artemisia herba-alba Asso*. the essential oil tested has an interesting allelopathic potential.

Benmeddour *et al.*, 2019. Chemical composition and antifungal activity of the essential oils of Algerian *Vitex agnus-castus* and *Artemisia herba alba*:

Abstract

This study aims to compare the chemical composition of essential oils of two plants harvested in the northern Algerian Sahara *Vitex agnus-castus* and *Artemisia herba alba* and determine the components possessing antifungal properties.

Materials and Methods: Aerial parts of the two plants were collected at the flowering stage in 2012 from Biskra, Algeria. The essential oils were extracted by steam distillation method (for 5 h) using a Clevenger apparatus and were analyzed by GC and GC/MS techniques. The antifungal activity was tested against two pathogenic fungi *Aspergillus niger* and *Scedosporium apiospermum* and was evaluated by measuring the mycelial radial growth diameters on PDA medium and by calculating fungal inhibition rate compared to the control.

The results: The oil yield obtained from *V. agnus-castus* is low (0.68%) compared to that of *A. herba-alba* (1.93%). The main components of essential oils were 1,8-Cineole (17.54%), γ-Elemene (10.47%) and α-Pinene (9.03%) in *V. agnus-castus* and α-Thujone (20.36%), Verbenone (9.40%) and β-Thujone (7.60%) in *A. herba-alba*. The effect on the tow mold species is manifested by a delay in growth. Both oils showed high inhibition rates on *S. apiospermum* especially that of *Artemisia herba alba.*

Benmenine *et al.*, 2018. Essential Oil Extrat of *Artemisia herba alba* as Green Inhibitor against the corrosion of X52 steel in 20% sulfuric Acid Medium:

Abstract

Aim of the study: The present work concerns the study of corrosion rate of X52 steel using Tafel curves obtained in acid medium (H2SO4 20%) in the presence and absence of extracts of *Artemisia herba alba*.

Materials and methods: *Artemisia herba-alba* was collected in the region of Ouargla in July 2016. The essential oil extract was obtained by hydro-distillation using a Clevenger apparatus. Aggressive solutions were prepared (H2SO4 20%) by dilution of a stock solution of sulfuric acid (98%, 1.18). A typical three-electrodes cell with a working electrode made up of carbon steel X52 with an active surface of 1 cm² was used. The auxiliary electrode was a platinum plate (1 cm²) and the reference electrode was represented by a saturated calomel electrode (SCE). Potentiodynamic polarization curves were obtained with the scan rate of 0.5 mV s-1, in the potential range of -750 to -200 mV. The immersion time of the X52 plates in the blank as well as in the presence of different concentrations of essential oil of *Artemisia herba-alba* was 40 minutes in open circuit at room temperature. The temperature was thermostatically maintained at 25 °C. Oxygen was removed from the corrosive medium by bubbling nitrogen for 2 min before each measurement.

The results indicated that the inhibition efficiency increases with increasing extract concentration. Tafel curve analysis showed that the inhibition rate was around 98.29%. The *Artemisia herba alba* plant seems to be a good corrosion inhibitor of cathodic type based on the obtained results.

Benyoucef *et al.*, 2018. Synergistic Antioxidant activity and chemical composition of essential oils from *Thymus fontanesii* , *Artemisia herba alba* and *Rosmarinus officinalis*,:

Abstract

The aim of the present study was (1) to determine the chemical composition of the essential oils of *Thymus fontanesii* , *Artemisia herba alba*, and *Rosmarinus officinalis*, (2) to evaluate the antioxidant power of each essential oil by DPPH and FRAP assays, and (3) to investigate the possible synergistic impacts of the combination of three essential oils.

Materials and Methods: Aerial parts of *T. fontanesii*, *A. herba-alba*, and *R. officinalis* were collected at the flowering stage from May to June 2017. Essential oils were obtained from fresh material (300-400 g) by hydrodistillation for 5 hours using a Clevenger-type apparatus with yields (w/w) of 3.7% for *T. fontanesii*, 0,7% for *A. herba-alba* and 0.4% for *R. officinalis*. Essential oils were analyzed by gas chromatography (GC) and gas chromatography-mass spectrometry (GC/MS). The antioxidant properties were evaluated using two different methods, α, α-diphenyl-β-picrylhydrazyl (DPPH) radical scavenging activity and ferric reducing antioxidant power (FRAP).

The results: GC–FID and GC–MS analysis of *T. fontanesii*, *A. herba alba*, and *R. officinalis* oils accounted for 99.3%, 93.4%, and 91.1% of oils, respectively, and allowed the identification of 31, 20, and 19 components, respectively. The essential oil of *T. fontanesii* was dominated principally by monoterpenoid phenol (84.7%). The main components were thymol (76.6%) and p-cymene (7.4%). The constituents identified of *R. officinalis* and *A. herba-alba* essential oils were oxygenated monoterpenes (80.2 and 65.9%, respectively), followed by monoterpene hydrocarbons (10.8 and 21.5%, respectively). The main components of *A. herba-alba* essential oil were camphor (32.3%), chrysanthenone (25.6%), 1,8-cineole (8.4%) and borneol (4.5%). While, *R. officinalis* essential oil was characterized by 1,8-cineole (18.3%), camphene (15.4%), α-pinene (12.8%), borneol (12.7%), verbenone (12.7%) and limonene (4.2%). *T. fontanesii* essential oil indicated the significantly highest activity in quenching of DPPH radical, followed by *R. officinalis* and *A. herba-alba* essential oils with IC50 of 13.7, 24.5, and 79.4 mg/L, respectively. The combination of *T. fontanesii*, *A. herba-alba*, and *R. officinalis* essential oils showed the greatest antioxidant activity with an IC50 of 2.6 mg/L almost equal to the synthetic antioxidant butylated hydroxytoluene (BHT). These results provide a new source of antioxidants that can be used as a natural food preservative and alternative to chemical synthetic preservatives.

Bertella *et al.*, 2018. *Artemisia herba alba* Asso. Essential oil anti bacterial activity and acute toxicity:

Abstract

The objective of the study is to search the chemical composition and the antibacterial activity of *Artemisia herba-alba* essential oil, and its acute toxicity by thedefinition of the median lethal dose (LD50).

Materials and Methods: plant material is aerial part of *Artemisia herba alba* Asso. were collected in October-November 2015 from a population located at bouilef in Batna province, east of Algeria. The essential oil extracted by the hydro-distillation method and isolated volatile compounds were analyzed by GC/MS, using a Shimadzu GC/MS-QP2010 ultra chromatographer. The antibacterial activity of *Artemisia herba alba* Asso. essential oil was preliminarily tested by disc diffusion method against 21 bacterial strains and the diffusion of active volatile components of essential oil was assessed by the micro atmosphere method. Acute toxicity (lethal dose 50) was tested on 100 NMR-I mice divided into 10 groups injected in different doses of Essential oil, the animals were placed under observation and symptoms of toxicity were noted. by the end of the experiment period, dead animals were counted to calculate the LD50 using the arithmetic method of Karber.

Results: The analysis of the essential oil by gas chromatography/mass spectrometry gave 19 different compound representing 98.3% of the total composition and the major constituent was camphor with an amount of 50.7%. A significant antibacterial effect was observed with important zones of inhibition against *Klebsiella oxytoca* (31.3 mm) by disc diffusion method and against *Acinetobacter baumannii* (47.6 mm) by microatmoshphere method. The minimum inhibitory concentration and the minimum bactericidal concentration values were ranging from 5 to 10 mg mL−1 and 10–20 mg mL−1 , respectively. The toxic median dose of the essential oil is 615 mg kg−1 . The results of this study were compared to those of similar studies and the results were consistent.

Bezza *et al.*, 2010. Composition chimique de l'huile essentielle d'*Artemisia herba alba* provenant de la région de Biskra (Algérie):

Abstract

The aim of this study is to investigate the chemical composition of the essential oil of *Artemisia herba-alba* from the region of Biskra (Algeria).

Materials and Methods: *Artemisia herba-alba* Asso plant was collected in October 2009 from Biskra, Algeria. Essential oil (EO) was extracted by hydrodistillation from aerial parts and was investigated using GC-FID and GC-MS techniques.

The results: The oil yield, based on dry weight, was 0.95% (v/w). Forty-six components corresponding to 92.61% of the oil were identified. The essential oil contained in the majority: cis-chrysanthenyl acetate (25.12%); (2E,3Z) 3,5-heptadienal-2-ethyliden-6-methyl (8.39%); α-thujone (7.85%); myrtenyl acetate (7.39%); verbenone (7.19%), chrysanthenone (4.98%).

Boukhennoufa *et al.*, 2020. Antifungal activity of Topical formulation containing *Artemisia herba alba* Asso. Essential oil:

Abstract

The aim of this study is the formulation of a hydrophobic ointment based on the use of essential oils of *Artemisia herba alba* as an active ingredient.

Materials and Methods: Preparation of an ointment based on *Artemisia herba alba Asso* essential oil (10%). The quality and the toxicity of the ointment was tested in five strains of *Candida albicans*. by numerous physical and microbiological tests. the determination of the antifungal activity of this preparation was assessed against five strains of *Candida albicans* (S1, S2, S3, S4, and S5) by the disk-diffusion agar method.

Results: The pH value was found equal to 5.98, this prevents the growth of germs promoting the degradation of its microbiological and organoleptic quality. A significant effect of the ointment was found against S1, S3, S4, and S5 strains Compared to the placebo formulation with the p value equal to 0.004. No significant effect of *Artemisia herba alba* Asso. ointment was observed compared to that of reference, nystatin against the tested strains (P= 0.66). However, the S2 strain was marked resistant to this ointment. The ointment formulated with essential oil from *Artemisia herba alba Asso* has proven useful against candidiasis caused by *Candida albicans* species.

Boukhennoufa *et al.*, 2020. Antioxidant activity of extracts formulated from *Citrus aurantium* and *Artemisia herba alba:*

Abstract

The aim of the present study is to evaluate the antioxidant activities of three organic and aqueous extracts, contained *Artemisia herba alba* and *Citrus aurantium* collected in North West of Algeria (Mascara province).

Materials and Methods: The three extracts were prepared from the aerial part of Artemisia herba alba, peel, and leaves of Citrus aurantium.The formulated extracts were analyzed by thin layer chromatography (TLC) and then confirmed by High performance liquid chromatography coupled with DAD detector (HPLC-DAD).The antioxidant activity of three extracts was evaluated by DPPH and ferric reducing antioxidant power methods.

The results showed the richness of these extracts in phenolic compounds. Three major compounds, resveratrol (17.98%), kaempferolglucoside (7.23%), and vanillic acid (10.64%) were detected in methanolic extract of *Citrus aurantium* peel, aqueous extract of *Citrus aurantium L.* leaves and ethanolic extract of *Artemisia herba alba Asso* respectively by HPLC-DAD. However, the ethanolic extract of *Artemisia herba alba Asso* achieved 50% of the anti-radical activity at a concentration equal to 0.8 mg/ml. A higher antioxidant activity measured by ferric reducing antioxidant power was marked in the same extract with an absorbance equal to 0.824. The ethanolic extract of the aerial part of *Artemisia herba alba* Asso, the methanolic extract of *Citrus aurantium* peel and the aqueous extract of *Citrus aurantium* leaves were considered as powerful scavengers of free radicals and can be incorporated into the pharmaceuticals preparations to treat many diseases.

Boukhennoufa *et al.*, 2019. Comparative study of *Artemisia herba alba* Asso. and *Citrus aurantium* Essential Oils:

Abstract

The aim of this study is to investigate the chemical composition of three essential oils by the gas chromatography coupled to mass spectrometry (GC/MS) and to improve their antifungal activities by disc diffusion method on Muller–Hinton agar.

Materials and Methods: The plant materials were *Artemisia herba alba* Asso. (aerial part) and *Citrus aurantium* (peel and leaves). These plants were collected in March 2015 from the west of Algeria. The extraction of the essential oil was carried out by the hydrodistillation process. The essential oils obtained were concentrated with a rotary evaporator and were dried with anhydrous sodium sulfate. Then, it was stored at 4°C until analysis. The essential oils obtained were analyzed by gas chromatography coupled to mass spectrometry. The antifungal activity of the essential oils was determined by the disc diffusion method on five clinical strains of *Candida albicans* (S1, S2, S3, S4, and S5) were isolated in the hospital laboratory of Mascara.

The results of chemical analysis revealed 40 constituents in *Artemisia* essential oil, where the major components were camphor (34.89%) and chrysantenone (19.60%). While, the main component of peel and leaves of *Citrus* essential oils was the Linalol (42.33%, 60.62%) respectively. The *Artemisia herba alba* Asso. essential oil was chosen for the study of antifungal activity. And it was selected among the other oils, according to its large content of chemical compounds, revealed by GC-MS. The present study showed that this essential oil was characterized by its important antifungal activity, against the five isolated clinical strains of *Candida albicans*.

Bouzeraa *et al.*, 2018. Evaluation of the insecticidal activity of *Artemisia herba alba* essential oil against *Plodia interpunctella* and *Ephestia kuehniella* (Lepidoptera, Pyralidae):

Abstract

The aim of the present study is to determine the insecticidal activity of *Artemisia herba alba* essential oil on the two stored food insects *Plodia interpunctella* and *Ephestia kuehniella*. This would lead to prior knowledge of the insecticidal activity of the essential oil against related insect species.

Materials and Methods: The larvae of *P. interpunctella* and *E. kuehniella* were collected from the infected durum and soft wheat flour stock, respectively, and were reared in the laboratory at 25°± 3 and 60±5% relative humidity. The essential oil of *A. herba alba* was extracted from the plant using Clevenger's apparatus hydrodistillation method. Different concentrations of the oil were tested on the last instar larvae for repellent activity (25, 75, 100, 120, 130 and 150µl/ml ethanol for both insect) and fumigant toxicity bioassay (50, 75, 100 and 120 µl/l air for *P. interpunctella* and 50, 150, 180, 200 and 600 µl/l air for *E. kuehniella*) under laboratory conditions.

Results showed the oil have repellent activity against both insects after 2h of exposure. The oil caused toxicity in both insect larvae. Median lethal concentrations of the oil (LC50) recorded against *P. interpunctella* larvae were 162.1, 144.9 and 141.1 µl/l air at 24, 48, and 72h after exposure. LC50 values of this oil against the larvae of *E. kuehniella* were 901.1, 782.4, and 514.2 µl/l air after exposure at the same times, respectively. According to the results, the oil had a stronger activity on *P. interpunctella*, whereas, *E. kuehniella* was the most tolerant to the oil activity.These results confirm the efficiency of *Artemisia herba alba* essential oils in the control of two insects pests of stored products.

Bouzidi *et al.*, 2016. Antioxidant Activity of Essential Oil of *Artemisia herba alba*:

Abstract

The aims of this study are to investigate the chemical composition and to determine the antioxidant activity of the essential oil of *A. herba-alba.*

Materials and Methods: The aerial part of the *Artemisia herba alba* plant was collected in Sidi Ahmed station (Saida province), situated in the Tell steppe interface area in North West of Algeria. The essential oil was isolated by hydrodistillation using a Clevenger apparatus, and was analyzed by GC/MS techniques. Antioxidant effectiveness was examined by the radical scavenging method (DPPH) and determination of ferric reducing antioxidant power (FRAP).

The results: The yield obtained of essential oil is 0.932%. This oil has a density and a refractive index of the order of 0.912 and 1.4811 respectively. Chemical composition of the essential oils were identified, in which camphor (29.8%), 1, 2, 5, 5-tetramethyl-1, 3-Cyclopentadiene (15.6 %), Chrysanthenone (8.2%), eucalyptol (6.5%), Arthole (4.5%) were the most abundant components. Results from antioxidant activities reflected by the DPPH and FRAP assay were demonstrated that the *Artemisia herba-alba* essential oil possesses an important antioxidant activity. Thus, *Artemisia herba-alba* may therefore be a good candidate for functional foods as well as plant-based pharmaceutical products.

Chirane *et al.*, 2020. Diversity and antibacterial activity of endophytic fungi associated with the Algerian medicinal plant *Artemisia herba alba*:

Abstract

This study is interested in the isolation, identification, and antibacterial activity of the endophytic fungi from the Algerian medicinal plant *Artemisia herba alba*.

Materials and Methods: The plant material was collected in February, 2019 from the Maadid region, M'sila, Algeria. the endophytic fungi were isolated After 7-10 days of incubation. The fungi were identified up to the genus level based on their morphological and microscopic characteristics such as colony topography, color, and growth pattern. The antibacterial activity of the endophytic fungi was determined against five pathogenic bacterial by agar-fungi disk diffusion method. the secondary metabolites of fungi were extracted after a fermentation by the butanol solvent.

Results: The isolation and identification allowed us to get ten (10) fungal strains from 22 segments of the studied plant belonging to four genera: *Fusarium, Penicillium, Alternaria,* and *Aspergillus*. All isolated fungal strains exhibited antibacterial activity against at least one of the bacteria tested with an inhibition zone (IZ) ranging from 7.5 to 25 mm. *Fusarium sp* and *Penicillium sp1* has the highest antibacterial activity with an inhibition zone of 23.5 and 25 mm against *S. aureus* and *B. subtilis*, respectively. The antibacterial activity of the extracts was determined and results showed that *Penicillium sp*2 has the highest effect against *Bacillus subtilis* with inhibition zone of 27.3 mm. conclusion, the present study is the first report about the antimicrobial activity of endophytic fungi residing in *A. herba alba*. This study helped to prove the use of *A. herba alba* in traditional medicine. In fact, the fungus *Penicillium* and *Fusarium* demonstrated the ability to produce bioactive agents with an antibacterial potential.

Dahmani-H. & Baaliouamer, 2010. Chemical composition of Algerian *Artemisia herba alba* Essential Oils Isolated by Microwave and Hydrodistillation:

Abstract

The two aims of the present work are to extend the authors' qualitative and semi-quantitative analysis of *A. herba-alba* oils from North Sahara desert in Algeria isolated by hydrodistillation and microwave distillation, and to compare their chemical compositions.

Materials and Methods: The aerial parts of *A. herba-alba* were collected in June 2005 at the flowering stage from the Boussaada region in high table-lands of Algeria.Plant samples were air-dried (3–6 days), minced, and subjected immediately to oil isolation. Isolation of the essential oil has been conducted by hydrodistillation (HD) and a microwave distillation process (MD).The chemical composition of the two oils was investigated by GC and GC/MS.

The results: A total of 94 compounds were identified by GC and GC/MS in *A. herba alba* oils isolated by HD and MD. The main components in HD and MD oils were camphor (49.3% HD; 48.1% MD), 1,8-cineole (13.4% HD; 12.4% MD), borneol (7.3% HD; 7.1% MD), pinocarvone (5.6% HD; 5.5% MD), camphene (4.9% HD; 4.5% MD), chrysanthenone (3.2% HD; 3.3% MD) and b-thujone (2.1% HD; 1.9% MD). In comparison with HD, MD offers important advantages such as shorter

isolation times, lower production of potential by-products and substantial savings of energy.

Dahmani-H. *et al.*, 2012. On-Line Radical Scavanging Detection and Characterization of Antioxidants from *Artemisia herba alba*:

Abstract

The aims of this study are to detect and subsequently isolate and characterization the antioxidants present in *Artemisia herba alba Asso* (Asteraceae) wild-growing in Algeria, using the on-line radical-scavenging detection technique.

The aerial parts of *Artemisia herba alba,* used in this study were collected from Msila region, located in the high tab-lelands of Algeria in June 2008 at the flowering stage. Four caffeoylquinic acid (CQA) derivatives, 5-O-caffeoylquinic acid , 3,5- di-O-caffeoylquinic acid, 4,5-di-O-caffeoylquinic acid, and 3,4,5-tri-O-caffeoylquinic acid, have been isolated from *Artemisia herba alba,* using the on-line HPLC-DAD-DPPH radical scavenging detection technique as guidance.

In the course of the purification work, the non-frequent (E)- 2-(β-D-glucopyranosyloxy)-4-methoxycinnamic acid (2) has also been isolated. The CQAs showed fairto-good antioxidant activities determined by the DPPH. scavenging assay. The structures of the five isolated compounds were determined by spectroscopic methods. The on-line HPLC-DAD-DPPH technique allowed for a rapid pinpointing of antioxidants in the studied plant, accomplishing the facile guided isolation of the target molecules. Algerian *Artemisia herba alba,* could be an interesting source of natural antioxidants that deserve further work.

Demnati & Allache, 2013. Toxicite de trois extraits de poudres végétales originaires des regions semi-arides et arides sur le comportement d'un insecte de denree stockee (*Callosobruchus maculatus F.*):

Abstract

The aim of this study is to determine the effectiveness of three extracts of plant powders from the semi-arid and arid zone, they are: *Juneperus oxycedrus*, *Juneperus communis*, and *Artemisia herba alba*, on the behavior of‘a *Callosobruchus maculatus F.* chickpea insect.

A mortality rate of adult insects has been reported, estimated at 50% treated with *A. herba alba*, and 40% in adults treated with *Juniperus oxycedrus* and *J. communis*. A

significant decrease in the fertility of females treated with *J. oxycedrus* is observed compared to those treated with *A. herba alba* and *J. communis*.

Dif *et al,* 2018. Phenolic content and antioxidant activity of *Artemisia herba alba,* a medicinal plant from Algerian aride zone:

Abstract

Several researches have confirmed the pharmacological efficiency of medicinal plants that grow in arid zone. *Artemisia herba-alba* is a plant that grows in El bayadh region (Western Algeria) and used in traditional therapy. The present work is about phytochemical screening with quantification of phenolic compounds and determination of its antioxidant activity using different solvent maceration extract of aerial parts. Results highlighted the richness in phenolic compounds and antioxidants of this plant.

Dob & Benabdelkader, 2006. Chemical Composition of the Essential Oil of *Artemisia herba alba* Asso. Grown in Algeria:

Abstract

The aims of this work are to provide more information on the chemical composition of *A. herba-alba* essential oil and to compare it with other *A. herba-alba* oils from different localities.

Materials and Methods: Aerial parts (leaves, stems) of *A. herba alba* were harvested in April 2001 at Djebel Messâd near M'sila, Algeria. The essential oil from the aerial parts of *Artemisia herba-alba* Asso. was obtained by hydrodistillation, using a modified Clevenger-type apparatus. The oil was investigated by GC and GC/MS techniques.

The results: The oil yield was 1.02% based on dry weight. Sixty-eight components amounting to 94.7% of the oil were identified, 33 of them being reported for the first time in Algerian *A. herba-alba* oil and 21 of these components have not been previously reported in *A. herba-alba* oils. The oil contained camphor (19.4%), *trans*-pinocarveol (16.9%), chrysanthenone (15.8%) and β-thujone (15%) as major components. Monoterpenoids are the main components (86.1%), and the irregular monoterpenes fraction represented a 3.1% yield.

Fekhar *et al.*, 2017. Thionation of Essential Oils from Algerian *Artemisia herba alba L.* and *Ruta Montana L.* Impact on their Antimicrobial and Insecticidal Activities:

Abstract

The objectives are to test different essential oils and to determine which are the most effective against bacteria, fungi, and insects, that is, alleviating the relative resistance of these species towards the treating molecules, that thionation of the essential oils of *Ruta Montana L.* (Rutaceae) and *Artemisia herba-alba L.* was undertaken. By doing so, the physicochemical properties of the essential oils from these plants, and their hydrophobicity and volatility are expected to be enhanced as a result of the formation of thioketones (or thiones), less polar groups than ketones; this would induce a hydrogen bonding lowering, in addition to the displacement of the tautomeric equilibrium towards the formation of the enethiol.

Materials and Methods: The plants *Artemisia herba-alba L.* and *Ruta montana L.* were harvested in March 2016 at Djelfa (North-central Algeria) and Hammam Melouane (Northern Algeria), respectively. Essential oils were extracted from *Artemisia herba-alba L.* and *Ruta montana L.* by means of steam distillation and thionated with a reagent combination of phosphorus pentasulfide and sodium bicarbonate. The antimicrobial activity was determined by two microbial and one fungal strains: *Staphylococcus aureus* ATCC 6538 (gram-positive), *Escherichia coli* ATCC 10536 (gram-negative), and *Candida albicans* ATCC 10231(fungus). Both parent essential oils and their modified ones were screened for their biological and insecticidal activities.

The results showed that essential oils were composed mainly of ketones; essential oils from *Artemisia herba-alba* L. and those from *Ruta montana* L. consisted of bicyclic monoterpenes and acyclic aliphatic ketones (thujone, camphor and 2-undecanone), respectively. The antimicrobial activity of essential oils was substantially improved upon thionation (from 10 to 34 mm and from 11 to 32 mm). The insecticidal effect of the thionated essential oil from *Ruta montana L.* was observed to be very significant, but that of the essential oil from *Artemisia herba-alba L.* was observed to decrease (from 100% to 70% after 24 hrs).

Goudjil *et al.*, 2016. Bioactivity of *Artemisia herba alba* essential oil against plant pathogenic Fungi:

Abstract

This work was focus on the study of the antifungal activity of essential oil of *Artemisia herba alba*. It was conducted to illustrate the use of these essential oil as a natural alternative to chemical fertilizers (biopesticide).

Materials and Methods: Aerial part of *Artemisia herba alba* were collected in April 2013 from Mount of Boukhil in Djelfa region (Algeria). The extraction of essential oil was carried by steam distillation, in a Clevenger apparatus by immersing 100g of dry leaves in a flask of 1000 ml of water for 3 hours. The obtained essential oil was dried with MgSO4 and stored in the dark at 4°C. Essential oil analysis and separated by gas chromatography coupled by a mass spectrometry (GC/MS). The fungi used in this study were isolated from tomato leaves, peppers and wheat leaves. These are 03 species within the genus Fusarium (*Fusarium moniliforme, Fusarium solani, Fusarium oxysporum*) and a specie belonging to the genus *Stemphylium solani* they entail considerable loss of production in several varieties of plant.The evaluation of the antifungal activity of essential oils is adopted by the direct contact method where four concentrations are obtained by addition of 30, 150, 300, and 450 µl of essential oils upon 60ml warm PDA in a vial with adding drops of tween 20.

Results: The chromatographic analysis of essential oil has identified Thirty-three compounds, representing about 97.54% of the whole harvested plant *Artemisia herba alba.* Essential oil is composed mainly by Davanon (42.8%), Camphor (15.96%) and Thujone (9.63%), which represent 68.39% of our oil's total. The essential oil of *Artemisia herba alba* showed an increase in mycelial growth with the incubation time except for the concentration of 7.5 µl/ml (0.75%) that exhibits no mycelial growth for all the strains. However, a reduction in mycelial growth with increasing concentration of *Artemisia* oil is noted. These results demonstrate that the essential oil could supply a valid alternative to chemical treatments on the basis of their efficacy on different types of plant pathogens and their flexibility of use.

Hechiche *et al.*, 2019. *Artemisia herba alba* essential oil as green corrosion inhibitor for Aluminum in Hydrochloric acid solution:

Abstract

The aim of this study is to investigate of inhibitive properties from *Artemisia herba alba* essential oil as corrosion inhibitor of Aluminum in Hydrochloric Acid Solution.

Materials and Methods: The flowers and leaves of *Artemisia herba-alb*a plant were collected from Guelma in eastern Algeria. Essential oils were isolated by hydrodistillation. The chemical composition of oils was analyzed by GC and GC/MS. Essential oil inhibitive properties on the corrosion behavior of Al in 1 M hydrochloride acid solution, were investigated by means of weight loss measurement and electrochemical techniques. The influence of temperature was also studied, and some thermodynamic parameters were calculated too.

The results: The chemical analysis of essential oil revealed 68 components, the major constituents were: Camphor (26.2 %), Chrysanthenone (12.4 %), 1,8-Cineol (8.0 %), α-Thujone (7.8 %) and β-Thujone (6.6 %). The weight loss measurements indicated that inhibition efficiency (IE %) increases with *Artemisia* oil concentration and decreases with temperature. The results revealed an increase of inhibition efficiency by maximum 92% trough increasing the oil concentration to 3 g/L at 333 K. The oil compounds adsorb by physisorption, follow Langmuir adsorption isotherm and act as mixed type inhibitors. The Electrochemical impedance spectroscopy (EIS) results confirmed the adsorption mechanism process and the SEM observations.

Heleili *et al.*, 2018. Antimicrobial activity of essential oil of *Artemisia herba alba* Asso. from Eastern Algeria:

Abstract

The aim of this study is to evaluate the in vitro antibacterial activity of the essential oil of *Artemisia herba alba* Asso. grown in eastern Algeria.

Materials and Methods: The aerial parts (leaves and flowered tops) of the plant ware collected in March 2017, in the region of Chemora, Batna governorate in northeastern Algeria. The essential oil was obtained by hydrodistillation of 100 g of the powdered seed for 4 h using a Clevenger-type apparatus to collect the oil. For investigating the anti-microbial effect, *Candida albicans* and 7 bacterial strains (*Staphylococcus aureus* (ATCC 25923), *Pseudomonas aeruginosa* (ATCC 27853), *E coli* (ATCC 25922) and *Enterobacter cloacae* (ESBL), *Staphylococcus aureus* (MRSA), *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* MBL) were tested against *Artemisia herba alba* essential oil. Antimicrobial activity of the essential oil was assessed by the disk-diffusion method on agar.

The results: the essential oil yield was about 0.526%. The analysis of *A. herba-alba* oil showed that it exhibited antimicrobial activity against different microorganisms

and varied according to the type of pathogen. *Candida albicans* and Gram-positive bacteria were more sensitive to essential oil. The maximum zone of inhibition was recorded against *Candida albicans* 33.85 mm. The present study showed *Artemisia herba-alba* is effective against all tested microorganisms (bacteria and yeast) Therefore, it deserves to be exploited by the pharmaceutical and food industry.

Houmani *et al.*, 2004. Intérêt de *Artemisia herba alba Asso* dans l'alimentation du bétail des steppes algériennes:

Abstract

The objective of this study is to determine the chemical constituents and fodder value of the Algerian populations of *Artemisia herba alba* which, for the first time, would allow us to understand the relationship between its medicinal and antifungal use and its fodder properties.

Materials and Methods: The Aerial parts (leaves and flowers) of *A. herba-alba* were collected from the Djelfa region, were weighed, and dried in the shade. The essential oils of *A. herba-alba* were isolated by hydrodistillation, using a Clevenger-type apparatus and were analyzed by HP-GC 5890 II. The in vitro digestibility of organic matter and crude fibre is measured by two steps, the first step simulates digestion in the rumen, and the second step simulates digestion in the curd.

The results: *A. herba alba* is characterized by a high content of crude fibre (31.9%), medium nitrogen materials (12.I%) and low mineral materials (7.5%). *A. herba alba* is digestible with 65.7% for organic matter and 54.6% for crude fibre. The analyses of the essential oils of the aerial parts show three levels of compounds: the first is camphor (39.16%), the second is made up of compounds with levels above 5%, represented by 1,8-cineo1 (12.38%), 1a chrysanthenone (7.06%), 1a α-thujone (6.85%), and camphene (6.0%), and the third level includes compounds with levels below 5%, these are β-thujone (4.78%), borneol (3.55%), pinocarvone (2.92%), and spathulenol (1.31%).

Khannouf *et al.*, 2010. Antioxidant and antibacterial activities of extracts from *Artemisia herba alba.* Leaves and some phenolic compounds:

Abstract

The aim of this study is the determination the phenolic compounds, antioxidant and antibacterial activities of extracts from *Artemisia herba alba* leaves.

Materials and Methods: Polyphenolic compounds (flavonoids and phenolic acids) of *A. herba alba* leaves were extracted, quantified and analyzed by HPLC. The antioxidant and free radical scavenging activities of the extracted materials were tested together with their antibacterial effects against selected bacterial strains. The antioxidant and antibacterial activities of some pure phenolic compounds were also examined.

Results: High flavonoids contents (apigenin and luteolin) were present in the ethyl acetate phase, in addition to phenolic acids (protocatechic acid, caffeic acid, gallic acid and ferulic acid derivatives). The aqueous phase contains smaller amounts of phenolic acids while the chloroform phase contains phenolic acids and aglycon flavonoids. The antioxidant properties of these extracts and some phenolic compounds were estimated by measuring the capacity of these extracts and compounds in scavenging the free radical 1,1-diphenyl-2-picrylhydrazyl (DPPH) and inhibition of the volatile organic compounds and the conjugated diene hydroperoxides arising from linoleic acid oxidation and inhibiting lipid peroxidation. The antibacterial activity of *Artemisia* extracts and phenolic compounds was also estimated against some bacterial strains.

Kolai *et al.*, 2012. Effet inhibiteur in vivo de l'huile essentielle d'*Artemisia herba alba* sur deux souche de *Fusarium oxysporum F. sp. Radicis-lycopersici*:

Abstract

The aim of this work is to study the antifungal activity of the essential oil of *Artemisia herba alba* used in the Algerian tradition medicine on two strains of *Fusarium oxysporum F. sp. radicis-lycopersici.*

Materials and Methods: The essential oil was extracted from aerial parts of *Artemisia herba alba* by hydrodistillation method, the obtained residue was stored at (4 °C). Antifungal Activity of *Artemisia herba alba* essential oil was investigated in vitro on solid medium agar against two strains of *Fusarium oxysporum F. sp. radicis-lycopersici*, isolated from the first and the second variety Marmande and Agora. The oil at different concentrations (0.1%, 0.5%, 1%, 2%, 3% and 5%) were added to PDA medium at a temperature of 40°C and then poured into petri boxes. Each is inoculated with mycelial an explants of about 5 mm in diameter, from a fungus culture aged one week. The effectiveness of each concentration studied, is estimated by calculating the

percentage inhibition of growth of the fungus tested, according to relationship LEROUX and CREDET.

The results: With a yield of 1%, the essential oil of *Artemisia* has shown remarkable efficacy of both strains with a minimum inhibitory concentration MIC of 2%, and 100% inhibitory activity was observed by applying a concentration of 200 µL/mL. These results, although preliminary, show a good antifungal activity, to limit and inhibit stop the development of the pathogen agent.

Lakehal *et al.*, 2016. Essential Oil Composition and Antimicrobial Activity of *Artemisia herba alba* Asso. Grown in Algeria:

Abstract

The aim of the present investigation was to study the antibacterial effect of *Artemisia herba-alba* Asso. essential oil on different bacterial species.

Materials and Methods: The aerial parts of *Artemisia herba-alba* Asso were collected on April 2013 from Djelfa, Algeria. After been harvested, the fresh vegetable matter was first weighted and then dried on the shadow, until weight stability. Then the leaves were separated from stems. The essential oil was extracted by hydro distillation using a Clevenger-type apparatus. The oil was analyzed by Gas Chromatography-Mass Spectrometry (GC-MS). Bacterial strains used in this study were obtained from American Type Culture Collection (ATCC), USA: *Pseudomonas aeruginosa* ATCC12228, *Staphylococcus aureus* ATCC 25923, *Klebsiella pneumoniae* (ATCC 13883), *Bacillus cereus* (ATCC, 11778) and *Escherichia coli* ATCC125922. Two techniques were used to test the microbial activity of *Artmisia herba-alba* essential oil: the agar diffusion assay as well as the agar dilution method was used for determination of Minimum Inhibitory Concentration (MIC).

The results: The major components of the essential oil were found to be camphor (39.5%), chrysanthenone (10.38%), 1,8-cineole (8.6%), α-thujone (7.03%), Borneol (3.35%) and bornyl acetate (2.52%). The data shows that this oil had variable antimicrobial activity against all tested strains. The inhibition zones were in the range of 15-33 mm. Gram positive bacteria were shown to be more sensitive to the *Artemisia herba-alba* Asso essential oil. The data indicated that Gram-positive *S. aureus* was the most sensitive strain tested to the oil of *Artemisia herba-alba* Asso with the strongest inhibition zone (33.00 ± 0.45 mm). Gram-negative strains also displayed variable degree of susceptibility against investigated oil. Maximum activity

was *E. coli* (19.00 ± 0.55). Modest activities were observed against *K. pneumoniae*, with inhibition zones of (15 ± 0.54 mm).

The results indicate that the oil may be used in the treatment of diseases caused by the micro-organisms tested.

Lakehal *et al.*, 2017. Chemical composition and antibacterial activity of the essential oil of *Artemisia herba alba* Asso, from Djelfa:

Abstract

The aim of the present investigation was to enhance our diverse and rich national heritage and to study the antibacterial effect of *Artemisia herba-alba* Asso. essential oil on different bacterial species.

Materials and Methods: The aerial parts of *Artemisia herba-alba* Asso. were collected on April 2012 from Djelfa. Dried leaves were subjected to the hydrodistillation using a Clevenger apparatus. The composition of the essential oil was studied by GC-MS. The antibacterial activity was evaluated using the agar diffusion method against six microbial strains. The minimum inhibitory concentration (MIC) was determined using the agar dilution method.

The results: The essential oil was characterized as having a high content of camphor (37.5%) followed by chrysanthenone (10.38 %), 1, 8-cineole (8.6 %) and α-thujone (7.03%). The latter showed good activity against all the bacteria tested, with the exception of *Pseudomonas aeruginosa*, which proved to be resistant. The minimum values of the inhibitory concentration (MIC) varied between 0.10 mg. ml-1 and 0.84 mg. ml-1. The essential oil of *Artemisia herba-alba Asso.* is a potential source of natural antibacterial agents in the pharmaceutical industry in order to find possible alternatives to antibiotics.

Mehani *et al.*, 2016. Antifungal activity of *Artemisia herba alba* on various fusarium:

Abstract

The aim of this study is to determine the biological activity of extracts of two medicinal and aromatic plants *Artemisia herba-alba* was chosen for therapeutic characteristics in traditional medicine.

Materials and Methods: Plant material is the aerial part of *Artemisia herba alba* were collected in December 2014 from Gardaia region (Algeria). The essential oil

extracted by the hydro-distillation method. For the evaluation of the antifungal activity, was adopted the method of direct contact. For preparation, different concentrations were taken from essential oil of *Artemisia herba-alba* (50, 10, 5, 2.5, 1.25/ml) and adjusted to 20 mLof potato dextrose agar (PDA) and then stirred for 5 min tohomogenize the medium PDA with essential oil. The antifungal activity of the essential oils was tested on three fungi: *Fusarium sporotrichioides, Fusarium graminearum,* and *Fusarium langsethiae*.

Results: Significative reductions of mycelium growth have been observed 0.025 and 0.05% *Artemisia herba-alba* concentration for Fusarium sporotrichioides. 0.025 % concentration of essential oil extracted from *Artemisia herba-alba*, has significative inhibitory effect on mycelial growth.

Messai *et al.*, 2008. Sesquiterpene lactones from Algerian *Artemisia herba alba*:

Abstract

The objective of this study is to investigate the chemical constituents (Sesquiterpene lactones) of the Algerian medicinal plant *Artemisia herba alba*.

Materials and Methods: The aerial parts of *A. herba-alba* were collected during the flowering stage in September 2005, from Tebessa (East of Algeria). Air-dried plant material (1 kg) was ground and extracted with CH2Cl2–MeOH (1:1) at room temperature. The structures of the compounds were determined by comprehensive NMR studies, including DEPT, COSY, NOESY, HMQC, HMBC and HRMS.

The results: The phytochemical investigation of the methylene chloride/methanol extract of the aerial parts of *Artemisia herba-alba* afforded two new natural sesquiterpene lactones 1b,9b-diacetoxyeudesm-3-en-5a,6b,11bH-12,6-olide and 1b,9b-diacetoxyeudesm-4-en-6b,11bH-12,6-olide .

Nedjimi & Beladel, 2015. Assessment of some chemical elements in wild Shih (*Artemisia herba alba* Asso.) using INAA technique:

Abstract

The aim of this study is to determine the chemical elements of *Artemisia herba alba* Asso. by the analytical technique INAA.

Materials and Methods: Leaves of *A. herba-alba* were collected in spring 2013 from Moudjbara region in Djelfa, Algeria. The samples were washed several times with distilled water and were dried for 48 h in an oven at 60 ◦C. The dried samples were

ground to a fine powder using a porcelain mortar and pestle. All samples were irradiated for 6 h at a thermal neutron flux of 4.5 × 1013 cm−2 s−1 in the pneumatic tube facilities, together with the standard GBW07605 (GSV-4 tea leaves) from the National Research Center for Certified Reference Materials (China). After appropriate cooling, the irradiated samples and standards were transferred to new polyethylene capsules. The software Genie-2000 version 2 (Canberra Industries, USA) was used for spectra processing and peak area determinations. The chemical elements were detected following their characteristic peak areas and decay data.

The results: Twenty chemical elements were identified in *A. herba alba* (7 essential, 3 potentially toxic, and 10 other elements). The seven essential elements were in descending order K> Ca > Fe > Na > Zn > Cr > Co.The toxic elements in this species were within the safety limits suggested by WHO/FAO. These data analyses for this medicinal plant can be useful for therapeutics and pharmaceutical purposes.

Rekkab *et al.*, 2016. Chemical composition of the essential oil of aerial parts of *Artemisia herba alba* Asso. From Oum El-Bouaghi (Algeria) and cheno-taxonomic survey:

Abstract

The objective of this study is to determine the chemical composition of *Artemesia herba-alba* essential oil.

Materials and Methods: Aerial parts of *Artemisia herba-alba* Asso. were collected in July 2012 from Ain Babbouche Province of Oum El Bouaghi (Northern Eastern Algerian). The essential oil was extracted by hydrodistillation, using a Clevenger-type apparatus. The chemical composition of essential oil was analyzed by GC and GC/MS.

The results: Forty compounds were characterized representing 93.6% of the essential oil with the prevalence of chrysanthenone (16.2%), camphor (15.6%), β-thujone (14.2%), α-Thujone (9.1%), 1,8-cineole (8.9%), and piperitenone (7.6%). This composition was compared to numerous reported essential oils from *Artemisia herba-alba*, worldwide distributed.

Salhi *et al.*, 2017. Antifungal Activity of Aqueous Extracts of some dominant Algerian Medicinal Plants:

Abstract

The aim of the study is the determination to explore the in vitro potential antifungal activity of aqueous extracts of the aerial parts of four dominant Algerian medicinal plants which are *Artemisia herba alba*, *Cotula cinerea*, *Asphodelus tenuifolius*, and *Euphorbia guyoniana*.

Materials and Methods: The plants were collected during the vegetative stage in Algerian natural habitats. The samples were air-dried, grinded in a Wiley Mill to fine uniform texture, and stored in glass jars until use. the plant aqueous extracts were prepared by the maceration and tested by phytochemical Screening. Fungal materials were used *Fusarium graminearum* and *Fusarium sporotrichioides*. The poisoned food method was used in the preliminary screening of aqueous extracts for their antifungal properties evaluation.

The results of this study revealed that the *A. herba alba*, *C. cinerea, A. tenuifolius*, and *E. guyoniana* aqueous extracts are effective at both concentrations of 10% and 20% for the *Fusarium mycelia* growth inhibition. The phytochemical characterization of the compositions of the aqueous extracts has revealed that the presence of some chemical compounds (tannins, flavonoids, saponins, steroids, and alkaloids) is likely to be responsible for the antifungal activities sought.

Salhi *et al.*, 2019. The antifungal activity of *Artemisia herba alba* aqueous extract and essential oil against storage fungus *Alternaria spp* and *Fusarium spp*:

Abstract

This study aims to test the effectiveness of aqueous extract and essential oil of *Artemisia herba-alba* on both the inhibition of the growth and the antifungal activity of some fungi responsible for the cereals grains deterioration in the post-harvest period (*Alternaria spp* and *Fusarium spp*) aims to develop natural substances alternatives to chemical control used in agriculture.

Materials and Methods: The aerial part of *Artemisia herba-alba* at the vegetative stage was harvested in the region of Illizi from southeastern Algeria.The plant material was washed, dried, and powdered by mechanical grinder. The aqueous extract of the plant *Artemisia herba-alba* Asso was prepared by maceration method and extraction of essential oil by hydrodistillation method. Phytochemical tests techniques were used to determine the different chemicals contained in the aqueous extracts. To evaluate the antifungal activity, Potato Dextrose Agar medium (PDA) was used and the funguses *Alternaria spp* and Fusarium spp. The tested strains were

incubated at 25 °C in Petri dishes (9 cm diameter) on PDA for 7 days. The direct contact method was applied to test the sensitivity of fungal strains to the aqueous extract or essential oils.

Results: The aqueous extract of *Artemisia herba-alba* has antifungal activity against the fungi *Fusarium* and *Alternaria*. The mycelium growth was decreased as the concentration of the aqueous extract was raised and the total inhibition for Alternaria was achieved in 30% of the aqueous extract. The concentration of 0,025 % of essential oil recorded a good antifungal activity. the aqueous extracts was showed better efficacy than essential oil on *Fusarium spp* and *Alternaria spp*. For phytochemicals test, the results showed the richness of the *Artemisia herba-alba* aqueous extract in secondary metabolites compound like alkaloids, steroids, tannins, flavonoids, saponins and the absence of anthocyanins. These substances play a determining role in antifungal activity.

Touil & Benrebiha, 2012. Composition chimique et activité antimicrobienne des huiles essentielles d'*Artemisia herba alba* Asso et *Artemisia campestris* L. de la region Aride de Djelfa:

Abstract

The aim of this study was conducted to characterize the chemical composition of essential oils of *Artemisia campestris L* and *Artemisia herba Alba* Asso. from the Djelfa region.

Materials and Methods: Essential oils extracted by hydrodistillation from the aerial parts of *Artemisia campestris L* and *Artemisia herba Alba*. The essential oils were analyzed by gas chromatography coupled to mass spectrometry (GC / MS) to determine their chemical composition and their identification chemotype.

The results: The yields of aerial parts of *Artemisia campestris L* and *Artemisia herba Alba* were 0.3 and 0.7% respectively. The analysis showed that oil *A. herba alba* chemotype is davanon which consists mainly of davanon (62.2%) while EO *Artemisia campestris* is characterized by the presence of β-pinene (20.75%) and limonene (10.46%) and γ-terpinene (10.18%) as major chemical constituents.

Touil *et al.*, 2019. Identification and quantification of phenolic compounds of *Artemisia herba alba* at three harvest time by HPLC-ESI-Q-TOF-MS:

Abstract

The aim of this study is to determine the effect of the harvest period on the phenolic compounds of *A. herba-alba* and evaluate the antioxidant potential of the plant extracts.

Materials and Methods: The aerial parts of *A. herba-alba* utilized in this study were collected in summer at a late vegetative stage (July 2013), in winter at the full-flowering stage (December 2013), and in spring at the early vegetative stage (May 2014) from Djelfa, Algeria. Samples were air-dried for 15 days in the laboratory a room temperature till the weight stayed stable. Methanolic plant extracts were obtained by means of ultrasound-assisted extraction and then analyzed by HPLC–electrospray ionization–Q-TOF–MS for their phenolic profile.

The results: The HPLC allowed the identification of 26 phenolic compounds, 12 of them were identified for the first time for this material. The phenolic compounds detected were 8 phenolic acids, 12 flavones, 4 isoflavone, 1 flavonol, and 1 flavanone. Results showed that during the all harvesting date, phenolic acids were predominant. In November, at the flowering period, it revealed the highest accumulation of total phenolic contents (515 ± 142 mg GAE/g dry matter weight [DMW]) in the methanolic extracts. November at the flowering period was characterized by the highest levels of flavonoids 8.3 mg/g DMW and the lowest contents of phenolic acids 3 mg/g DMW. Finally, the richness of *A. herba-alba* in phenolic active compounds known for their antioxidant, antimicrobial, and insecticidal activities could support the utilization of this plant in a large field of application including cosmetic, pharmaceutical, agro alimentary, and biological defense.

Zouaoui *et al.*, 2020. Characterization of volatile organic compounds from six aromatic and medicinal plant species growing wild in North African drylands:

Abstract

The present study focused on the identification and semi-quantification of volatile organic compounds (VOC) in six aromatic and medicinal plant species growing wild under hot arid climatic conditions at Biskra region in northeastern Algeria. The study seeks to compare the quantitative and qualitative composition of VOC and chemical families between these species, then to determine the characteristic compounds/ chemical families of each plant species. The study aims also at analyzing the qualitative and quantitative similarities between species in order to group them according to the homogeneity of the common volatile compounds.

Materials and Methods: The plant material analyzed was the aerial parts including tender, woody, and hard stems, leaves, flowers, and fruits (if existing) of six aromatic and medicinal plant species namely: *Thymus algeriensis L.*, *Artemisia campestris L., Juniperus phoenicea L., Teucrium polium L., Artemisia herba-alba* Asso. and *Rosmarinus officinalis L.* samples were harvested during the period April–May 2016. The collected plant materials were dried at room temperature in the shade and away of direct sunlight to prevent photo-oxidation. Drying lasted until the moisture stabilized in all samples, where plant samples of each species were weighted before and after drying. Plant samples prepared for the analysis of VOC included a grinded mixture of all the aerial parts of each species. The micro-extraction of VOC was carried out using the headspace-solid phase microextraction (HS-SPME) method.

The results: The chromatographic analysis of six aromatic and medicinal species allowed the identification and semi-quantification of 91 VOC: 39 VOC were identified in *T. algeriensis* (with dominance of β-myrcene = 13.78%, camphor = 12.29%, linalyl acetate = 9.11%); 37 VOC in *A. campestris* (β-farnesene = 14.17%, β-myrcene = 13.84%); 50 VOC in *J. phoenicea* (α-pinene = 27.18%); 42 VOC in *T. polium* (α- guaiene = 11.33%, trans-caryophyllene = 9.49%, γ-elemene = 9.25%), 45 VOC in *R. officinalis* (camphor = 17.46%, trans-caryophyllene = 14.83%); and 41 in *A. herba-alba* (α-thujone = 24.59%, β-thujone = 13.73%). The higher percentage was observed in *A. campestris* with 52.83% while the lower percentage was recorded in *A. herba-alba* with 5.73%.

3.2. Theses:

Benyoucef, 2020. Extraction et caractérisation des huiles essentielles de six plantes provenant de l'ouest algérien (*salviaargentea , ammoidesvertieillata , sature jacan didissima thymus fontanesii , artemisia herba-alba et rosmarinus offieinalis*): effet de synergisme ou d'antagonisme sur l'activité antioxydante et antimicrobienne:

Abstract

The main objective of this work was the chemical and biological characterization of six medicinal plants growing spontaneously in western Algeria for their medicinal uses which may be related to their antioxidant and antimicrobial properties.

Materials and methods: The plants used in this study are *Ammoides verticillata*, *Satureja candidissima*, *Salvia argentea*, *Thymus fontanesii*, *Rosmarinus officinalis*, and *Artemisia herba-alba.* Extraction of essential oils (EO) was carried out by hydrodistillation, using a type Clevenger and analyzed by CG and CG-MS. The antioxidant activity of the essential oils was evaluated by DPPH and FRAP (ferric reducing antioxidant power) methods.

The results: EO's roots of *S. argentea* was rich in ferruginol (19.5%), pulegone (17.9%), (E) -phytol (13.5%), 6.7 dihydroferruginol (11.3%) and abitatriene (10.0%); 9%). *A. verticillata* EO was dominated by carvacrol (44.3%), limonene (19.3%), p-cymene (19.2%) and γ-terpinene (11, 1%). While, the main components of *S. candidissima* EO were pulegone (70.4%), menthol (5.2%) and iso-menthone (4.5%). The EO of *T. fantenezi*i was characterized by thymol (76.6%) and p-cymene (7.4%). The EO of *A. herba-alba* was dominated by camphor (30.2%) and chrysanthenone (24.3%). *R. officinalis* EO was characterized by presence of 1,8-cineole (15.4%), α-pinene (11%), borneol (12.7%), camphor (15%), and verbenone (10.7%). On the other hand, *A. verticillata* and *S. argentea* EOs had the highest antioxidant potency with IC50 values of 0.7 mg/ml and 0.4 mg/ml, respectively. While a synergistic antioxidant capacity was observed with the combination of *A. verticillata* and *S. candidissima* oils with an IC50 of 0.17 mg/ml which showed a capacity close to both synthetic antioxidants. The antimicrobial activity showed an inhibitory effect against several bacteria by the essential oils and the different fractions, individually or in combination with bactericidal and fungicidal effects. The most intense inhibitory effect was observed with *S. argentea* EO, which showed very good inhibitory effects against all strains including *L. rhamnosus*, *B. cereus*, *B. subtilis* and *P. aeruginosa* with MICs ranging from 0.02 to 0.8 mg / ml. On the other hand, the association of EO from *T. fontanesii/S. argentea/R. officinalis* significantly reduced MICs of *E. coli* and *B. subtilis* bacteria. Similarly, the combination of EOs of *S. argentea/A. verticulata* showed a very interesting antimicrobial activity against strains of *S. Typhi, C. sporogenes* and *E. faecalis* with very low MIC.

Bertella, 2019. Etude de l'activité antimicrobienne et antioxydantedes huiles essentielles d'*Artemisia herba-alba, Artemisia compestris* et *Rosmarinus tournefortii:*

Abstract

The objective of this study is to investigate the antimicrobial and antioxidant effect of the essential oils (EO) extracted from the species of *Artemisia herba alba* (AHA), *Artemisia campestris* (AC), and *Rosmarinus tournefortii* (RT).

Materials and methods: The aerial parts of the three plants were harvested in during the period of October-November 2015 in the region of Bouilef from Batna in the east of Algeria. The essential oils extracted by hydrodistillation and analyzed by GC-MS method. Antioxidant effectiveness was examined by the radical scavenging method (DPPH) and by free radical generato in situ. The antibacterial activity of the essential oil was assessed by the disk-diffusion method on agar and by microatmosphere method. The antifungal was assessed by the direct method. The toxicity of the essential oils was assessed by the analysis HS-SPME-GC-O-MS .

The results: The most important yield of the essential oils returns to AHA with a rate of 0.6%. GC-MS analysis allowed the identification of a total of 41 chemical compounds. The major compound of the essential oils of AHA, RT, and AC are camphor (50.47%), (45.89%), and germacrene D (20.91%) respectively. The antibacterial activity reveals the potential effect of AHA EO, by disc diffusion technique especially on *Klebsiella oxytoca, Acinetobacter baumannii*, and *Staphylococcus aureus strains*, with diameters of the inhibition zone reaching 31.3mm, likewise by microatmosphere method with diameters going to 48 mm on the *Acinetobacter baumannii* strain. Low minimum inhibitory concentrations (MIC) and minimum bacterial concentrations (MBC) of 5 and 10 mg/ml was noticed on *Staphylococcus aureus* strains. A significant antifungal activity of AHA EO, is mainly translated by a 53.7 mm inhibition zone diameter on *Aspergillus niger*. The MIC and minimum fungicidal concentrations (MFC) are variable, the EO of AHA inhibited the *Aspergillus niger* strain at a concentration of 2.5 µl/ml, but the minimal fungicidal concentration was > 20 µl/ml. The EO of RT showed a significant MIC and MFC on *Penicillium sp.* which were 2.5 and 5 µl/ml respectively.The result of the antioxidant activity test showed the important power of the oil of AHA, translated by an IC50 of 41.73 mg/g and a reduced percentage of hydroxylation to 29.62%. The acute toxicity test showed that abnormal behavior of corner sitting and rapid respiration of treated animals was observed at a dose of 500 mg/g, while the median lethal dose (LD50) was 615mg/kg.

Bouchikhi, 2011. Lutte contre la bruche du haricot *Acanthoscelides obtectus* (Coleoptera, Bruchidae) et la mite *Tineola bisselliella* (Lepidoptera, Tineidae) par des plantes aromatiques et leurs huiles essentielles:

Abstract

The aim of this research work is to test the biological activity of the two insects *A. obtectus* and *T. bisselliella* of ten aromatic plants from the Tlemcen region, belonging to the different botanical families in two forms powder of leaves and essential oils.

Materials and methods: The powders of the leaves and the essential oils extracted by hydrodistillation from ten aromatic plants (*Ammoïdes verticillata, Mentha pulegium, Lavandula stoechas, Cistus ladaniferus, Origanum glandulosum, Ruta chalepensis, Thymus capitatus, Schinus molle, Rosmarinus officinalis, Artemisia herba-alba*) were tested under conditions of laboratory with various amounts on the bruchid Acanthoscelides obtectus and the mite Tineola bisselliella. The efficacy of two pesticides MALGRAIN 2% and ACTELLIC were tested on the two insects studied.

The results: These powders of the leaves and oils essential present an insecticidal activity and involve in the females of the two studied insects a significant reduction of the laying compared to that in the control. The powder of the leaves of *Artemisia herba-alba* is most effective against the adults of *A. obtectus* and the larval of *T. bisselliella*, the powder of the leaves of *Rosmarinus officinalis* is most effective on the longevity of the adults of *T. bisselliella*, the essential oil extracted from *R. officinalis* is most toxic on the adults of *A. obtectus*, while the essential oil extracted from *Origanum glandulosum* is most toxic on the adults of *T. bisselliella*, the essential oil extracted from *A. herba-alba* is most toxic against the larvae of *T. bisselliella*. Among the ten aromatic plants tested*, R. officinalis* remains the most effective plant on the fecundity of the females of *A. obtectus* and *T. bisselliella*. Essential oils of *A. herba-alba*, *R. officinalis*, and *O. glandulosum* completely inhibit the fecundity of the beetles to an amount of 5 µL/30g seeds, whereas the essential oils extracted from *A. herba-alba*, *O. glandulosum* and *Lavandula stoechas* inhibit the fecundity of the mites to an amount of 3µL/50,24cm². The efficacy of the two pesticides showed an activity significantly greater than of the powders of the sheets and oils essential even with a low amount.

Boudjelal, 2013. Extraction, identification et détermination des activites biologiques de quelques extraits actifs de plantes spontanées (*Ajuga iva*, *Artemisia herba-alba* et *Marrubium vulgare*) de la région de M'Sila, Algérie:

Abstract

The aim of this study is to contribute to the valorization and protection of medicinal flora of M'Sila region. Ethnobotanical surveys with herbalists in the region have allowed an inventory of 58 wild plants, most of which are used as antidiabetic. Among these species, *Artemisia herba alba, Ajuga iva,* and *Marrubium vulgare* were selected for this study.

The qualitative and quantitative analysis by LC-UV-vis-DAD-ESI-MS showed the richness of methanolic and aqueous extracts of active ingredients, particularly polyphenols and flavonoids in extracts of *Artemisia herba alba* and *Marrubium vulgare*, then *Ajuga iva* that is poor in these compounds but rich in iridoids.

The biological study showed that extracts of the three species have antidiabetic effects, antioxidant, antimicrobial and leishmanicidal with differences in the strength of these effects. *Artemisia herba alba*, with a dose of 300 mg / kg bw resulted in the highest percentage of reduction of glycemia (73,88%); the *Marrubium vulgare* revealed to have the best antioxidant effect with an IC50/DPPH of 0,49 mg/ml.

For leishmanicidal activity, the highest IC50 was obtained with *Marrubium vulgare* (25 mg/ml) followed by *Artemisia herba alba* and *Ajuga iva* (10 µg/ml); whereas, for the antimicrobial activities, *Artemisia herba alba* can be a good antimicrobial agent against *Staphylococcus aureus* and *Candida albicans* with a diameter of inhibition of 18 and 15 mm respectively, compared to the other two species.

Boukhalfa, 2017. Contribution à l'etude des plantes aromatiques et médicinales de la région de l'Ahaggar:

Abstract

The work focuses on the botanical and phytochemical study of fifteen plants collected at Ahaggar National Park in southern Algeria and a review of some of their biological activities: antimicrobial, antioxidant, or hypoglycemic. Among these plants, three species are considered toxic.

Materials and methods: After extraction, chromatographic analysis is performed in the eleven essential oils species:

(5) species and subspecies of the Asteraceae family: *Artemisia judaïca* subsp. sahariensis, *Artemisia campestris* subsp. glutinosa, *Artemisia herba alba*, *Pentzia monodiana* and *Asteriscus graveolens* subsp. graveolens, (3) species and sub-species of the Lamiaceae family: *Teucrium polium* subsp. geyrii, *Teucrium polium* subsp. helichrysoides and *Salvia chudaei*, (1) species of the Poaceae family: *Cymbopogon schoenanthus*. (1) species of the Apiaceae family: *Deverra scoparia*. (1) species of the Myrtaceae family: *Myrtus nivellei.*

The results: The results showed on average that the yields of essential oils were below 1.7 ml per 100 g of the plant (0.3 to 1.6% MS). The highest values were given by *Cymbopogon schoenanthus* (4%) and *Artemisia judaïca* subsp. sahariensis, (3.5%). *Deverra scoparia* and *Salvia chudaei* displayed intermediate values, respectively, 2.8 and 2.7%. The essential oil of *Artemisia judaïca* subsp. sahariensis is rich in monoterpenes 83.5% (73% of piperitone) against 78.5% for *Myrtus nivellei* (34% eucalyptol) and 59.7% for *Cymbopogon schoenanthus* (50.25% of piperitone). The antimicrobial activity of the essential oil was investigated in the eleven above-mentioned plants. it reported a significant antifungal power of the essential oil of *Teucrium polium* subsp. geyrii and *Cymbopogon schoenanthus*. The antioxidant activity was investigated in two essential oil plants: *Artemisia judaïca* subsp. sahariensis and *Cymbopogon schoenanthus as* well as in *Balanites aegyptiaca* (phenolic compounds of saponosides type) and *Pentzia monodiana* (phenolic compounds of flavonoid type). The first three plants show a significant antioxidant activity. Tests for determining the lethal dose 50 (LD50) of the essential oil of *Cymbopogon schoenanthus* and *Myrtus nivellei* were performed on mice (oral) resulting in an LD50 of 4.1 g / kg for the latter, the essential oil of *Cymbopogon schoenanthus* was been greater than 2g / kg.

Boukhannoufa, 2020. La formulation des extraits naturels de plantes médicinales de la région de Mascara et évaluation de l'activité antifongique sur Candida albicans isolée cliniquement:

Abstract

The aim of this study is to formulate natural extracts of plants grown in the region of Mascara and to examine their antifungal activities in vitro and in vivo against three pathogen yeast of Candida albicans.

Phytochemical screening has revealed the richness of drugs in different chemical groups (saponosides, polyphenols, flavonoids, tannins and coumarins). The determination of the total extractable polyphenols of the plant extracts by the colorimetric method made it possible to report a level of 218.82 ± 0.41 mg EAG / 100 ES at the ethanolic extract of *Artemisia herba alba* Asso., followed by the methanolic extract of the peel and that of the leaves of *Citrus aurantium* with rates equal to 144.38 ± 0.12 mg EAG/100 of CE and 80.82 ± 0.03 mg EAG/100 of CE respectively. This quantification is confirmed by analysis by (HPLC-DAD), where we have detected the predominance of vanillic acid (10.64%) in the EAH extract. While the other extract are found rich in phenolic acids and flavonoids. The CMF / MIC ratio has revealed the nature of the antifungal activity of oils and extracts against fungal strains,*Artemisia herba alba asso* oil has fungicidal activity. The LD50 found in Wistar rats treated by these extracts has been found to be strictly greater than 5 g/kg, and with a total absence of any tissue alteration of the kidneys and liver. However, the estimation of the primary irritation index of the ointments formulated indicates the safety of these preparations after direct contact with the skin. Better anticondidotic activity is noted in the groups of infected animals treated with ointments formulated compared to other nystatin-treated groups and placebo as antifungal therapy.

Based on the overall results, the research can contribute to the valorization of plants tested in the pharmaceutical field as an invaluable source of many antifungal agents.

Boutemak, 2011. Contribution a l'etude des procedes d'extraction conventionnels et innovants appliques a la recuperation de l'huile essentielle de l'armoise blanche d'Algerie (*Artemisia herba-alba*):

Abstract

This work is the result of research carried on the one hand, the optimization of two conventional processes steam water distillation and hydrodiffusion by the methodology of design of experiments. And on the other hand, the research of the two innovative extraction processes: solvent-free microwave extraction (SFME) and microwave hydrodiffusion and gravity (MHG) applied to the recovery of the desert wormwood essential oil: *Artemisia herba alba.*

A central composite face-centered experimental design has been employed to optimize the conventional process in order to investigate and evaluate the influence of operating parameters on the essential oil yield and its chemical composition. The

recovered essential oils have been characterized as a function of their chemical composition by GC and GC/MS. The effect of the operating parameters on the variation of essential oils chemical composition obtained with the two conventional processes has been studied and optimal operating experimental conditions were obtained.Moreover, the extraction of essential oils by innovative techniques has been applied. Thus, a comparison between innovative techniques and conventional techniques in terms of yield and kinetics has been studied. The comparative research showed that the advantages of microwaves processes are the gain of time and therefore the economy of energy.

Chniti & Seffih, 2018. Extraction et activite antifongique de l'huile essentielle de l'armoise blanche de la region de Setif:

Abstract

The aim of this study is to evaluate the *in vitro* antifungal activities of *Artemisia herba alba* essential oil growing wild in Boutaleb region (Setif, Algeria).

Materials and methods: Aerial parts of *Artemisia herba alba* were collected in November 2017 from Boutaleb region in Setif , Algeria. The aerial parts essential oils were extracted by hydrodistillation type Clevenger. The antifungal activities of *Artemisia herba alba* essential oils were evaluated by the method of dilutions in liquid medium followed by statistical analysis, which allowed us to determine the inhibitory activity of the essentail oil, against *Candida albicans.*

The results: The average yield was about 0.708%. The inhibitory activity of the essential oil, against *Candida albicans* expressed by its MIC, is 80% equal to 10.054 µl/ml. Through this study and according to the results obtained, the essential oil of white wormwood showed, *in vitro*, an interesting antifungal activity.

Dahmani-H., 2010. Etude de la composition chimique de l'*Artemisia herba alba* poussant en Algerie:

Abstract

The aim of this thesis work is a contribution to the analytical study of the essential oils of white wormwood (*Artemisia herba alba Asso.*) growing in Algeria obtained by hydrodistillation and microwave.

Materials and methods: The samples of *Artemisia herba alba* were collected from eleven regions of Algeria: Batna, Bordj Bou Arréridj, Bordj Ghédir, Draâ Ech Chih,

Djelfa, M'sila, Bousaâda, Roumana, Medjedel, Ghardaia, and Laghouat. The essential oils were extracted by two methods hydrodistillation using a Clevenger device and microwaves and analyzed by GC and GC/MS. The antioxidant activity was evaluated on essential oils obtained by hydrodistillation by the reducing power and inhibition of the radical 2,2-diphenyl-1-picrylhydrazyl (DPPH). Antimicrobial activity was evaluated by the dilution method on fourteen microorganisms (7 bacteria, 5 fungi and 2 yeasts). The detection of antioxidant compounds in certain fractions and the separation of the most active were carried out by the On-line HPLC-DAD-DPPH technique. The structures of molecules isolated by column chromatography and HPLC semi-preparative reverse-phase were determined by spectroscopic methods such as H NMR, C NMR, 2D NMR, UV, IR, and MS. The antioxidant activity of pure extracts and compounds was determined by measuring radical activity using 2,2-diphenyl-1-picrylhydrazyl (DPPH).

The results: The selection of the samples studied revealed a remarkable difference in the chemical composition and extraction yields depending on the regions and extraction techniques used. Microwave extraction gave relatively low yields compared to hydrodistillation: (0.15-0.55%) for microwave versus (0.31-1.00%) for hydrodistillation. The analysis of species by GC and GC/MS showed significant differences in their composition from a qualitative and quantitative point of view. Ketone compounds such as α-thujone, β-thujone, camphor, chrysanthenone, and davanone make up the bulk of it. The combination of GC and GC/MS allowed to identify 164 constituents, representing between 65.2 and 98.3% of the total composition for essences extracted by hydrodistillation and between 61.4 and 95.6% for those obtained by microwave. Among all the samples tested, Medjedel essential oil was the most active on all bacteria and yeasts compared to other essences, except *Fusarium oxysporum lini* which was best inhibited by Ghardaia essence (MIC<0.5mg/ml) against 1 mg/ml for Medjedel. On the other hand, the study of the antioxidant activity of *Artemisia herba alba* oils vis-à-vis the DPPH radical was very weak. Finally, this work was intended to complement and deepen what was previously reported on the *Artemisia herba alba* of Algeria.

Derfouf, 2019. Etude de l'inhibition de la corrosion de l'acier au carbone (XC38) par l'extrait aqueux de plantes sahariennes dans la milieu acide chlorhydrique 1M:

Abstract

The objective of this thesis was to promote aqueous extract of the Saharans plants, *Hammada Scoparia*, *Zygophyllum Alba L*, and *Artemisia herba Alba* as a corrosion inhibitor of XC38 carbon steel in a solution of 1M HCl.

Materials and methods: The influence of concentration, immersion time, and temperature on the corrosion processes of XC38 steel in 1M HCl medium in the presence of inhibitor was studied by means of gravimetric measurements. The mechanism of inhibition is monitored by an electrochemical method (polarization curves and electrochemical impedance spectroscopy). Following these tests, the corrosion rate was calculated for the different experimental conditions. The thermodynamic parameters and activations have been determined. This investigation is complemented by an analysis of the morphology of the metal surface using infrared spectroscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy dispersion spectrometry (EDS).).

The results obtained showed an increase in effectiveness with concentration. A maximum of 90%, 89% is reached for a concentration of 1000 mg. L-1 from *Hammada Scoparia*, *Zygophyllum Alba L.*, and *Artemisia herba Alba* respectively. The effect of immersion time was also realized, this study confirmed the stability of the inhibitors on the carbon steel surface.

Goudjil, 2016. Composition chimique , activité antimicrobienne et antioxydante de trois plantes aromatique:

Abstract

The aims of this work are to study the chemical composition, antibacterial, antifungal, and antioxidant activity of three aromatic and medicinal plants of the Algerian flora, which are *Artemisia Herba Alba, Laurus nobilis*, and *Mentha Piperita.*

Materials and methods: The three aromatic plants were collected from regions of Djelfa, Skikda, and Ouargla (*Artemisia Herba Alba, Laurus nobilis,* and *Mentha Piperita* respectively). After the dried of the plant materials, the essential oils of the three plants were extracted by hydrodistillation and analyzed by CG and CG-MS. Antioxidant effectiveness was examined by the radical scavenging method (DPPH) and determination of ferric reducing antioxidant power (FRAP). The antibacterial activity of the essential oil was assessed by the disk-diffusion method on agar. The antifungal was assessed by the direct method.

The results: The screening by GC/MS identified 33 components for essential oils of *Artemisia Herba Alba* with 42.8% of davanon, 22 constituents of *Laurus nobilis* with (45.36%) of 1.8 cineole , and finally *Mentha Piperita* containing 23 compounds with Carvone (51.04%). The results indicate that the oil of *Artemisia herba alba* showed the highest radical scavenging activity against DPPH radical, followed respectively by those of two species *Mentha piperita* and *Laurus nobilis* but remains moderate compared with standard antioxidant employees. The antibacterial study of essential oils showed a high inhibitory effect on the growth of the tested germs. *Staphylococcus Sp* most sensitive to oil of *Artemisia herba alba* with an inhibition zone of 23.10 mm. The essential oil of laurel recorded a 20.47 and 21.93 mm inhibition zone against strains of *Salmonella enterica* and *Klebsiella pneumonia* respectively. Finally, the essential oil of *Mentha Piperita* revealed a 21.47 mm diameter of inhibition against *Escherichia coli* strains which are most susceptible. The antifungal study against *Fusarium moniliforme, Fusarium solani, Fusarium oxysporum,* and *Stemphylium solani* strains also reported meaningful results and significant.

Messai, 2011. Etude phytochimique d'une plante medicinale de l'Est Algerien (*Artemisia herba-alba*):

Abstract

The aim of this work is a contribution to the valorization of the principal active components in the Algerian *Artemisia herba alba*.

Materials and methods: The aerial parts of *Artemisia herba-alba* were collected during the flowering stage in September 2005 in the Tebessa region of eastern Algeria. 1800 g of the air-dried aerial parts were powdered and extracted by a CH2CL2-MeOH mixture (1:1) at room temperature, and the extract was concentrated under vacuum to obtain 100 g of residue. The residue was prefractionated by silica gel column chromatography eluting with n-hexane and a gradient of CH2Cl2 up to 100% CH2Cl2 and CH2CL2-MeOH (2 L of each mixture). The residues were subjected to further separations. The structures of the compounds were determined by comprehensive NMR studies, including DEPT, COSY, NOESY, HMQC, HMBC, and HRMS.

The results: The chemical screening revealed two new sesquiterpene lactones involved in methylene chloride/methanol extract of the aerial parts. The afforded new natural sesquiterpene lactones are 1β,9β-diacetoxyeudesm-3-en-5α,6β,11β H-12,6-

olide, and 1β,9β- diacetoxyeudesm-4-en-6β,11β H-12,6-olide together with 4 known compounds.

Miloudi, 2018. Contribution à l'étude de l' extraction des huiles essentielles par champ électrique pulsé haute tension:

Abstract

High voltage pulsed electric field treatment is of commercial importance in food preservation, biotechnology, water treatment, medicine, and as a technique for solid-liquid extraction from plant matter. In this context, this thesis work aims to study the influence of high-voltage pulsed electric field treatment on the intensification of the essential oil yield of two medicinal and aromatic plants *Marrubium vulgare* and *Artemisia herba alba* widely used by the local population in traditional Algerian medicine. The quantitative study allowed to recognize a clear increase in extraction yield (more than 100%) and a decrease in distillation time (minus 50%) compared to conventional methods. The qualitative analysis by CG/SM, allowed to control the quality of the essential oil obtained. These analyses showed a better quality of the products obtained by the pulsed electric field treatment compared to those obtained without treatment. This technique has shown that it can be one of the most promising technologies in the essential oils industry for an increase in extraction yield, the quality of the products obtained as well as the decrease in production costs.

Mouchem, 2015. Contribut à l'etude des huiles essentielles de l'armoise blanche de trois localités de l'ouest algérien (Ras-Elma , el-Aricha et Mécheria) et leurs effets antimierobiens:

Abstract

The aim of this study is to determine the biological activity of *Artemisia herba-alba* essential oils that were chosen for therapeutic characteristics in traditional medicine.

Materials and methods: Ethnobotanical study of wormwood (*Artemisia herba–alba Asso*) was conducted in the circle of the town of Sidi Bel Abbes about the therapeutic uses practiced by the local population. Plant material of *Artemisia herba alba* was collected from three localities Ras El Ma, Aricha, and Mecheria. The essential oil extracted by the hydro-distillation method and analyzed by CG and CG-MS. A comparative study of the essential oils of *Artemisia herba alba* of three localities was done by comparing the physicochemical characteristics of these essential oils. The

antimicrobial activities of *Artemisia herba-alba* essential oils were studied on six microbial strains (four bacteria and two fungi).

The ruselts: The results of the ethnobotanical study showed that wormwood foliage is the most used part and the majority of remedies are prepared as an infusion. In terms of the treated disease of the respiratory system rank first. The average yield obtained from the essential oils extracted from the *Artemisia herba-alba* plant studied in the three localities varies according to the station. El Aricha and Mecheria have the highest yields, which are of the order of (1.2% and 1% respectively). Ras El Ma station provides the lowest efficiency (0.7%). The essential oil of the white wormwood of the three localities does not differ greatly in its Physico-chemical properties. The essential oil of white wormwood is known for its composition rich in monoterpenoids, especially oxygenated. The use of gas chromatography to determine the components of the *Artemisia herba-alba* Essential Oils has revealed 36 compounds. The thresholds of the antibacterial activity of essential oils of white wormwood is at the concentration of 25% and the antifungal activity is between 50% and 25% v/v.

Nabti, 2020. Inventory, Biology, and Ecology of Culicidae (Diptera) of Setif region and control tests using plant extracts:

Abstract

The aims of this study are to perform a species mosquito inventory in the Setif region (Algerian high plains) from 2016 to 2019, in order to provide the list of mosquito species in the study area and analyze their biodiversity, density, and species distribution across two climate zones (Mediterranean Csa and steppe BSk Zones) using different statistical tests, and to assess the larvicidal activity of the essential oils extracted from plants collected from northeastern Algeria as potential alternatives to synthetic insecticides.

Materials and methods: The identification of species was done using a combination of morphological (diagnostic keys) and molecular (PCR-RFLP analysis of Cytochrome c Oxidase subunit 1 gene) approaches. The essential oils extracted from *Thymus vulgaris, Artemisia herba-alba, Juniperus phoenicea, Rosmarinus officinalis,* and *Eucalyptus globulus*, were tested against the 3rd and 4th instar *Culiseta longiareolata* larvae; the larvae were exposed to a series of concentrations of the

tested essential oils for 24h. The concentrations that caused between 10% and 90% mortality were replicated four times, the entire test was repeated three times.

The results: The sampling yielded the identification of nine mosquito species including the malaria vectors *Anopheles labranchiae* (4.4%) and *An cinereus hispaniola* (0.5%). The pairwise comparison and Ordination Corresponding Analyses ascertained the presence of a significant association between species distribution/density and climate zones in the study area, and confirm the effect of the climate changes on the mosquito population. The tested oils revealed an efficient larvicidal activity, *T. vulgaris* showed 100% mortality at 80ppm final concentration, while the other tested oils showed 100% mortality at 200ppm. Thus, The use of essential oils or their principal active components as α-pinene, 1,8-cineole, and Camphor may serve as an eco-friendly method to control mosquito larvae. Consequently, the study provides a comprehensive program to control the mosquito population in the Setif region.

Nia, 2018. Effet des extraits phénoliques sur le potentiel biotique du puceron vert du pêcher (*Myzus persicae Sulzer,* 1776) (Homoptera: Aphididae):

Abstract

Two main objectives of this study are: the first characterizes the study of some bioecological parameters of the green peach aphid (*Myzus persicae)* during the 2013 study year in an orchard located in the Beni Fdhala region (Ain-Touta, Batna). The second concerns the study of the impact of extracts of six medicinal plants and according to three modes of extraction on the insect considered for the purpose of control test, noting that the tests are conducted in the laboratory.

This insect completed two flight periods, the first of which corresponds to the Flight of Emigration and Dissemination and which took place from April to June. The second period corresponds to the return flight which began on 13 September before ending on 15 November 2013. The degree of infestation varied between (2) and (3).

Six plants (*Artemisia herba alba, Peganum harmala, Schinus molle, Nerium oleander, Eucalyptus camaldulensis*, and *Rosmarinus officinalis*) were selected with three extraction modes according to the increasing polarity of 3 solvents (Petroleum ether, Ethanol, and Distilled Water). The ethanolic extract of *Nerium oleander* caused a mortality rate of 73% and the phytochemical screening showed its richness in polyphenols compared to other plants. The application of three families of

polyphenols (Flavonoids, Tannins, and Phenolic Acids) gave convincing results on all the parameters chosen for the tests (mortality, repulsion, inhibition of growth, development time, fertility, and adults longevity).

3.3. Magister Memoirs:

Amor, 2010. Etude de certaines propriété biochimique de la plante d'armoise blanche (*Artemisia herba alba* Asso.):

Abstract

The aim of this study is to characterize the chemical composition of essential oils of *Artemisia herba alba* and to assess their antimicrobial and antioxidant activity.

Materials and Methods: The plant was collected at the flowering stage in Setif region. Essential oils were obtained by hydrodistillation using a Clevenger type apparatus, whereas aqueous extract was obtained by maceration and organic extract by soxhlet apparatus using acetone as solvent. Essential oils analyzed by GC and GC/MS. Total phenolic contents were determined using the Folin-Ciocaltou reagent. Free radical scavenging effects were evaluated using DPPH radical. Antimicrobial activities, as well as the MICs, were determined using three bacterial strains and five fungal strais according to the disk diffusion assay.

The results: The yields were 0.94% (v/w), 15% (w/w), and 7.5% (w/w) of hydrodistillation, maceration, and Soxhlet apparatus respectively. The analysis of essential oils allowed the identification of 50 constituents dominated by cis-thujone (28.1%), camphor (22.8%), 1,8-cineole (8.2%), and trans-thujone (7.8%). The aqueous extract content was 1.35 mg CAE/mg dw and the organic extract content was 0.32 mg CAE/mg dw. Aqueous and organic extract flavonoid contents were respectively 0.53 mg QE/g dw and 0.54 mg QE/g dw. The IC50 was 2.67 mg/ml, 236 µg/ml, and 331 µg/m for the essential oils, aqueous and organic extract respectively. All extracts had an effect on the microorganisms tested. Pseudomonas aeruginosa was resistant.

Bekka, 2009. Effet des huiles essentielles d'*Origanum glandulosum Desf.* et d'*Artemisia herba alba* Asso. sur des bactéries multirésistantes:

Abstract

The aim of this study is to evaluate the antibacterial effect of *Origanum glandulosum* and *Artemisia herba alba* essential oils on four bacterial, pathogenic, and resistant strains: *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Escherichia coli*, and *Pseudomonas aeruginosa*.

Materials and Methods: The aerial parts of *Origanum glandulosum* and *Artemisia herba alba* were collected in Mai 2008 from Bejaia. The essential oils of aerial parts was extracted by hydrodistillation. The antibacterial activity of the essential oils was evaluated on the four bacterial strains by the disk diffusion method. The inhibiting minimal quantities (IQM) of the volatile phase and the minimum bactericidal concentrations (MBC) were determined.

The results: The essential oils from *Origanum glandulosum* was found efficiency against the four strains. However, the essential oil from *Artemisia herba alba* inhibits only the growth of *S. aureus*. The volatile phase of *Origanum glandulosum* showed an antibacterial activity on *S. aureus*, *K. pneumoniae* (IQM are equal to 20 µl) and *E. coli* (IQM inferior or equal to 10 µl). On the other hand, the volatil phase of *Artemisia herba alba* presents only an activity on *S. aureus* with IQM equal to 80 µl. The MBC of the essential oil of *Origanum glandulosum* on *E. coli* is 4 µl/ml, it is 3.2 µl/ml for *K. pneumoniae*. However, it is higher than 4 µl/m for *S. aureus*. The MBC of the essential oil of *Artemisia herba alba* is higher than 8 µl/m for *S. aureus.*

Benmokadem, 2003. Contribution à l'étude des profils des huiles essentielles produites chez quelques espèces spontanées algériennes du genre Artemisia:

Abstract

Essential oils have been the subject of several studies on their mode of formation, their location in the plant, their role in the metabolism of the planta, the influence of the environment on their biosynthesis. The aim of this study was to contribute to the valorization of the species selected as the most important of this genus in Algeria, by a bio-ecological study and by the determination of the chemical compounds of the essential oil present in each species.

Materials and Methods: The essential oils of The aerial parts of the Artemisia species collected from South (*Artemisia campestris* and *Artemisia judaïca*), the high steppe (*Artemisia herba alba*), and North Algeria (*Artemisia arborescens*), were extracted by hydrodistillation and analyzed by CPG.

The results: The essential oils yield of *Artemisia herba alba* and *Artemisia judaïca* was produced two times more than *Artemisia campestris* and *Artemisia arborescens*. The same species presented some compounds to strong concentration. *Artemisia herba alba* contained camphor (40%) and the 1,8 cineol (10%), *Artemisia campestris* contained β-pinene (7%) and α_pinene (5.5%), *Artemisia judaïca* contained the Piperitone to 65% and essential oil of *Artemisia arborescens* was composed of 47.5% of β-thyone and 11% of camphor essentially. The variability of the EO can be assigned to the species, to the climate, and to the soils conditions.

Chaabna, 2014. Activité anticoccidienne des extrais d'*Artemisia herba alba:*

Abstract

The objectives of this study are to evaluate the efficacy of the ethanolic extract of *Artemisia herba alba* leaves and compared it to a standard anticoccidial (Amprolium) in the treatment of caecal coccidiosis caused by *Eimeria tenella* in broiler chicken and discussed how the treatment by extract could improve the growth performance of chicken.

Materials and Methods: The leaves were collected at the flowering stage in October-November 2012 from the Ain Smara region in Constantine. Leaves were dried and powdered. Extract ethanolic was obtained by the Maceration method. The efficacy of *Artemisia herba alba* ethanolic extract was evaluated at concentrations of 390 mg/kg, 780 mg/kg, and 1170 mg/kg in the treatment of caecal aviatrix coccidiosis caused by *Eimeria tenella* in experimentally infected broilers.

The results showed that *Artemisia herba alba* has anticoccidial virtues similar to those of Amprolium, et ethanolic extract at 390 mg/kg gave the best results in the case of caecal coccidiosis. *Artemisia herba alba* has also a significant improvement in feed efficiency and growth of chickens at a concentration of 780 mg/kg ($p < 0.05$). And when the concentration is equal to or over 1170 mg/kg it causes an adverse effect which is manifested by hemorrhage at the caeca.

Cherib, 2009. Etude des activités antimicrobienne et antioxydante des huiles essentielle et des flavonoides d'*Artemisia herba alba* Asso., *Artemisia judaica. L. ssp. Sahariensis, Artemisia campestris L.,Herniaria mauritanica* Murb et *Warionia saharae* Benth. et Cou.:

Abstract

The aims of this study are to evaluate the antimicrobial and antioxidant activities of essential oils of *Artemisia herba alba* Asso.; *Artemisia judaica L; Artemisia campestris L* and *Warionia saharae,* and flavonoids of *Herniaria mauritanica* Murb and *Warionia saharae.*

Materials and Methods: Plants material were collected from Naâma region. The essential oils were extracted by hydrodistillation. The essential oils *Warionia saharae* and *Artemisiajudaica L* analyzed by gas chromatography (GC) and nuclear magnetic resonance (NMR *13* C). The analysis of flavonoids in *Warionia saharae* and *Herniaria mauritanica* was done by thin layer chromatography (CCM) and high-performance liquid chromatography (HPLC).

The results: These different plants contained different levels of essential oil (from 0.50% in *Warionia saharae* to 0.20% for *Artemisia herba alba*). These variations were closely related to the harvest period and the extraction method. The major constituents were β-eudesmol (34.6%), (E)-nerolidol *(25.7%)* and Linanol (14.6%) for *Warionia saharae* and Camphor (20.2%), Borneol (8.8%) and davanone (7.6%) for *Artemisia judaica.* Regarding *Herniaria mauritanica* Murb four compounds were identified: catechin, p-coumaric acid, gallic acid and Pyrocathéchol. The essential oils have antibacterial and antifungal activity of the significant majority of strains (the minimum inhibitory concentration of essential Oil was 50% of bacterial strains ranged from 0.25 pi/ml to 3.5 pi/ml) while the flavonoids are or less low. The antioxidant activity of flavonoids of *Warionia saharae* is comparable to that of ascorbic acid (The effective concentration of substrate that causes the loss of 50% of the activity of DPPH (EC50) varies from 0.04 g/ml to 7.48 g/ml). The yield of phenolic compounds was considerable in *Warionia saharae* (3.14%) compared to *Herniaria mauritanica* (0.92%).

Dahmani, 2004. Extraction et analyse d'huiles essentielles d'Armoise Algerienne (*Artemisia herba alba*):

Abstract

The aim of this study is to undertake the qualitative and semi-quantitative analysis of various essential oils of *Artemisia herba alba* from the highlands of Algeria: Batna, M'sila, Bordj Bou Arréridj, Djelfa, Boussaâda.

Materials and Methods: The essential oils of the stems and leaves of *Artemisia herba alba* were extracted by hydrodistillation and analyzed by GC and GC/MS.

The results: The yields of the species were of the same order of magnitude (0.46 - 0.65%) with the exception of those of M'sila and Batna were higher (0.94% and 1.03%). The mass spectrum by the electronic impact was allowed to confirm the identification made by simple gas chromatography and to identify 149 compounds of which 57 are common to the six essential oils, while 42 were highlighted to knowledge for the first time in the essential oils examined. The composition of the different essential oils differs in particular in the content of five constituents: α-thujone, β-thujone, camphor, chrysanthenone, and 1.8 cineol. The Djelfa sample has a completely different composition and has majority constituents such as 1,8-cineol, nordavanone, davanic ether, and davanone.

Irateni, 2008. Etude des activités antibactérien et antioxydante des extraits d'AHA et Punica pranatum et d'éspèces Quercus et de certains composés phénoliques:

Abstract

In this study, the antibacterial and antioxidant activities of some medicinal plant extracts were examined. These plants are widely used in the Algerian folk medicine. They are indicated in *Artemisia herba alba*, *Punica granatum* and some *Quercus* species. Phenolic compounds were extracted and quantified in the aqueous and organic extracts of the previous plants. The antibacterial activity of plant extracts and phenolic compounds was examined using disc diffusion agar method. Their antioxidant activity was assessed by DPPH and β-carotene/linoleic acid assays. From one hand; plant extracts and phenolic compounds exhibited antibacterial activity against some bacteria species like: *Staphylococcus aureus*, *Enterobacter agglomerans*, *Salmonella typhi* and *Citrobacter freundii*. In the other hand, these extracts and phenolic compounds exhibited strong antioxidant and free radical scavenging properties.

Touil, 2012. Composition chimique et activite antimicrobienne des huiles essentielles d'*Artemisia herba alba* Asso. et *Artemisia Campestris L.* de la region aride de Djelfa:

Abstract

The aim of this study is to characterize the chemical composition of essential oils of *Artemisia campestris* and *Artemisia herba alba* and assess their antimicrobial activity

vis-à-vis the three bacterial strains (*Bacillus subtilis*, *Escherichia coli*, *Micrococcus luteus*) and three fungal species (*Aspergillus carbonarius*, *Aspergillus flavus*, *Penicillium expansum*).

Materials and Methods: The aerial part of *Artemisia campestris* and *Artemisia herba alba* were collected from the Djelfa region. The essential oils was extracted by hydrodistillation and analyzed by GC/MS to determine their chemical composition and their identification chemotype.

The results: The extraction of *Artemisia campestris* and *Artemisia herba alba* showed a yield of 0.3 and 0.7% respectively. The results of the analysis showed that oil *Artemisia herba alba* chemotype is davanon which consists mainly of davanon (62.2%) while essential oil *Artemisia campestris* is characterised by the pressence of β-pinene (20.75%) and limonene (10.46%) and γ-terpinene (10.18%) as major chemical constituents. The essential oils are active in vitro against *E. coli*, *Bacillus subtilis* and *Micrococcus luteus*. However all fungal strains tested proved impervious to oils studied.

3.4. Summary of results:

Plants of the genus Artemisia (family Asteraceae) have been used in folk medicine by many cultures since ancient times. Herbal tea from these species has been used as an analgesic, antibacterial, antispasmodic, and hemostatic agent. Historically, Artemisia has been a productive genus in the search for new biologically active compounds. Phytochemical investigations have proven that this genus is rich in sesquiterpenes and monoterpenes

Phytochemistry studies were carried out on the composition chemic and the bioactivities of *Artemisia herba alba* extracts and essential oils were collected from different regions in Algeria in the last twenty years.

In most studies, the essential oils were extracted from aerial parts of *Artemisia herba alb* by hydrodistillation and analyzed by the GC-MS method. Antioxidant effectiveness was examined by the radical scavenging method (DPPH) and by a free radical generator in situ. The antibacterial activity of the essential oil was assessed by the disk-diffusion method on agar. The antifungal was assessed by the direct method in vitro on solid medium agar. The analysis HS-SPME-GC-O-MS has assessed the

toxicity of the essential oils. The concentration of toxic chemical elements (As, Br, Ce, Co, Cr, and Sb) was determined by the Instrumental neutron activation analysis (INAA) method.

The chemical analysis of essential oil was revealed many components, the major constituents were: Camphor, Chrysanthenone, 1,8-Cineol, α-Thujone, and β-Thujone. These chemical components may vary or their concentration depending on the region and year the plant was harvested. The results of bioactivities of *Artemisia herba alba* essential oils were showed a good effectiveness.

4. Ecophysiology studies:

Plant ecophysiology is an experimental science that seeks to describe the physiological mechanisms underlying ecological observations. In other words, ecophysiologists, or physiological ecologists, address ecological questions about the controls over the growth, reproduction, survival, abundance, and geographical distribution of plants, as these processes are affected by interactions of plants with their physical, chemical, and biotic environment. These ecophysiological patterns and mechanisms can help us understand the functional significance of specific plant traits and their evolutionary heritage **(Lambers *et al.*, 2008).**

We found sixteen scientific works; Theses (4), Articles (7), Magister Memoirs (4), where represent 13% of the total.

4.1. Articles:

Ayad *et al.*, 2007. Dynamique des peuplements d'*Artemisia herba alba* Asso dans la steppe du Sud Oranais (Algérie occidantale):

Abstract

The objective of this study is to establish the spatial distribution of wormwood (*Artemisia herba alba*) in two stations geographically in South Oran.

Materials and Methods: The study was carried out at two stations located in the high steppe plains of South Oran (Ras Elma and El Aricha). This study was based on systematic sampling to determine the density of *Artemisia herba alba* per square meter through the sampled transects.

The results are processed by statistical tests of heterogeneity. The study of the spatial distribution of wormwood (*Artemisia herba alba*) has made it possible to highlight the progressive occupation of areas initially populated by alfa (*Stipa tenacissima L.*). The gradual degradation of the water slicks, the manifestation of the phenomenon of allelopathy, and the sedentarization of livestock have favored the large-scale installation of wormwood. The descriptive study analyzed by several statistical tests of heterogeneity highlights the complexity of the horizontal structuring of the *Artemisia herba alba*, the implantation of wormwood being very irregular.

Ayad *et al.*, 2017. Interféences alfa-armoise blanche dans la steppe du sud de la wilaya de Tlemcen (Algérie occidantal):

Abstract

The objective of this study is to investigate *Artemisia herba alba-Stipa tenacissima L.* interference in the steppe of south Tlemcen.

Materials and Methods: The study was made from systematic surveys on six transects and completed by simple random sampling points quadrats "Circles & Rectangles". The collected data about *Artemisia herba alba* and *Stipa tenacissima L.* were processed statistically by calculating the density, the index of dispersion, and the analysis of variance.

The results: The analysis of data indicated a uniform distribution on aggregative in studied two species. The various tests confirm the random regular distribution *Stipa tenacissima L.* and complexity to that of the *Artemisia herba alba*. The *Stipa tenacissima L.* clumps spatially distributed regularly at random. By cons, *Artemisia herba alba* presents a more complex spatial distribution (random to aggregative). The occupation of land by *Artemisia herba alba* in some areas is following the disappearance of *Stipa tenacissima L.*.

Benabadji *et al.*, 2004. Les sols de la steppe a *Artemisia herba alba* Asso au sud de Sebdou (Oranie-Algérie):

Abstract

The aim of this study is to evaluate the soils of steppe environments southwest of Sebdou (Oranie-Algeria) of *Artemisia herba-alba* groups in the semi-arid and arid bioclimatic stage.

Materials and Methods: The selected *Artemisia herba-alba* study stations are mostly located on the Sidi Djilali, Magoura, El-Aicha, El-Aouedj (Western Algeria) axis. these stations are located on the arid margins of the high plains where the degradation of the forest is followed by the invasion of perennial steppe species such as: *Stipa tenacissima* and *Artemisia herba-alba*. The analysis Physico-chemical of the study area was carried out to get to know the ecological aspect of the various soils.

The result showed a homogeneous textural composition of the soil profile and soil poverty of organic matter and mineral materials. The results indicate that this soil is suitable for the growth of wormwood.

Bouazza *et al.*, 2004. Evolution de la végétation steppique dans le sud-ouest de l'Oranie (Algérie):

Abstract

The objective of this work is to estimate the evolution of the vegetation cover of a steppe area in Algeria, by a diachronic study of the state of land use and vegetation over 30 years and three reference periods (1973, 1990, and 2003).

Materials and Methods: The study is based on three cartographic surveys performed in 1973, 1990, and 2003, in order to quantify the evolution of these ecosystems. The area selected for this diachronic cartographic study corresponds to the high steppe plains located along the National Road 22, between Sebdou, El-Aouedj and El-Aricha (south-western Oranie). This territory represents an area of 53,119 ha, on an altitudinal range varying between 1,100 and 1,200 m.

The results: The steppe plant communities are threatened by an increase in the magnitude of diverse ecological processes (desertification, deforestation, dematerialization, and desertisation). The intact communities with *Stipa tenacissima* decrease in surface, with 6.61 % of the surface studied in 1973, but only 2.24 % in 1990, and the total disappearance of these formations in 2003. The surfaces occupied by *Artemisia herba-alba* and *Stipa tenacissima* decrease considerably along the road of Sebdou, El-Aouedj, El-Aricha. The overgrazing and human disturbance on the Stipa tenacissima and *Artemisia herba-alba* steppe favour in some places the colonisation of these habitats by ruderal plants and therophytes Furthermore, the increase of dryness had induced the decay of huge surfaces with *Stipa tenacissima*, and the regeneration capacity of this keystone species is seriously jeopardized.

Lahmar & Aidoud, 2016. Suivi à long-terme dans la steppe d'Armoise blanche (*Artemisia herba alba* Asso.) du sud-oranes (Algerie): Facteurs et indicateurs de changements:

Abstract

The objective of this study is to identify and evaluate changes in vegetation cover and the dynamic characteristics of the ecosystems of wormwood steppe.

Material and method: They made an assessment of the main vegetation and soil surface parameters in the BEM site between 1975 and 2013.The Bordj-El-May (BEM) site has been selected as a pilot site for the ROSELT project: Observatory Network for Long-Term Ecological Monitoring of the OSS (Observation du Sahara et du Sahel).

The data used in this work are data from sampling of pre-existing systems in 1975, from long-term monitoring at the monitoring site in the use of reference years and from the diachronic approach from other locations in the region sampled in 1975/76 and in 2013/2015.

The results are a degradation that has been accompanied by changes in the composition and dominance of communities with the appearance or extension of species indicative of changes in use and ecological conditions. The increase in ephemeral species can explain the increase in beta diversity, while at the same time gamma diversity has decreased, accompanied by a banalisation of the flora. Compared to the rest of the pre-existing wormwood (*Artemisia herba-alba* Asso.) steppe in the monitoring site, sand fixation following a series of rainy years would have played an important role in the regeneration of the vegetation cover.

4.2. Theses:

Ayache, 2013. Dynamique des peuplementes de l'armoise blanche (*Artemisia herba alba* Asso) de la région d'El-Aricha (Algerie occidentale):

Abstract

The aim of this study is to investigate the dynamics of land and stands of wormwood (*Artemisia herba alba* Asso) to understanding the evolution of the operating modes of each space, and the causes contributing to the degradation of steppe rangelands in the high plains of Western Algeria.

Materials and methods: The study area is part of the steppe located in the high plains of Western Algeria and is an evolving area, subject to very significant anthropogenic pressures. The data usedfor the study of the dynamics of land use are images « Landsat 5 » TM (Tematic Mapper) in March 1987 and March 2010. For each image, a supervised classification of NDVI values (Index Difference Standardized Vegetation) has been applied. Two lands «1987 and 2010 » maps were produced with six thematic classes defined. The density and the rate of recovery following the method sampled points quadrats aligned two transects 200 m and 300 m in the eight stations in the study area are the main parameters describing the dynamics of stands of wormwood.

The results: The analysis of land-use change shows an increase of cleared and cultivated surfaces respectively 55% and 49%, therefore, a remarkable reduction in the size of the risk zones by 31% between the two dates. However, the structure parameters of wormwood stands are well correlated. The disparity values recorded for these two parameters indicates the existence of a strong heterogeneity in these stands. The study of the spatial and temporal dynamics of land use and the stands of *Artemisia herba alba* showed that there are processes irreversible degradation of steppe vegetation involved in the complexity of the implementation method of the species studied, reinforcing the risk of desertification.

Berrached, 2017. Contribution à l'etude spatio-temporelle des stations à armoise blanche (*Artemisia herba-alba* Asso) des hautes palaines steppiques et études phénologiques:

Abstract

Steppe ecosystems have experienced significant degradation affecting their structure, functioning and ecological services. However, determining the abiotic and/or biotic factors acting on the composition and diversity of flora, the structure of the vegetation cover and the phenology of species would contribute to the management of these ecosystems and benefit sustainably from ecological services. To this end, a Spatio-temporal study of the vegetation was carried out to protected the wormwood ecosystems (*Artemisia herba-alba* Asso.) in the Djelfa region. The phenology and vegetative growth were studied of white wormwood in the provenance test at the university nursery (Algiers). All of this work was carried out through two complementary approaches; a descriptive approach and a functional approach.

The results reveal that the species' response to water stress controls the temporal distribution of floristic composition, specific diversity, vegetation cover structure, and species phenology. The availability of pollinators and phylogeny also contribute to the explanation of phenology. The long duration of protection of anthropogenic action favored the increase in the overall vegetation cover, but has a negative effect on the morphology of white wormwood. In addition, phenotypic variability in wormwood has been identified.

Conclusion: the response of plants to abiotic (water stress) and biotic (pollinator availability) constraints, the duration of protection of anthropogenic action and possibly genetic factors are essential in the determinism of the structure, functioning and services of steppe ecosystems.

Houamel, 2018. les steppes d'armoise blanche (*Artemisia herba alba* Asso) dans l'est algérien : répartition actuelle, biodiversité , dynamique et conditions de durabilité:

Abstract

The objective of this study is to understand the dynamics of the white wormwood steppe (*Artemisia herba-alba*) in eastern Algeria.

Materials and methods: This study was conducted long-term monitoring the evolution of qualitative (richness and diversity of flora, plant groups, and composition) and quantitative (vegetation cover, biomass, and fodder production) and ecological (climate, soil) in the White wormwood steppe. This follow-up made it possible to understand the importance and causes of the change.

The results: White wormwood (*Artemisia herba-alba*) was present in the eastern steppes from 1968 to 2016-2017. Its distribution at the levels of the sites studied expresses a great heterogeneity as confirmed by the high value of the coefficient of variation which varies from 48% to 90%. A highly significant difference in the average frequencies of white wormwood appears between 1968 and 2016-2017. The year 1968 is characterized by low frequencies for white mugwort with 8.6%, while in 2016-2017 there is a frequency with an increase of more than 40% with a frequency of 19%. Regarding floristic wealth, the highest value is observed in the pre-existing system in 1968. A significant decrease in this wealth occurs after in 2016-2017, the floristic decreases significantly from 245 species in 1968 to 90 species in 2017. Diachronic analysis almost 50 years apart showed regression of steppe vegetation by

the decrease in the number of species. Significant variation in éphémères during the follow-up years was observed. Significant recovery is achieved in 1968 with 70% while 21.4% in 2016-2017. The production of plants perennials was experiencing a slight decrease according to the "Celles" surveys carried out in 2017. At the end of this work, we can conclude to an effective degradation of the white wormwood steppe as is advanced in most writings on the state of the steppes of the High Plains of Algeria. Compared to the results obtained according to the same protocol, this degradation was faster and more intense in the alfa steppe than in the wormwood steppe.

Lahmar, 2016. Les steppes à chaméphytes ligneux des hautes plaines d'Algérie: Etat actuel, dynamique et réhabilitation:

Abstract

The aims of this thesis work are to study long-term dynamics and to highlight the factors and indicators of change in the white wormwood (*Artemisia herba alba Asso*.) steppe of the Bordj-El-May region in the South Oran. This work incorporates the results of monitoring that began more than 40 years ago.

Materials and methods: The data processed were collected between 1993 and 2015 and supplemented by those of the monitoring of vegetation in the same site collected between 1975 and 1993 and the sampling of wormwood steppes in 1975/76.

The results showed degradation of perennial vegetation that has been accompanied by changes in community composition with the appearance or extension of species indicative of changes in use (overgrazing) and ecological conditions marked mainly by the increase in the sand rate. The significant rainfall of the last ten years explained the increase in *Ephemeroptera* (aquatic insects), which has led to an increase in stationary diversity, while at the same time, overall diversity has decreased. Compared to the rest of the pre-existing steppe in which the *Artemisia herba alba* has regressed a lot, the monitoring site, despite siding, showed some regeneration of this species.

Saidi, 2017. Inventaire et analyse de la phytodiversité dans les steppes à armoise blanche de la wilaya de Saida (algérié occidentale):

Abstract

The aim of this work is to characterize the floristic and edaphic composition of steppe formations based on white wormwood (*Artemisia herba alba* Asso.) through the steppe zones of the Saida region, in seven stations belonging to the municipalities of Moulay Larbi, Sidi Ahmed, Maamora, and Ain Skhouna.

Materials and methods: The study was undertaken during the years 2013, 2014, and 2015 to inventory the natural vegetation and characterize it in ecological terms by highlighting the importance of environmental conditions. The method used consists of determining the plant composition of the species by means of phytoecological surveys and the study of edaphic parameters. In parallel, was developed a map of the distribution of white wormwood formations in the study area. correspondence analysis (FCA) and ascending hierarchical classification (AHC). Subsequently, the spatial and temporal variations of the essential floristic parameters (vegetation recovery rate, floristic richness, specific diversity, biological types, systematic composition) were studied.

The results of the spatial was analysis show an important floristic richness of the white wormwood formations with a total of 77 species inventoried in the study area. The biological spectrum was characterized by a clear dominance of therophytes compared to other biological types. From a systematic point of view, 65 genera belonging to 24 botanical families were determined in the study area, the largest number of species belongs to the Asteraceae family. The Poaceae, the Fabaceae, the Caryophyllaceae, and the Boraginaceae were also present with high levels. The analysis of the biogeographic spectrum reveals the dominance of the species of Mediterranean affinity whereas the endemic species represent 10 % of the inventoried species. The analysis of the average recovered for the seven stations revealed three classes: a class of stations with average recovery rates exceeding 50 %; A class of stations with an average recovery rate between 30 and 50%; A class of stations with an average recovery rate of less than 30 %. The average dry matter production varies from one station to another (between 540 and 2 550 kg DM/ha); It is related to the state of degradation of the stations. The Physico-chemical analyzes of the soils showed that the soils of the study area are superficial soils, of sandy loam texture, and poor in organic matter. The results of the analysis of the temporal variations of the floral cortège were highlighted by the inter-annual comparison over three years (2013, 2014, and 2015): 87 species were recorded on the 187 surveys carried out during the three years of study on the white wormwood formations in the steppe zone of the

Saida region (27 surveys per station), the total number of species recorded each year in the whole study area is comparable during the three years of study: 77 in 2013, 78 in 2014 and 72 in 2015. This study did not detect large temporal variations in floristic parameters. Finally, the map of the distribution of the white wormwood formations in the zone established using the tools of remote sensing and the geographic information system, allowed us to have an overall idea of the distribution of the formations of white wormwood in the steppe area of the Saida region.

Yousfi, 2017. Contribution à la détermination d'un modèle d'exploitation d'un parcours steppique à base d'espèces autochtones par simulation de pacage:

Abstract

The objective of this study, which was carried out for two years on natural steppe ranges in the region of Thlidjène (Wilaya of Tébessa), is to contribute to the implementation of mathematical models determining the rate of regeneration of the phytomass of the two indigenous species *Salsola vermiculata L.* and *Artemisia herba alba Asso.* forming the two dominant fodder shrubs in these courses.

Materials and methods: The species *Salsola vermiculata L.* was subjected to a cutting treatment (simulation of grazing) according to three different degrees: severe (75% of the volume of the shrub), medium (50% of the volume of the shrub), and light (25% of the volume of the plant). For the species *Artemisia herba alba* Asso. this was done by applying an animal load of 5 head/ha. The data was processed by statistica 6.0 and Excel 7.0 software (Microsoft Corporation).

The results: The study of *Salsola vermiculata L.* demonstrated that the regeneration rate is subject to the cutting effect and phenological stage. In addition, the rate of regeneration of phytomass follows different mathematical equation models depending on the degree of severity of the cut for this species. The phytomass regeneration rate follows a neperian logarithm function trajectory for severe and light cuts, as well as for all cuts, and a quadratic equation for average cutting. The results of *Artemisia herba alba* Asso. showed that the regeneration rate follows an exponential equation model.

4.3. Magister Memoirs:

Gordo, 2014. Contribution a l'analyse phytoecologique de la région d' AIN SEFRA (Naama):

Abstract

This study is a phyto-ecological approach that aims to study the flora and vegetation of the region of Ain Sefra and Djebel Aïssa (Ksour Mountains) in particular classified National Natural Park in 2003. by its geographical location, this region is a real charm between the high plains and the Sahara. Jebel Aïssa, which is characterized by a diversity of exposures, altitudes and substrates, induces a diverse range of plant formations. As a first step, An area survey was conducted. This allowed identifying about 260 taxa. From these first results, were noted the regional floristic diversity since the taxa have different origins: tellienne, steppe and desert. In a second stage, 50 Phyto-ecological surveys were conducted in the Jebel Aïssa following an NNW-SSE transect from the vicinity of Mekalis in the north to the oasis of Tiout on the southern foothills. In this phytogeographical section, 130 taxa were recognized. Similarly, different types of vegetation were distinguished with the exception of halophilic vegetation. From the bottom to the top of the Jebel, was observed: the subdesert facies occupying the warm slopes to the south, the steppe groupings on the northern foothills as well as the psammophyl facies.

In addition, the floristic relays were treated with 2 types of multivariate analyses (AFC and CAH). these treatments revealed 4 plant groups:

Group with *Quercus rotundifolia* and *Stipa tenacissima*

Group with *Juniperus oxycedrus rufescens* and *Atractylis caespitosa*

Group with *Atractylis serratuloides* and *Thymelaea microphylla*

Group with *Arthrophytum scoparium* and *Artemisia herba alba*

Hamdi, 2012. Interférences alfa-armoise dans la steppe du sud de Tlemcen, Laboratoire de biodiversité végétal:

Abstract

In recent decades, there has been an accelerated degradation of the alfa steppes in the high steppe plains of southern Tlemcen. In many sites, alfa (*Stipa tenacissima L.*) tends to be replaced by wormwood (*Artemisia herba-alba* Asso.).

This work investigates the interference between alfa and wormwood at three stations in the steppes south of Tlemcen. Systematic surveys on six transects, supplemented by leatorial samples, and treated statistically by the calculation of density, the dispersion index, and analysis of variance confirm the regular distribution of *Stipa tenacissima L.* and the complexity of that of *Artemisia herba-alba* Asso..

Lahmar, 2001. Mécanismes de désertification dans une steppe à armoise blanche (*Artemisia herba alba* Asso.) cas de la région d'El May (sud-oranais, Algérie):

Abstract

The objective of this work was to show the effects of grazing and overgrazing on a steppe ecosystem by highlighting the nature and significance of changes in key vital attributes both biotic and abiotic.

Materials and methods: The impact of the grazing was assessed to the study area on vegetation through changes in the specific composition of communities, density, and biomass of major plant populations and forage resources; and the edaphic conditions expressed here by changes in the characteristics of the soil surface, those in texture and organic matter content.

The results obtained showed that the degradation of vegetation was faster and more intense in the alfa steppe than in the wormwood steppe. This degradation has mainly resulted in a significant change in vegetation. Despite a significant reduction in the physical and trophic abilities of the soil, it seems that the ecological and biological potential of this steppe is still at a level still close to that noted in the pre-existing system. From this point of view, rehabilitation actions by resting can make it possible to restore a sufficient level of functioning to the system.

Taibaoui, 2008. Etude phytoécologique et diachronique de la végétation d'une steppe à armoise blanche (*Artemisia herba alba* Asso.) de la coopérative Yahiaoui (région d'Ain Oussera, Wilaya de Djelfa):

Abstract

The present work was carried out in the high steppe plains of southern Algiers, at the level of the Yahyaoui cooperative (Aïn-Oussera region, wilaya of Djelfa) in order to follow the dynamics of the *Artemisia herba alba* routes as well as the determination of the factors acting on the distribution of vegetation at a stational scale.

Materials and methods: The diachronic study was carried by means of a GIS (Geographic Information System) between the map of old land use (1985) and that reflecting the state of the current plant carpet (2008), generated from aerial photographs and supplemented by phyto-ecological surveys.

The results: the regressive evolution of the vegetation cover was observed by the substitution of alfa-based grassy climatic steppe with an *Artemisia herba alba*-based chamaephyte climatic steppe, with the extension of mainly post-cultural degradation formatons. This regressive evolution has its origins in two essential factors: a climatic aridity, resulting in a clear decrease in precipitation and a rise in temperature; an edaphic aridity induced by the anthropogenic factor thus facilitating the invasion of species considered desert such as *Noaea mucronata*.

The statistical analysis of the results by the AFC made it possible to give five homogeneous sets individualized by their geomorphology and their dominant species.

4.4. Summary of results:

The main objective of these studies is to identify and evaluate changes in vegetation cover and the dynamic characteristics of the ecosystems of wormwood steppe in Algeria, by diachronic studies and Long-Term Ecological Monitoring of the evolutions qualitative (richness and diversity of flora, plant groups, and composition) and quantitative (vegetation cover, biomass, and fodder production) and ecological (climate, soil) in the White wormwood steppe.

The results are processed by statistical tests of heterogeneity. The studies of the spatial distribution of wormwood (*Artemisia herba alba*) have made it possible to highlight the progressive occupation of areas initially populated by alfa (*Stipa tenacissima* L.). The gradual degradation of the water slicks, the manifestation of the phenomenon of allelopathy, and the sedentarization of livestock have favored the large-scale installation of wormwood. The descriptive studies analyzed by several statistical tests of heterogeneity highlights the complexity of the horizontal structuring of the *Artemisia herba alba*, the implantation of wormwood being very irregular.

5. Physiology studies:

Plant physiology seeks to understand all the aspects and manifestations of plant life. In agreement with the major characteristics of organisms, it is usually divided into three major parts: (1) the physiology of nutrition and metabolism, which deals with the uptake, transformations, and release of materials, and also their movement within and between the cells and organs of the plant; (2) the physiology of growth, development, and reproduction, which is concerned with these aspects of plant function; and (3) environmental physiology, which seeks to understand the manifold responses of plants to the environment (**Aldesuquy, 2012)**.

We found eight scientific studies; 1 Theses, 5 Articles and 2 Magister Memoirs, where represent 7% of the total.

5.1. Articles:

Abderabbi *et al.*, 2018. Leaf morphological and anatomical traits variation of *Artemisia herba alba* in a steppe zone of Algeria:

Abstract

The aim of this study is to elucidate the anatomical particularities of the leaf and their relationship with its morphological, micro-morphological characteristics and variation of *Artemisia herba-alba* Asso. population in a steppe zone of western Algeria.

Materials and Methods: The samples of *Artemisia herba-alba* were taken from El-Mansab located in the province of Tiaret, Algeria. They were collected during the developed vegetative stage, in September month. All measurements were made on completely differentiated leaves located at the middle part of the stem. The quantitative parameters relate to the number of leaflets per leaf, the number of small leaflets per leaflet, and the distance between the leaflet in millimeters (mm). The qualitative parameters concern the leaves' color and the arrangement of leaves on the leaf axis. For the color, three-level scales were used, dark green (1), intermediate green (2), and pale green (3). Two modes of disposition are retained opposed and alternate. The micro-morphological parameters measured on the impression of the blade epidermis concerned the density of the stomata and the length of the ostiole.

The results showed significant micro- and macromorphological variability between individuals in the study population. The leaf anatomy brings the presence of a water reserve parenchyma in this species. This parenchyma would be a water accumulation site during dry periods and it is therefore an effective mechanism for drought adaptation. The anatomical parameters studied also show signififi cant variations. The other anatomical parameters of the leaf also have a very pronounced variability. It is shown through this study that morpho-anatomical models are established. Thus, the increase of the water reserve parenchyma thickness is accompanied by an increase of the chlorophyll parenchyma and the stomatal density, and the opposite situation was observed.

Maghni *et al.*, 2017. Evaluating morphological variability of *Artemisia herba alba* Asso. from western Algeria:

Abstract

The aim of this work is to investegate of the morphological variability of 120 individuals of *Artemisia herba-alba* Asso. coming from three stations in western Algeria , which was assessed through 15 quantitative and qualitative characters.

Materials and Methods: Study sites known as El-Manseb (Altitude 1326m) are located in the highlands of the South East of the province of Tiaret (001° 48’ 40.8’’ E, 35° 01’ 19.2’’ N) in the North West of Algeria.Samples collected from the *A. herba alba.*for studying morphological parameters of the sheet were made during the most developed vegetative stage, which corresponds to September. To see the characteristics of the reproductive organs, échantillons were collected during the flowering which spreads out end of October until late December 2012. The characteristics of the samples were observed under a binocular microscope and photographers. The analyzes of the expression of the characteristics frequencies in individuals from each population, comparison of means by analysis of variance (ANOVA), and the hierarchical ascending classification allowed us to evaluate the variability within and between populations.

The results: Analysis of variance (ANOVA) and hierarchical cluster analysis (HCA) results showed significant morphological variability inter and intra-population. This phenotypic variability is explained by a high genetic polymorphism determined at another genetic study that we conducted in parallel on individuals of the same site using molecular markers types ISSR.This study also revealed a large variability

within *A. herba alba* which could help investigation on a large collection of individuals and therefore select the most efficient ecotypes for re-introduction this species in steppes and highlands of Algeria.

Maghni *et al.*, 2018. Dynamics of the anatomical variability of *Artemisia herba alba* in Algeria:

Abstract

The aim of this work is the anatomical study of variability in *Artemisia herba-alba* in three different bioclimatic stages and its relation to the distribution and adaptation of the species.

Materials and Methods: The anatomical variability in *Artemisia* herba-alba Asso. was studied based on 90 individuals taken from three regions El-Faidja located in Tiaret, Oued Morra in Laghouat, and Hassi Er' Mel of different bioclimatic zones in Algeria (inferior semi arid, arid and Saharan) as well as the relationships of the dynamics of this variability with the distribution and adaptation of the species. The existence of the anatomical variability observed through the observations of the anatomical sections and the differences in the measurements of the characters noted in each site and also between the different sites has been confirmed through three statistical tests, the first is Multivariate Tests of Significance, the second is a Multivariate Analysis of Variance (MANOVA), ANOVA and the Ascending Hierarchical Classification (CHA).

The results: The interpretation of the results of this study through the analysis of variance and the ascending hierarchical classification allowed us to detect a very high intra- and inter-specific anatomical variability, as well as the presence of a parenchyma of water reserves observed in individuals of each studied region. The existence of relationships between environmental conditions and the dynamics of anatomical variability have been established. The results also indicated a high variability in *A. herba alba* which could help the choice of the most effective ecotypes for the reintroduction of this species in the degraded steppe ecosystems of Algeria and thus of North Africa.

Nedjimi & Zemmiri, 2018. Salinity effects on germination of *Artemisia herba-alba* Asso.: Important Pastoral Shrub from North African Rangelands:

Abstract

The aim of this study is to determine the effect of four soluble salts on germination of *Artemisia herba alba* seeds.

Material and methods: *Artemisia herba alba* seeds were harvested in August 2014 from the rangelands of Moudjbara in the province of Djelfa (Algeria). Seeds were externally disinfected with 10% NaOCl solution and 60% alcohol for 10 min and were washed with distilled H2O. Seeds were germinated in different concentrations (0, 50, 100 and 150 mM) of four soluble salts (NaCl, Na2SO4, MgCl2 and CaCl2).

The germination test was carried out in an incubator with a 12h photoperiod under 15°C/ 25°C light.The four concentrations of each salt were used to test the influence of salinities on germination percentege (GP), rate of germination (RG) and germination tolerance index (GTI%).A two-way analysis of variance (ANOVA) was carried out to test the effects of salts, concentrations and their interaction on the (GP), (RG) and (GTI%).

Resuts: study showed that seeds of *A. herba alba* can germinate under moderate concentration of 50 mM for all tested salts.The germination tolerance index (GTI%) revealed that *A. herba alba* seeds were more tolerant to CaCl2 than other soluble salts. MgCl2 and Na2SO4 were generally the most toxic salts on germination seeds.

Rebhi *et al.*, 2019. Response of *Artemisia herba alba* to hexavalent chromiun pollution under arid and Semi-arid conditions:

Abstract

The objective of this study is to determine the rosponses of *A.herba alba* to the stress invented by the hexavalent chromium present in the Algerian steppe région soil and eventually application in phytoremediation.This plant was selected for morphological and physiological characteristics and its ability to adapt in the arid and semi-arid climate of Algerian steppe egion.

Materials and methods: The experiment was conducted in the fied near Ain Oussera, 200km in the South of Algiers, located at the area of Algeria steep. Ten plants were selected from the wornwood, five for the control and five for the pollution simulation, and were treated weekly with hexavalent chromium solution over a period from February to May for 3 years respectively. Plants were harvested, dried, and separated into leaves, stems and roots, and were crushed and sieving to have powder for metal concentration analysis.The soil was sampled from the same place as the plant.

Metal chromium contents of the soil and the plant samples were extracted by acide digestion, followed by measurement of all elements concentrations by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) using an iCAP 6000 series ICP-spectrometer apparatus.

The results from this study showed that the *Artemisia herba alba* has strong resistance to the high concentrations of hexavalent chromium. The results of physiological elementary analysis indicated that chromium was absorbed by *A. herba alba* . the high chromium concentrations have not affected the growth and development of the wormwood.

5.2. Theses:

Henni, 2018. Etude comparative de l'adsorption des ions (Pb+2 , Cd+2) par l'armoise blanche et l'alfa, et l'élaboration d'un film biodégradable à base amidon/fibre d'alfa:

Abstract

The objective of this thesis is based on two main themes: The valorization of lignocellulosic fibers of wormwood (*Artemisia herba-alba*) and alfa (*Stipa tenacissima)* and their application in the treatment of water loaded with metal pollutants. The synthesis of a biodegradable plastic film with low starch and alfa fiber. In the first theme, the removal of metal ions Pb2+ and Cd2+ was studied by these two materials. The adsorbents were previously characterized and then subjected to a series of experiments in order to study their adsorption capacity vis-à-vis metal cations. All the results obtained showed that the kinetics of adsorption of the two metal ions on the two materials was well described by the pseudo-second-order model. The adsorption isotherms of the adsorbent/adsorbate systems studied were satisfactorily described by the mathematical model of Langmuir and Freundlich. The second theme, devoted to the elaboration of starch films and starch/alfa fiber films, then evaluation of the biodegradation of these films by certain bacterial suspensions, two media were considered; solid medium (agricultural soil, sand, and activated sludge), and liquid medium (seawater, activated sludge suspension). The results obtained reveal that these media have a good capacity for degradation of these films and with considerable loss of mass.

5.3. Magister Memoirs:

Chebab, 2012. Etude des caracteristiques physiologiques et biochimiques d'*Artemisia herba alba*:

Abstract

The aim of this study is to investigate *Artemisia herba alba* as one of the suitable species for the reconstruction of degraded pastoral ecosystems in Mediterranean bioclimate. Three study areas were selected (Djelfa, Ksar Chellala, and Bou Saâda) and two seasons (winter and spring) to identify the adaptation of this species to environmental conditions by changing the biochemical and physiological parameters.

The three ecotypes (Djelfa, Ksar Chellala, and Bou Saâda) during the two seasons (winter and spring) revealed the existence of a correlation between seasonal variation and ecotype response. The winter was a rough period, it presented a state of stress for both ecotypes Djelfa and Ksar Chellala which have responded by increasing the accumulation of Na+ ions, soluble sugars, proline, and soluble proteins and low amount of chlorophyll, flavonoids, and low accumulation of K+ ions. This situation was reversed in the spring with an increase in the amount of chlorophyll (a,b, and c) and K+ ions. Regarding the ecotype Bou Saâda, the best time was winter where recorded large amounts of chlorophyll (a,b, and c) and flavonoids were. The period of spring was the hardest unlike the ecotypes Djelfa and Ksar Chellala with large accumulations of Na+ ions, soluble sugars, proline, and soluble proteins. The aqueous extract of Artemisia given to groups of mice provokes a fall in inflammation at 0.2 g/l concentration during the spring period. The *Artemisia herba alba* is non-toxic plant and it does not present any danger to the mice tested. Note also that it is widely used by the local population againt various diseases.

Torchit, 2009. Effet du stress salin sur les parametres morphologiques et physiologiques d'*Artemisia herba alba* Asso. en culture in vitro:

Abstract

The aim of this study is to determine the behavior of white wormwood (*Artemisia herba alba*) from Djelfa region in different levels of salinity, as well as the tolerance threshold for the type of salt used (Sodium chloride) by referring to certain morphological and physiological parameters and these under conditions *in vitro*.

The results showed that the tolerance of *Artemisia herba alba* to the NaCl was estimated to be 10 g/l. The test of germination to show an effect remarkable of NaCl on the rate of the seeds germinated, with a rate of high germination of 66% for the control T1 (0 g/l) and rates relatively weak for the treatments T2 (5 g/l) and T3 (10 g/l) valued of 22% and 9% respectively. The effect of salt stress was highly significant on the totality of morphological and physiological traits analyzed. The depressive action of salt was appeared by a reduction of the growth of stem and root of in vitroplants as the concentration in salt increases. The application of a severe salt stress T2 (5g/l) and T3 (10g/l), was induced at this species a reduction of the number of leaves and by consequence a reduction of the biomass. Concerning the variations noted on the parameters bound to the physiology of the plant, one recorded a gradual decrease in the content in the chlorophyll of the leaves to reach minimal values to sever stress T2 (5g/l) and T3 (10g/l). This lowering is followed by an important accumulation of solutions (glucose and proline). This accumulation became more pronounced as the treatment became severe. All-time, we noted at the level of the treatments T2 (5g/l) and T3 (10g/l) of NaCl, this accumulation of solutions will be fitting in its major part to active osmoregulation meaning the probable placing the phenomenon of the tolerance to the saltiness like the osmotic adjustment.

The augmentation of the membrane permeability was remarked parallel to the augmentation of solutions, which was marked for the level of salt stress 5 g/l and 10 g/l of NaCl, to decrease at control treatment.

5.4. Summary of results:

Artemisia herba alba was selected in these studies for morphological and physiological characteristics and its ability to adapt to the arid and semi-arid climate of the Algerian steppe region.

Among the objectives of these studies are to elucidate the anatomical particularities and their relationship with its morphological, micro-morphological characteristics and variation of *Artemisia herba-alba* population in a steppe zone of Algeria (**Abderabbi *et al.*, 2018; Maghni *et al.*, 2018**) and to determine the effect of salinity on the germination of seeds (**Nedjimi & Zemmiri, 2018**) and the growth development (**Torchit, 2009**) of *Artemisia herba alba* .

The interpretation of the results of these studies allowed to detection of a very high intra- and inter-specific anatomical variability, as well as the presence of parenchyma of water reserves observed in individuals of each studied region. The existence of relationships between environmental conditions and the dynamics of anatomical variability have been established. The results also indicated high variability in *A. herba alba* which could help the choice of the most effective ecotypes for the reintroduction of this species in the degraded steppe ecosystems of Algeria and thus of North Africa.

Chapter III:

Research projects related to *Artemisia herba alba*

Chapter III: Research projects related to *Artemisia herba alba Asso.*

1. The ROSELT/OSS program:

The Sahara and Sahel Observatory (OSS) has set up a Network of Observatories for Long-Term Ecological Monitoring (ROSELT/OSS) in the circum-Saharan zone, as part of its environmental monitoring program, in support of policies for the implementation of National and Sub-Regional Action Programmes (NAP and SRAP) to combat desertification (**ROSELT/OSS DS4, 2004**).

The ROSELT/OSS program relied heavily on the recommendations of the meeting organized jointly by Pics, MAB/UNESCO, and I'OSS in July 1992 in Fontainebleau (France), which also gave rise to the GTOS program (**ROSELT/OSS DS1, 2004**).

This system was designed with and at the service of African countries, to ensure the long-term monitoring of desertification and to develop associated research activities (**ROSELT/OSS DS4, 2004**). The countries are Algeria, Burkina Faso, Cape Verde, Chad, Egypt, Erythrea, Ethiopia, Gambia, Bissau Guinea, Djibouti, Kenya, Libya, Mali, Mauritania, Morocco, Niger, Senegal, Somalia, Sudan, Tunisia, Uganda (**ROSELT/OSS DS1, 2004**).

The fundamental objectives of ROSELT/OSS are: monitoring the long-term evolution of ecological systems; understanding the interactive functioning between populations and their environment at the local level, in particular for the determination of the respective and/or synergistic share of the climatic and anthropogenic causes of land degradation (**ROSELT/OSS DS2, 2004**).

Biologically productive environments including the pastoral domain: low woody vegetation (eg Boscia senegalensis, *Artemisia herba alba*), herbaceous plants (eg Cenchrus ciliaris, Stipa tenacissima) are the subject of an in-depth study by the ROSELT / OSS program.

In its study of the steppes, a lot of Algerian research relied on the information collected from the observatories of this program ROSLET/OSS in Algeria.

2. Flore du Maghreb:

Following the publication of L'Index synonymique de la flore d'Afrique du Nord in 2013 by Dobignard and Chatelain, a digital flora project of the Maghreb was set up in collaboration with botanists from Tunisia, Algeria and Morocco.

The main objectives of the Flore d'Afrique du Nord project are the collection of botanical data from vascular plants including *Artemisia herba-alba* in North Africa from a nomenclatural, systematic, biogeographic, ecological and conservatory angle to make them available to botanists and researchers.

This flora, which will be available on the web, is based on the two volumes of the New Flora of Algeria and the southern territories of Quézel and Santa of 1963, which were converted into digital format and then updated at the nomenclature level (towards 35-45% changes). More than 400 taxa present in Algeria have been added as well as about 2000 Moroccan and 200 Tunisian taxa.

New digital technologies offer fabulous advantages such as the reuse of existing documents (OCR) and especially the sharing of real-time data on the cloud with foreign colleagues, not to mention the possibility of inserting a large number of color illustrations, such as photographs and distribution cards. This Flora, gathering more than 6400 taxa, will be quickly usable online and can be implemented over the next few years by the various stakeholders (**Chatelain, 2017)**.

The project has been the subject of the workshop at the OPTIMA congress in Montpellier (June 2016), a conference at the AETFAT congress in Nairobi (June 2017), and a publication in the FeuilleVerte (June 2017) for the BGCI 2017 congress in Geneva).

CONCLUSION

Conclusion

Artemisia herba alba (white wormwood) is one of the most important plants in Algeria, where many studies have been done about this plant. The objective of the present study is to conduct a database on the scientific studies carried out during the last two decades on this species in Algeria.

We collected these studies from the websites google, google scholar, scientific journals, Algerian university sites, and the Thesis Algeria; We focused our study on Theses, Articles, and Magister Memoirs. we summarized and divided it into five fields according to their objectives.

We found one hundred and fourteen (114) scientific studies (27 Theses, 73 Articles, 14 Magister Memoirs). We divided these studies into five fields:

- Ethnobotanical and Ethnopharmacological studies
- Karyological and cytogenetic studies
- Phytochemistry studies
- Ecophysiology studies
- Physiology studies

In the third chapter, we presented two projects that may be related to the wormwood plant.

The ROSELT/OSS program: fundamental objectives are: monitoring the long-term evolution of ecological systems; understanding the interactive functioning between populations and their environment at the local level, in particular for the determination of the respective and/or synergistic share of the climatic and anthropogenic causes of land degradation. This program helped in scientific research such as Long-term monitoring in the White Sagebrush steppe (*Artemisia herba alba* Asso.) of southern Oranes (Algeria): Factors and indicators of change.

Flore du Maghreb: is a digital flora project of the Maghreb that was set up in collaboration with botanists from Tunisia, Algeria, and Morocco.

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