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Ethnopharmacological Survey of Plants used in Folk Medicine by the Amazigh Tribe of Ait Youssi Amkla, Morocco

Khadija Tarmoun[1]*, Houria Nekhla[2], Aziz Zahri[2], Najoua Benchemsi[2], EL Houssaine Harki[1]

[1]*Laboratory of Microbial Biotechnology and Bioactive Molecules, Faculty of Sciences and Technologies, University of Sidi Mohammed Ben Abdellah, FEZ, 2202, Morocco*
[2]*Functional Ecology and Environment laboratory, Faculty of Science and Technologies, University of Sidi Mohammed Ben Abdellah, FEZ, Morocco*

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ABSTRACT

Moroccan people tend to rely on medicinal plants as the primary source of healthcare, especially in rural areas. This source has been upgraded through generations thanks to the diversity of the Moroccan culture and the existence of many ethnical groups that transmitted the know-how of the medicinal plants leading to a rich Moroccan pharmacopeia.
In this light, this ethnopharmacological study aims to get data on medicinal plants used by the Amazigh tribe, in the region of Ait Youssi Amkla, to treat different ailments. This research was conducted using a questionnaire that includes demographic information of informants and some characteristics of the recorded plants. The information collected was analyzed using Informant Consensus Factor (ICF), Use Value (UV), Fidelity Level (FL), Frequency of Citation (RFC), and Rank Priority Order (ROP). In this survey, 35 plant species belonging to 22 families were inventoried, with the dominance of the *Lamiaceae* family *(*43.48%). Fresh leaves or dried ones were found to be the most used parts of the plants to prepare natural remedies, using the decoction as the mode of preparation. The high use value index was assigned to *Arbutus unedo L.*, *Artemisia herba-alba Asso* (UV= 0.43 each), and *Ranunculus calandrinoides* (UV= 0.40). According to the Informant Consensus Factor, we noticed that majority of the plants inventoried are dedicated to treating some skin diseases. Besides, *Arabis alpina L.*, *Aethionema saxatile* (L.) W.T.Aiton and *Ranunculus calandrinoides* have been registered for the first time as remedies against some skin diseases.

***Keywords*:** Folk medicine, Amazigh tribe, Medicinal plants**,** Quantitative ethnopharmacological analyses, Morocco.

Introduction

Moroccans have large experience in the use of plants for therapeutic purposes for a long time,[1] which has been transmitted through generations. Furthermore, several ethnopharmacological studies show that the use of plants as a traditional cure to treat diseases is widespread in Morocco,[2-5] especially in the rural regions. Indeed, Moroccan pharmacopeia is enriched by the knowledge brought by Amazigh and Arabic ethnic groups.[6] Additionally, due to its geographical situation and the wide range of its bioclimates, Morocco is inhabited by vast and diverse vegetation estimated at 4500 taxa with 920 genera and 130 families.[7] The importance of medicinal plants is enormous, it has been reported that they played an importance roles in new drug developpement.[8] Plants are rich in a variety of secondary metabolites that have a broad spectrum of physiological properties e.g. treatment of diabetes,[9-10] antifungal, [11-12] antimicrobial [13], and anti-inflammatory activity[14]. Therefore, a large number of studies are oriented towards plants, which remain an inexhaustible source of new bioactive molecules. To our knowledge, Ait youssi Amkla is a region that was not exploited before in term of ethnopharmacological surveys, so it is considered a new source for gathering valuable information on medicinal plants used in folk medicine. Therefore, the purpose of this study is to document the information on medicinal flora and the traditional knowledge of herbal remedies of the Amazigh tribe of Ait Youssi Amkla on medicinal plants.

*Corresponding author. E mail: khadija.tarmoun@usmba.ac.ma
Tel: (438) 765-0093

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Official Journal of Natural Product Research Group, Faculty of Pharmacy, University of Benin, Benin City, Nigeria.

Materials and Methods

Study area

The present study was carried out within the Amazigh tribe of Ait Yossi Amkla, which is located at 20 km South of Sefrou city (33° 41' 5" N, 4° 49' 11,9" W; 1329 m) (Figure1). This area is characterized by a Mediterranean climate, (dry and hot summers, cool and wet winters) with an annual rainfall that exceeds 600 mm per year. The region of Ait youssi Amkla is bordered by two mountains, Jbel Aoudad (1767 m) and Jbel Bouimourdasen (1465 m)[15]; and the vegetation covers about 8000ha, which consists of holm oak and woody steppe.[16] Therefore, it has a very rich and diversified medicinal plants potential, which is not explored yet.

Data collection

This ethnopharmacological study was conducted among individuals selected randomly within the Amazigh tribe of Ait Youssi Amkla, to inventory the medicinal plants used in this region. 200 individuals were interviewed for ethnopharmacological data through a questionnaire that includes information about the interviewees (age, sex, level of education), and the used plants (common name, used

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Figure 1: Geographical position of the study area (Ait YoussiAmkla region, province of Sefrou, Morocco).

parts of the plant, mode of consumption, used organs, method of storage, dosage and efficacy, and toxicity). Thus, based on the interviewee's answers we made a list of different diseases treated and a list of plants used for their treatment. The age of the informants varied between 20 and 70 years old, whose intellectual levels are different. Interviews were carried out using the Amazigh dialect to facilitate communication with the informants. The taxonomic identification of the inventoried species was carried out employing traditional Moroccan pharmacopeia of Bellakhdar,[1] and some plant database to verify the taxonomic name of the inventoried plants: The plant list,[17] Tropicos,[18] International Plant Names Index (IPNI),[19] and Global Biodiversity Information Facility (GBIF).[20] Specimens of each plant have been gathered and deposited at the herbarium of the laboratory of Functional Ecology and Environment (FEE), Faculty of Science and Technology, University of Sidi Mohammed Ben Abdellah Fes.

Quantitative data analysis

Factor of informant consensus (FIC)

According to Heinrich *et al*, [21] ailments have been classified into categories, to specify for each illness the appropriate species are used as a cure. FIC variate from 0 to 1; when the FIC value is close to 1 this means that a large proportion of informants use one or a limited number of plants to treat a particular illness, while a low FIC value indicates that the informants randomly use the reported plant species. The FIC was calculated using the following formula:

$$FIC = \frac{Nur - Nt}{Nur - 1}$$

Where N_{ur} is the number of use citations reported for each category of diseases, N_t is the number of species used in each category.

Use value Index (UV).

The use-value is indented to evaluate the relative importance of the use of the plant.[22] It was calculated using the formula below:

$$UVi = \frac{\sum Ui}{\mathrm{N}}$$

Where N refers to the number of informants that mentioned the species, U is the number of therapeutic uses recorded for that species.

Fidelity level (FL %)

The fidelity level is the percentage of informants who separately mentioned the uses of plant species to treat a particular ailment. Thus, the FL is calculated as follows: [23]

$$FL\ (\%) = \frac{Np}{N} \times 100$$

N: number of informants reporting the species for any given diseases.
N_p: number of informants reporting the use of the plant species to treat particular diseases.
Quantitative data analysis is a useful tool for determining the more promising plants.

Relative popularity level (RPL)

The RPL is the ratio between the number of diseases treated by a particular plant species and the total number of informants for any disease. Thus, the result is between 0 and 1, with '1'being complete popularity of a plant for major ailments and '0' no disease treated by a plant species.

Rank Priority Order (ROP)

The Rank Priority Order was determined by multiplying the Fidelity level (FL) value by the Relative popularity level (RPL). [23]

Results and Discussion

Demographic data of informants

The use of home herbal remedies is widespread in all age groups of people within the Amazigh tribe of Ait Youssi Amkla, with the predominance of people who are between the ages of 50 and 60 years old (40%), followed by the oldest people (60 to 70 years old). The use of medicinal plants is low (12.85%) regarding people whose age is between 30 and 40 years old, while 8.57% is for people who are less than 30 years old as shown in Table 1.

Women (55.73 %) are more attached to folk medicine than men (44.27%) [24] and the large majority of medicinal plants users are un-educated (68.57%). Furthermore, people with primary school level have a low use percentage of home herbal remedies (28.75%), while a less percentage is observed for people in a secondary school and university level (Table 1). In the area of study, the knowledge about the medicinal plant is transferred through generations.

Medicine used by the population in the study area

In the study area of our research, we have observed that folk medicine is more popular (89.55 %) than modern medicine, and this could be due to the low price of phytotherapy. Moreover, the lack of health facilities in the local dispensary and the long way travel to the well-equipped hospitals are the reasons why people in the region of Ait Yossi Amkla are still linked to herbal medicine (Figure 2a). Overall, these results are in agreement with the previous studies which show that the percentage of using plants for medicinal purposes varies between 55% and 90%. [25-29] Furthermore, people in the area of study use medicinal plants for two different purposes; therapeutic (94%) and cosmetic (6%) (Figure 2 (b)

Medicinal plants in Ait Yossi Amkla

In this survey 35 plant species belonging to 22 families have been inventoried (Table 2); the *Lamiaceae* family is the most used to treat diseases in this region (40.90%), followed by the *Asteraceae* family (18.18%). The remaining plant families are used with similar percentages such as: *Apiaceae*, *Capparaceae*, *Fabaceae*, *Linaceae*, *Ranunculaceae*, *Rutaceae* and *Brassicaceae* (Complete list of family plants is listed in Table 2). In our research, we stated the widespread used families of medicinal plants in the region of Ait Yossi Amkla are *Lamiaceae* and *Asteraceae* families complying with other ethnobotanical studies conducted in the same region in Morocco.[30,31] Moreover, several studies have documented the aromatic and medicinal properties of the *Lamiaceae* family[32] as well as the

Asteraceae family, due to the presence of a large spectrum of secondary metabolites.[33]

The collected species are grown spontaneously (*Rosmarinus Officinalis* L., *Origanum compactum Benth*, *Mentha pulegium* L., *Herniaria Hirsuta* L, *Arabis Alpina L*, etc.) or are cultivated (*Allium sativum* L.) in our study area. Furthermore, we documented new therapeutic application forms of some plants.

The plants cited in this study are all known in the bibliography to have pharmacological activities (Table 2), these plants are similarly used as traditional remedies against various ailments in another region of Morocco, except *Arabis alpina L.*, Aethionema saxatile (L.) W.T.Aiton and *Ranunculus calandrinoides* have been reported for the first time as remedies against some skin diseases. Many studies have reported that some plants have a wide spectrum activity such as the *Nigella sativa* which has antimicrobial, antioxidant, nephroprotective, and hepato-protective activities.[34] Thus, the essential oil of *Rosmarinus officinalis* and *Salvia officinalis* have activity against microorganisms that cause oral diseases.[35] On the other hand, the combination of essential oil of *Syzygium aromaticum* and ethanol extract *Rosmarinus officinalis* with Ketorolac showed an anti-nociceptive activity.[36]

Used part of plants and its mode of preparation

Several parts of the plant are used in folk medicine especially leaves, bark, root, seed, whole plants, fruit, flower. In our study, the leaves were the most widely used part as traditional remedies (38%), the same results were reported in a similar study in a different region of Morocco. [37,30,38] Whereas, the aerial part comes in second place (21.42%) followed by seeds (9%), bark, roots (4.76% each). As regards to the whole plant, rhizome, and flower buds, they are not widely used (2.38 % each) (Fig.3).

Concerning the preparation mode, the local inhabitants use a variety of methods to prepare the traditional remedies from plants e.g. decoction, infusion, maceration, fumigation, Poultice, etc. Nevertheless, the decoction is the most used way to prepare remedies from these plants (27.39 %), followed by infusion and poultice (15.47%, 14.28% respectively), powder, tisane, fumigation, oil, and maceration (8.33 %, 7.14%, 4.76%, 3.57%, and 3.57% respectively) (Fig.3). Besides, some informants mentioned that they cook some medicinal plants with food; they also use the mixture of several plants, which can be used fresh or dried. Moreover, the traditional remedies from plants can be prepared with other ingredients such as honey, sugar, lemon, etc. In the area of study, the decoction is the most popular method used to prepare traditional remedies from plants, which is in agreement with several ethnopharmacological studies.[39,30]

Storage methods of medicinal plants

The survey carried out shows that Amazigh of Ait Yossi people use the dry medicinal plants, to extend the shelf life because they are not available all season of the year. Furthermore, the popular method of storage in the Ait Youssi Amkla region is conserving the medicinal plants in a dark and enclosed space chosen carefully, to maintain their quality. Amoo *et al* have demonstrated that medicinal plants can maintain their biological activity after long-term storage in dark conditions at ambient temperature.[40]

Dosage, duration of use, and administration route

Amazigh tribe of Ait Yossi Amkla pays less attention to the dosage part. In many cases, they use a handful as a unit of measurement that has a percentage of 50% (Figure 4 (a)). This lack of dosage is due to limitations in knowledge about the principal components of medicinal plants. There are different routes of administration e.g. bathing, eardrop, massage, and anal application, but most remedies are taken orally and topical application, for an undefined time (Figure 4 (b)). Some of the previous studies indicate that most of the herbal remedies are taken orally.[41] The Amazigh tribe of Ait Yossi burn some medicinal plant species to sniff the fumes for example to treat influenza or to sterilize a large sealed area. Furthermore, some parts of the plant such as the olive leaves are just crushed and used to treat mouth ulcer.

Effectiveness and toxicity of traditional remedies

According to the survey, 47 % of interviewees affirmed the efficiency of the medicinal plants, therefore, the use of drugs is not needed, 50% of users noticed an improvement in their health state. On the other hand, 3% of informants asserted the inefficiency of the use of medicinal plants to treat some diseases (Figure 5 (a)). Furthermore, 98% of people in the region of Ait Youssi Amkla find the use of medicinal plants to be safe and without side effects (Figure 5 (b)). According to the bibliography, some of the recorded medicinal plants are considered to be safe and they did not show any toxicity. [42,45] Whereas, the report on toxicity for most species is still lacking. Otherwise, some plants are toxic at certain doses for example *Capparis spinosa* L.[46] In addition, the Cutaneous application of *A. gummifera* L. induces severe toxicity, coma, hepatic failure, acute renal failure, and arrhythmia.[47]

Quantitative data analysis

Factor of informant consensus (FIC)

According to this study, we noticed that the majority of plants inventoried (28 species) are dedicated to treating some skin diseases, 17 species are used as a cure against digestive disorder, 11 species are used as treatment against respiratory diseases, followed by neurological disorders, ENT pathology, urinary tract infections (9 and 5 species respectively). Moreover, diabetes, menstrual disorders, and arterial hypertension are treated with 4 plants species each. The remaining plants are used as detox, aphrodisiac, blood purifier, etc. The factor of informant consensus for all categories of ailments variates from 0.661 to 0.955. Most of the ailment categories show a FIC value close to 1, indicating the uniformity in the use of traditional remedies by the population in the region of Ait youssi Amkla (Table 3).

Use value Index (UV) and Relative frequency of citation (RFC)

The current investigation shows that the highest use value index was calculated for *Arbutus unedo L.* and *Artemisia herba-alba Asso* (UV= 0.43 each), followed by, *Ranunculus calandrinoides* (UV = 0.40) *Herniaria hirsuta* L. (UV = 0.33), *Nerium oleander* L. (UV = 0.31), *Ajuga iva Schreb* and *Calendula officinalis* L (UV= 0.25 each). However, for the other plants, the use-value index varied from 0.03 to 0,.25 (Table4). According to the relative frequency of citation, the most widely used medicinal plants to treat some diseases are *Marrubium vulgare* L (0.50), *Olea Europea* L. (0.40), *Mentha pulegium* L. (0.39), *Allium sativum L.* (0.37), *Linum usitatissimum* L. (0.34) (Table4). In the region of Fez, *Olea europea* L and *Marrubium vulgare* L are among the plants which are used to treat diabetes, as they have a high relative frequency of citation [48]. Indeed, Barkaoui *et al* have reported that *Marrubium vulgare* L is used to treat diabetes with UV = 1.43, RFC 0.29.[48]

Table 1: Demographic data of informants (N = 200).

	Groups	Percentage %
Age	20-30	8.59
	30-40	12.85
	40-50	20
	50-60	40
	≥ 60	18.57
Sex	Female	59.16
	Male	40.84
School level	Illiterate	65.71
	Primary school level	28.59
	Secondary school level	4.28
	University level	1.42

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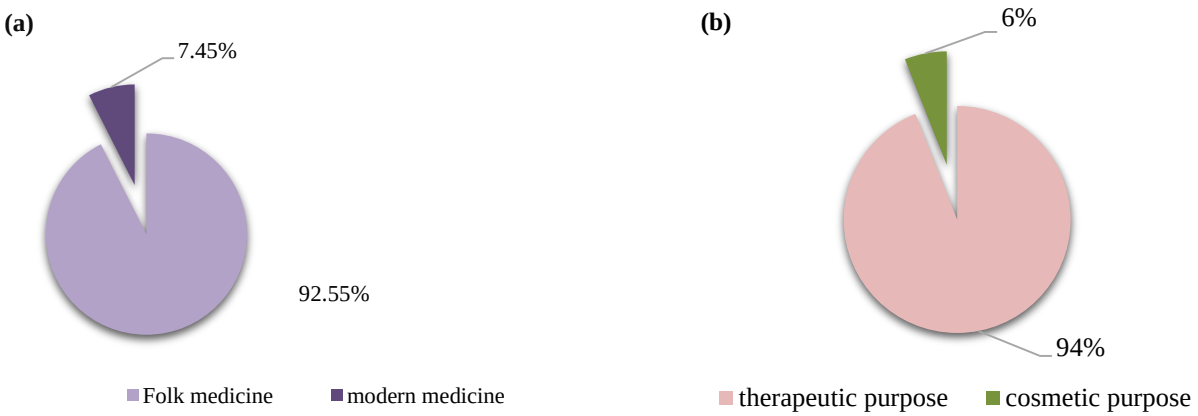

Figure 2: The most expanded type of medicine (a) and the therapeutic purpose of medicinal plants within the Ait Yossi tribe Amkla (b).

Fidelity level (FL %)

The level of fidelity (FL) of the most promising plant species used by the Amazigh tribe of Ait youssi Amkla varied from 15.25 to 91.11%. The high FL was recorded for *Leopoldia comosa* Parl. with a percentage of 91.1%, then the *Mentha rotundifolia* (L.) with 90.63 %, followed by the *Aloysia citriodora Palau* with 89.00%, the *Cistus Albidus* L.with 81.08%, the *Origanum majorama* L. with 69.70 %, and finally the *Syzygium aromaticum L. Merr. and L.M.Perry* with 58.70 % that are used to heal skin diseases, fever, insomnia, skin wounds, digestive disorders, toothache, respectively (Table 4). In a previous study which was made in High Atlas among Amazigh-speaking community, the *Lavandula angustifolia Mill.* is one of the most reported medicinal plants to treat general health, gastrointestinal, gynecological, musculoskeletal, otolaryngological and respiratory, pediatric, urological and nephrological, and dermatological diseases [49]. Furthermore, Mohamed Eddoukse *et al* reported that *Mentha rotundifolia* (L.) represents 42% FL against gastrointestinal disorders in Daraa-Tafilalet region. Whereas, *Capparis spinosa* L. was recorded to treat some sexual problems with 45 % FL [38].

Rank Priority Order (ROP)

This inquiry indicated that *Leopoldia comosa* Parl. (ROP=73%), *Mentha rotundifolia* (L.) (ROP = 64%), *Allium sativum L.* (ROP = 58%), and *Aloysia citriodora Palau*. (ROP=27%) had the highest values of ROP, which means that these medicinal plant species are the most used as traditional remedies in the area of study (Table 4).

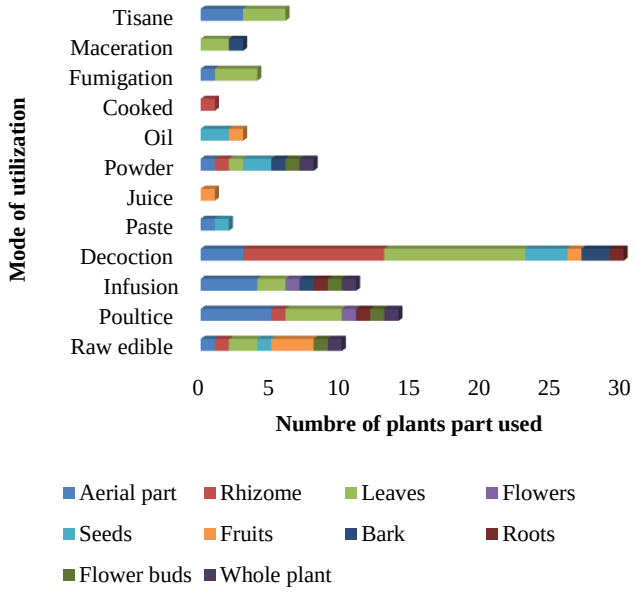

Figure 3: Number of part plants used and their mode of utilization

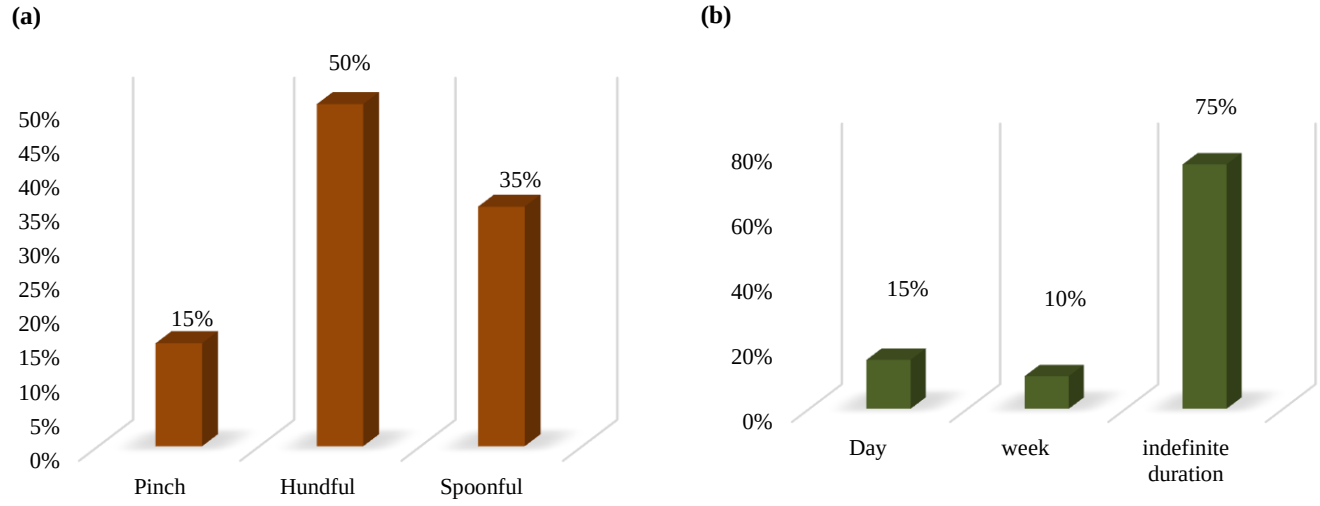

Figure 4: Plants dosage (a) and its duration of use (b)

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Table 2: List of medicinal plants used in region of Ait youssi Amkla with their therapeutic properties

Scientific Name	Local Name	Family	Used part/ Mode of consumption	Application Mode	Therapeutic Uses	U-value	RCF	Pharmacological Activities
Ajuga iva Schreb.	*Tadla*	*Lamiaceae*	*Areal part/Raw edible, infusion*	*Oral*	*Arterial Hypertension, diabetes, gastroenteritis*	0.25	0.06	Antidiabetic activities, analgesic activity, and antioxidant properties[50-52]
Allium sativum L.	*Ticharth*	*Liliaceae*	*Rhizome/Raw edible, paste, cocked, Poultice, powder*	*Topical, oral, anal application*	*Arterial Hypertension, rheumatism, cough, influenza, bronchitis, warts, angina, hair loss*	0.11	0.37	Hypertension, dyslipidemia[53] Immunomodulators, Hepatoprotectors, and Antimycobacterial Agents,[54] Antidote or a protective agent against natural or chemical toxicities[55]
Ammi visnaga (L.) Lam	*Tabchnikhth*	*Apiaceae*	*Leaves/Decoction,* *Seeds /Powder, infusion*	*Oral, toothbrush*	*Diabetes, asthma, gum diseases*	0.21	0.07	Anti-cancer activity, [56] anti-nephrotoxic [57]
Arbutus unedo L.	*Ousasno*	*Ericaceae*	*Leaves/Decoction,* *Fruits/ Raw edible* *Bark/Powder, decoction, infusion*	*Oral*	The digestive disorder, Arterial Hypertension, urinary tract infections	0.43	0.04	Antidiabetic activity,[58] antiaggregant activity[59], and antihypertensive activity [60]
Artemisia absinthium L.	*Chiba*	*Asteraceae*	*Leaves / decoction, fumigation*	*Inhalation, oral, eardrop*	*digestive disorder, nausea, influenza, blood purifier, antiseptic, ear pain*	0.11	0.28	Hepatoprotective activity, [61] antiparasitic,[62] antioxidant activity [63] and neuroinflammatory pathologies [64]
Artemisia herba-alba Asso	Ifssi	Asteraceae	Leaves /decoction, fumigation, infusion	Inhalation, oral	Digestive disorders, diabetes, Ritual, and magical practices	0.43	0.04	Antidiabetic [65] Antinociceptive, anti-inflammatory, [66] antifungal, [67] and Antimicrobial activity [68]

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Arabis alpina L.	Awrdal	Brassicaceae	Areal parts /Poultice	Topical	Eczema, skin wounds, leishmania	0.30	0.05	No report
Atractylis gummifera L.	Addad, taskra	Asteraceae	Roots / Poultice	Topical	Skin diseases	0.08	0.06	Antioxidant activity, [69] and anti-diabetic effect [70]
Aethionema saxatile (L.) W.T.Aiton	Tighighcht	Brassicaceae	Areal parts / Poultice	Topical	Skin diseases, Eczema, skin wounds, buns	0.17	0.12	No report
Calendula officinalis L.	Lâjamra	Asteraceae	Flowers / Infusion, poultice	Oral, topical	The digestive disorder, Eczema, wound healing, Peptic ulcer	0.67	0.03	Cytotoxic tumor cell activity, lymphocyte activation, [71] and antimicrobial activity [72]
Capparis spinosa L.	Kabbar	Capparaceae	Fruits/ Raw edible, Leaves /Decoction Roots/ Infusion	Oral, topical	Urinary Tract Infection, Digestive disorder, insect bites, anemia, fever	0.15	0.17	Anti-inflammatory activity,[73] antidiabetic, [74] and antibacterial activity [75]
Ceratonia siliqua L.	Téchétt	Fabaceae	Fruit Decoction, Raw edible	Oral	The digestive disorder, Diarrhea, anemia,	0.17	0.09	Gastrointestinal disorders,[46] antidepressant activity [76] and antioxidant activity [77]
Cistus Albidus L.	Rbibit	Cistaceae	Leaves / Poultice	Topical	Skin wound	0.03	0.19	Analgesic and anti-inflammatory properties[78]
Elettaria cardamomum Maton	*Hebbat el-hal*	*Zingiberaceae*	*Leaves /Decoction* *Seeds/ Decoction*	Oral	The digestive disorder, anemia, aphrodisiac	0.23	0.07	Antibacterial activity[79] and Gastroprotective effect [80]
Globularia alypum L.	*Tasalgha*	*Globulariaceae*	*Leaves/ Decoction, tisane*	*Oral*	*Menstrual pain*	0.04	0.12	Anti-inflammatory , wound healing [81] and antidiabetic activity [82]

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Herniaria hirsuta L.	*Herras lehjar*	*Caryophyllaceae*	*Whole plant/ Decoction, poultice, Powder*	*Oral, topical*	*Eczema, Urinary Tract Infection, skin wound*	0.33	0.05	Cholesterol-lowering effect in the bile of dogs, [83] and preventive agent against the formation of calcium oxalate kidney stones [84]
Lavandula angustifolia Mill.	*Lkhzama*	*Lamiaceae*	*Areal part/ Decoction, tisane, fumigation*	Oral, inhalation, topical	Skin diseases, Rheumatism, insomnia, asthma, antiseptic, acne, anxiety	0.13	0.28	Anti-insomnia, [85] antispasmodic actions, [86] neuropathic pain, [87] and peri-operative anxiety [88]
Leopoldia comosa Parl.	*Alzaz*	*Asparagaceae*	*Leaves / Maceration*	*Topical*	*Skin and capillary diseases, hair care*	0.07	0.23	Anti-obesity potential [89]
Linum usitatissimum L.	*Zariât lkatan*	*Linaceae*	*Seeds /Decoction, powder, oil*	*Oral, topical*	*The digestive disorder, Arterial Hypertension skin inflammations, urinary disorders, hair care*	0.07	0.34	Inflammatory disorders (rheumatoid arthritis), [90] analgesic activity, [91] burn wound healing, [92]repair of Skin Wounds, [93] and anti-diarrhea effects [94]
Aloysia citriodora Palau	*Lwiza*	*Verbinaceae*	*Leaves/infusion, tisane*	*Oral*	*Insomnia, Digestive disorder, stress anxiety*	0.03	0.50	Anti-snake Venom Activities, [95] antibacterial activity, [96] Gastrointestinal effects, [97] and spasmolytic effect[98]
Marrubium vulgare L.	*Ifzi*	*Lamiaceae*	*Leaves/ decoction, raw edible, maceration*	*Oral, topical*	*Cough, wound healing, bronchitis, Peptic ulcer, colagogic*	0.21	0.12	Antidiabetic activity, [99] antinociceptive,[100] antioedematogenic effect, [101] analgesic, [102] and antiulcer activity [103]
Mentha pulegium L.	*Fliyyo*	*Lamiaceae*	*Areal part/Infusion, decoction, poultice, tisane*	*Oral*	*Respiratory tract infection, headache, urinary problems,*	0.08	0.39	Antibiotic activity,[104] anticholinergics, [105] and antimicrobial activity [106]

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					cough, constipation, migraine			
Mentha rotundifolia (L.) Huds	*Timersit*	*Lamiaceae*	*Areal part/ paste, poultice*	*Topical*	*fever, headache,*	0.06	0.16	
Nerium oleander L.	*Alili*	*Apocynaceae*	*Leaves/ powder, poultice, fumigation*	*Sniff, topical*	*Fungal infection, influenza, sinus infection, Ritual, and magical practices*	0.31	0.07	Antibacterial activity [107] and cytotoxic activity [108]
Nigella sativa L.	*Sanûj*	*Ranunculaceae*	*Seeds /Raw edible, decoction, paste, oil*	*Topical, oral*	*Dizziness, joint pain, psoriasis, Eczema, hair coloring*	0.09	0.23	Antioxidant activity, [109] anti-inflammatory, analgesic, [110] Immunomodulatory properties, [111] and antibiotic activity [112]
Olea europea L.	*Zaytûne*	*Oleaceae*	*Leaves /Raw edible, decoction* *Fruits/ oil*	*Topical, oral, massage*	*Mouth ulcer, diabetes, wound healing, skincare*	0.05	0.40	Gastroprotective activity [113,114], oral mucositis, [115] antihypertensive, antiatherosclerotic, antioxidant activity, [116] and antidiabetic [117]
Origanum compactum Benth	*Za'tar*	*Lamiaceae*	*Arial part / Infusion, decoction,*	*Topical, oral*	*skin irritations, menstrual pain, rheumatism, antiseptic, digestive disorder*	0.09	0.28	Anti-dermatophytes activity [118], antioxidant, antibacterial activity [119] and anti-quorum sensing activity [120]
Origanum majorama L.	*Merdedûch*	*Lamiaceae*	*whole plant /Infusion*	*Oral*	*Digestive disorder, asthma*	0.06	0.17	The anti-proliferative effect, [121] antimicrobial activity [122]
Pelargonium roseum willd.	*Laatercha*	*Geraniaceae*	*Leaves /Decoction, tisane*	Oral	Influenza, bronchitis, **I**rregular menstruation	0.19	0.08	Anxiolytic and antidepressant activities [123]
Punica granatum L.	*Rummân*	*Punicaceae*	*Bark of fruit /Maceration, decoction*	*Oral, topical*	*Peptic ulcer, Arterial Hypertension, detox, hair*	*0.09*	0.24	Antioxidant and Antibacterial Activities, [124] wound healing,

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			Fruits/ juice		*coloring*			[125] antidiarrhoeal activity, [124] anti-inflammatory,[126] Anti-hyperglycemic [127]
Ranunculus calandrinoides	*Achhlaf Obakho*	*Ranunculaceae*	*Areal part / Poultice*	Oral, topical	Wound healing, cutaneous leishmaniasis	0.20	0.05	No report
Rosmarinus officinalis L.	*Âzir*	*Lamiaceae*	*Leaves /Decoction, fumigation, poultice*	*Topical, Inhalation*	*Digestive disorders, antiseptic* *Rheumatism, colagogic, insomnia*	0.08	0.30	Antibacterial and antioxidant effects, [128] Antibacterial, antioxidant, anti-inflammatory, analgesic activities, [129] and antifungal activities [130]
Ruta graveolens L.	*Mrijjô*	*Rutaceae*	*Leaves /Infusion, decoction* *Roots/ decoction*	*Tropical, oral*	*Digestive disorder, skin diseases*	0.15	0.07	Anti-inflammatory effect, [131] and antitumor activity[132]
Salvia officinalis L.	*Sâlmiya*	*Lamiaceae*	*Arial part /Infusion, tisane* *Leaves/ Poultice*	*Topical, oral*	*Gingivitis, mouth vomiting, diarrhea, Premenstrual syndrome, wound healing, diabetes*	0.17	0.18	Antibacterial activity,[133] anti-inflammatory ,[134] antioxidant activity, [135] and cytotoxic activity[136]
Syzygium aromaticum L. Merr. & L.M.Perry	*Nuwar*	*Myrtaceae*	*flower buds / Infusion, raw edible, poultice, powder*	*Topical, oral*	*Toothache, headache, fever, menstrual pain, asthma*	0.11	0.23	Anti-biofilm activity [137] and antinociceptive [138]

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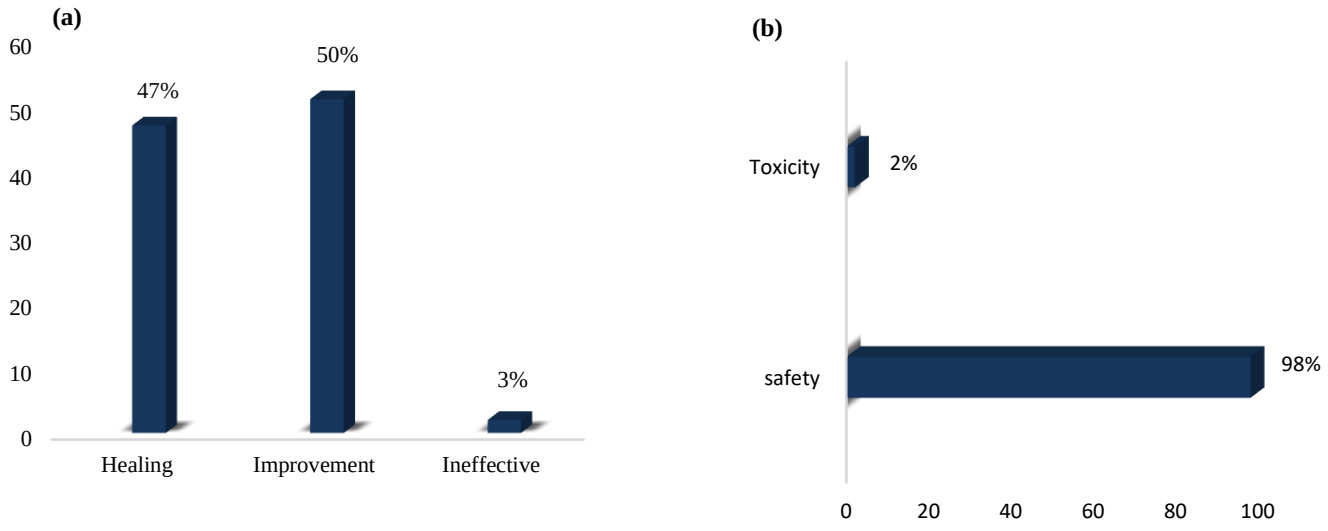

Figure 5: Efficiency (a) and safety (b) of medicinal plants

Table 3: Factor of informant consensus (FIC) of reported ailments category

Category of diseases	Number of use citations	Number of species used	FIC
Digestive disorder	89	17	0.818
Diabetes	43	4	0.929
Skin diseases	125	28	0.782
Oral diseases	67	4	0.955
Respiratory diseases	78	11	0.870
Ear, nose, and throat pathology (ENT)	102	7	0.941
Neurological disorder	25	9	0.667
Menstrual disorders	53	4	0.942
Arterial Hypertension	65	4	0.953
Urinary tract infections	42	5	0.902
Others	63	22	0.661

Table 4: FL, RPL, and ROP for the principal plants used in the area of study

Species names	Major diseases	Fidelity level (%)	Relative popularity level (RPL)	Rank Priority Order (ROP)
Allium sativum L.	Arterial Hypertension	28.77	0.2	58
Aloysia citriodora Palau	Insomnia	89.00	0.3	27
Artemisia absinthium L.	Ear pain	48.21	0.2	10
Capparis spinosa L.	Urinary Tract Infection	20.59	0.2	4
Cistus Albidus L.	Skin wound	81.08	0.1	8
Lavandula angustifolia Mill.	Skin diseases	21.43	0.2	4
Leopoldia comosa Parl.	Skin diseases	91.11	0.8	73
Linum usitatissimum L.	Digestive disorder	26.87	0.1	3
Mentha pulegium L.	Respiratory tract infection	33.33	0.1	4

Mentha rotundifolia (L.)	Fever	90.63	0.7	64
Nigella sativa L.	Dizziness	32.61	0.1	3
Olea Europea L	Diabetes	17.72	0.1	2
Origanum compactum Benth	Digestive disorder	48.21	0.2	10
Origanum majorama L.	Digestive disorder	69.70	0.2	14
Punica granatum L.	Arterial Hypertension	29.79	0.1	3
Rosmarinus officinalis L.	Rheumatism	15.25	0,1	2
Salvia officinalis L.	Premenstrual syndrome	17.14	0.2	3

Conclusion

In this survey, 35 plant species belonging to 22 families were inventoried, with a dominance of *the Lamiaceae* family *(*43.48%). Indeed, the surveyed plants are used to heal several ailments such as skin diseases, arterial hypertension, diabetes, menstrual disorder, ulcer, diarrhea, neurological disease, anorexia, gingivitis, and dental pain. Nevertheless, according to the quantitative ethnopharmacological analyses, we noticed that majority of plants are dedicated to treating some skin diseases. *Arbutus unedo L., Artemisia herba-alba Asso* (UV = 0.43 each), and *Ranunculus calandrinoides* (UV= 0.40) are the most used plants. Interestingly, we report for the first time the use of *Arabis alpina L., Aethionema saxatile (L.) W.T.Aiton and Ranunculus calandrinoides* for the treatment of some skin diseases. The Amazigh people of the Amkla region are attached to traditional medicine and have an important heritage on phytotherapy. Therefore, particular attention should be given to this region, and more extensive ethnopharmacological study is required, to preserve the knowledge on the use of medicinal plants.

Conflict of interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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References

1. Bellakhdar J, Claisse R, Fleurentin J, Younos C. Repertory of standard herbal drugs in the Moroccan pharmacopeia. J Ethnopharmacol. 1991; 35(2):123-143.
2. Jamila F and Mostafa E. Ethnobotanical survey of medicinal plants used by people in Oriental Morocco to manage various ailments. J Ethnopharmacol. 2014; 154(1):76-87.
3. El-Hilaly J, Hmammouchi M, Lyoussi B. Ethnobotanical studies and economic evaluation of medicinal plants in Taounate province (Northern Morocco). J Ethnopharmacol. 2003; 86(2-3):149-158.
4. Tahraoui A, El-Hilaly J, Israili ZH, Lyoussi B. Ethnopharmacological survey of plants used in the traditional treatment of hypertension and diabetes in south-eastern Morocco (Errachidia province). J Ethnopharmacol. 2007; 110(1):105-117.
5. Merzouki A, Ed-Derfoufi F, Mesa JM. Contribution to the knowledge of Rifian traditional medicine. II: Folk medicine in Ksar Lakbir district (NW Morocco). Fitoter. 2000; 71(3):278-307.
6. Bellakhdar J. The traditional Moroccan pharmacopeia: ancient Arabic medicine and popular knowledge. Le Fennec: Casablanca, 1997. 397-399.
7. Fennane M. Atelier national & quot; Zones Importantes de Plantes au Maroc", Rabat S O M M A I R E. 2004.
8. Balunas MJ and Kinghorn AD. Drug discovery from medicinal plants. Life Sci. 2005; 78(5):431-441.
9. Chukwuma CI, Matsabisa MG, Ibrahim MA, Erukainure OL, Chabalala MH, Islam MS. Medicinal plants with concomitant anti-diabetic and anti-hypertensive effects as potential sources of dual-acting therapies against diabetes and hypertension: A review. J Ethnopharmacol. 2019; 235:329-360.
10. Kooti W, Farokhipour M, Asadzadeh Z, Ashtary-Larky D, Asadi-Samani M. The role of medicinal plants in the treatment of diabetes: a systematic review. Electron Physician. 2016; 8(1):1832-1842.
11. Minooeianhaghighi MH, Sepehrian L, Shokri H. Antifungal effects of Lavandula binaludensis and Cuminum cyminum essential oils against Candida albicans strains isolated from patients with recurrent vulvovaginal candidiasis. J Mycol Med. 2017; 27(1):65-71.
12. Zida A, Bamba S, Yacouba A, Ouedraogo-Traore R, Guiguemdé RT. Anti-Candida albicans natural products, sources of new antifungal drugs: A review. J Mycol Médicale/Journal Med Mycol. 2017; 27(1):1-19.
13. Mostafa AA, Al-Askar AA, Almaary KS, Dawoud TM, Sholkamy EN, Bakri MM. Antimicrobial activity of some plant extracts against bacterial strains causing food poisoning diseases. Saudi J Biol Sci. 2018; 25(2):361-366.
14. Sharifi-Rad J, Hoseini-Alfatemi SM, Sharifi-Rad M, Da Silva JAT. Antibacterial, antioxidant, antifungal, and anti-inflammatory activities of crude extract from Nitraria schoberi fruits. 3 Biotech. 2015; 5(5):677-684.
15. Jennan L. L'évolution des structures socio-spatiales du Moyen-Atlas central : 1e cas du pays Amekla (Sefrou) / The change in socio-spatial structures in the central Middle Atlas Mountains : the case of the Amekla (Sefrou) region. Rev géographie Alp. 1996; 84(4):61-74.
16. Jennan L. L'évolution des structures socio-spatiales du Moyen-Atlas central : 1e cas du pays Amekla (Sefrou) / The change in socio-spatial structures in the central Middle Atlas Mountains : the case of the Amekla (Sefrou) region. Rev géographie Alp. 1996; 84(4):61-74.
17. Home — The Plant List. http://www.theplantlist.org/. Accessed June 7, 2020.
18. Tropicos Specimen Search. http://legacy.tropicos.org/SpecimenSearch.aspx. Accessed June 7, 2020.
19. International Plant Names Index. https://www.ipni.org/. Accessed June 7, 2020.
20. GBIF. https://www.gbif.org/. Accessed June 7, 2020.
21. Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. Medicinal plants in Mexico: healers' consensus and cultural

importance. Soc Sci Med. 1998; 47(11):1859-1871.
22. Phillips O and Gentry AH. The useful plants of Tambopata, Peru: II. Additional hypothesis testing in quantitative ethnobotany. Econ Bot. 1993; 47(1):33-43.
23. Friedman J, Yaniv Z, Dafni A, Palewitch D. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. J Ethnopharmacol. 1986; 16(2-3):275-287.
24. El Hafian M, Benlandini N, Elyacoubi H, Zidane L, Rochdi A. Étude floristique et ethnobotanique des plantes médicinales utilisées au niveau de la préfecture d'Agadir-Ida-Outanane (Maroc). J Appl Biosci. 2014; 81(1):7198-7213.
25. Magoua N. Les recettes familiales à la base de plantes médicinales dans la province de Salé. 1991.
26. Nabih M. Secrets et vertus thérapeutiques des plantes médicinales utilisées en médecine traditionnelle dans la province de Settat. PharmD thesis Univ Mohamed IV, Rabat Morocco. 1992.
27. Sekkat C. Le diabete et la phytothérapie. Enquête aupres de 100 DID et 100 DNID These de Pharmacie. Fac Méd Pharm Rabat. 1987.
28. Ziyyat A, Legssyer A, Mekhfi H, Dassouli A, Serhrouchni M, Benjelloun W. Phytotherapy of hypertension and diabetes in oriental Morocco. J Ethnopharmacol. 1997; 58(1):45-54.
29. Eddouks M, Maghrani M, Lemhadri A, Ouahidi M-L, Jouad H. Ethnopharmacological survey of medicinal plants used for the treatment of diabetes mellitus, hypertension, and cardiac diseases in the south-east region of Morocco (Tafilalet). J Ethnopharmacol. 2002; 82(2-3):97-103.
30. Idm'hand E, Msanda F, Cherifi K. Ethnobotanical study and biodiversity of medicinal plants used in the Tarfaya Province, Morocco. Acta Ecol Sin. 2020; 40(2):134-144.
31. Bouiamrine EH, Ibijbijen J, Nassiri L, El C, Bouiamrine H, Bachiri L. Fresh medicinal plants in middle atlas of Morocco: trade and threats to the sustainable harvesting. J Med Plants. 2017; 5(2):123-128.
32. Raja RR. Medicinally potential plants of Labiatae (Lamiaceae) family: an overview. Res J Med Plant. 2012; 6(3):203-213.
33. Achika JI, Arthur DE, Gerald I, Adedayo A. A Review on the Phytoconstituents and Related Medicinal Properties of Plants in the Asteraceae Family. IOSR J Appl Chem. 2014; 7:1-8.
34. Ahmad A, Husain A, Mujeeb M, Khan SA, Najmi AK., Siddique N.A, Nsir A.S, Zoheir A.D,Anwar, F. A review on therapeutic potential of Nigella sativa: A miracle herb. Asian Pac J Trop Biomed. 2013; 3(5):337-352.
35. Tardugno R, Pellati F, Iseppi R, Bondi M, Bruzzesi G, Benvenuti S. Phytochemical composition and in vitro screening of the antimicrobial activity of essential oils on oral pathogenic bacteria. Nat Prod Res. 2018; 32(5):544-551.
36. Beltrán-Villalobos KL, Déciga-Campos M, Aguilar-Mariscal H, et al. Synergistic antinociceptive interaction of Syzygium aromaticum or Rosmarinus officinalis coadministered with ketorolac in rats. Biomed Pharmacother. 2017; 94:858-864.
37. Lahsissene H and Kahouadji A. Usages thérapeutiques traditionnels des plantes médicinales dans le Maroc occidental: cas de la région de Zaër. Phytothér. 2010;8(4):210-217.
38. Eddouks M, Ajebli M, Hebi M. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. J Ethnopharmacol. 2017; 198:516-530.
39. Barkaoui M, Katiri A, Boubaker H, Msanda F. Ethnobotanical survey of medicinal plants used in the traditional treatment of diabetes in Chtouka Ait Baha and Tiznit (Western Anti-Atlas), Morocco. J Ethnopharmacol. 2017; 198:338-350.
40. Amoo SO, Aremu AO, Moyo M, Van Staden J. Antioxidant and acetylcholinesterase-inhibitory properties of long-term stored medicinal plants. BMC Compl Altern Med. 2012; 12(1):1060.
41. Jamila F and Mostafa E. Ethnobotanical survey of medicinal plants used by people in Oriental Morocco to manage various ailments. J Ethnopharmacol. 2014; 154(1):76-87.
42. Hilaly J El, Israili ZH, Lyoussi B. Acute and chronic toxicological studies of Ajuga iva in experimental animals. J Ethnopharmacol. 2004; 91(1):43-50.
43. Koriem KMM, Arbid MS, El-Attar MA. Acute and subacute toxicity of Ammi visnaga on rats. Interdiscip Toxicol. 2019; 12(1):26-35.
44. Mishra AK, Mishra A, Pragya, Chattopadhyay P. Screening of acute and sub-chronic dermal toxicity of Calendula officinalis L essential oil. Regul Toxicol Pharmacol. 2018; 98:184-189.
45. Skim F, Lazrek BH, El Amri H, Kaaya A, Jana M. Toxicological studies on Globularia alypum and Zygophyllum gaetulum in rats. Phyther Res. 1998; 12(8):592-594.
46. Heidari M, Mirshamsi M, Naghibi B, Heidari M, Vafazade J, Heidari M. Evaluation of Hepatotoxicity and Renal Toxicity of Methanolic Extract of Capparis Spinosa in Rats. SSU_Journals. 2010; 18(1):47-55.
47. Bouziri A, Hamdi A, Menif K, Ben Jaballah N. Hepatorenal injury induced by cutaneous application of *Atractylis gummifera* L. Clin Toxicol. 2010; 48(7):752-754.
48. Mechchate H, Es-safi I, Jawhari FZ, Bari A, Grafov A, Bousta D. Ethnobotanical survey about the management of diabetes with medicinal plants used by diabetic patients in Region of Fez-Meknes, Morocco. Ethnobot Res Appl. 2020; 19(Who 2016).
49. Teixidor-Toneu I, Martin GJ, Ouhammou A, Puri RK, Hawkins JA. An ethnomedicinal survey of a Tashelhit-speaking community in the High Atlas, Morocco. J Ethnopharmacol. 2016; 188:96-110.
50. Fettach S, Mrabti HN, Sayah K, Bouyahya, A., Salhi N, Cherrah Y, & El Abbes FM. Phenolic content, acute toxicity of Ajuga iva extracts and assessment of their antioxidant and carbohydrate digestive enzyme inhibitory effects. South Afr J Bot. 2019; 125:381-385.
51. Zeghad N, Ahmed E, Madi A, Halmi S, Belkhiri A. Acute Toxicity and Analgesic Activity of the Aerial Parts of Ajuga Iva (L.) Schreb. Grow in East of Algeria. FABAD J Pharm Sci. 2020; 45(1):1-7p.
52. Senhaji S, Lamchouri F, Bouabid K, Assem, N., El Haouari, M., Bargach, K., & Toufik, H. Phenolic Contents and Antioxidant Properties of Aqueous and Organic Extracts of a Moroccan Ajuga iva Subsp. Pseudoiva. J Herbs Spices Med Plants. 2020; 1-19.
53. Chan W-JJ, McLachlan AJ, Luca EJ, Harnett JE. Garlic (Allium sativum L.) in the management of hypertension and dyslipidemia – A systematic review. J Herb Med. 2020; 19:100292.
54. Oosthuizen C, Arbach M, Meyer D, Hamilton C, Lall N. Diallyl Polysulfides from *Allium sativum* as Immunomodulators, Hepatoprotectors, and Antimycobacterial Agents. J Med Food. 2017; 20(7):685-690.
55. Dorrigiv M, Zareiyan A, Hosseinzadeh H. Garlic (*Allium sativum*) as an antidote or a protective agent against natural or chemical toxicities: A comprehensive update review. Phyther Res. 2020; 6645.
56. Aydoğmuş-Öztürk F, Jahan H, Beyazit N, Günaydın K, Choudhary MI. The anticancer activity of visnagin, isolated from Ammi visnaga L., against the human malignant melanoma cell lines, HT 144. Mol Biol Rep. 2019;

46(2):1709-1714.
57. Abu-Serie MM, Habashy NH, Maher AM. *In vitro* anti-nephrotoxic potential of Ammi visnaga, Petroselinum crispum, Hordeum vulgare, and Cymbopogon schoenanthus seed or leaf extracts by suppressing the necrotic mediators, oxidative stress and inflammation. BMC Compl Altern Med. 2019; 19(1):149.
58. Bnouham M, Merhfour FFZ, Ziyyat A, Aziz M, Legssyer A, Mekhfi H. Antidiabetic effect of some medicinal plants of Oriental Morocco in neonatal non-insulin-dependent diabetes mellitus rats. Human & experimental toxicology, 2010; 29(10):865-871.
59. Haouari M El, López J, Mekhfi H, Rosado JA, Salido G. Antiaggregant effects of Arbutus unedo extracts in human platelets. J Ethnopharmacol. 2007; 113(2):325-331.
60. Afkir S, Nguelefack T, Aziz M, Johan A, Guy C, Cuisinaud G, Bnouham M, Legssyer A, Lahlou S, Ziyyat B. Arbutus unedo prevents cardiovascular and morphological alterations in L-NAME-induced hypertensive rats: Part I: Cardiovascular and renal hemodynamic. J Ethnopharmacol. 2008; 116(2):288-295.
61. Amat N, Upur H, Blažeković B. *In vivo* hepatoprotective activity of the aqueous extract of Artemisia absinthium L. against chemically and immunologically induced liver injuries in mice. J Ethnopharmacol. 2010; 131(2):478-484.
62. Gonzalez-Coloma A, Bailen M, Diaz CE, Fraga BM, Martínez-Díaz R, Zuñiga, Gustavo E, Rodrigo AC, Cabrera R, Jesus B. Major components of Spanish cultivated Artemisia absinthium populations: Antifeedant, antiparasitic, and antioxidant effects. Ind Crops Prod. 2012; 37(1):401-407.
63. Bora KS and Sharma A. Evaluation of antioxidant and free-radical scavenging potential of Artemisia absinthium. Pharm Biol. 2011; 49(12):1216-1223.
64. Zeng K-W, Liao L-X, Song X-M, Lv H. N, Song F. J, Yu, Qian Y, Dong X,Yong J, Peng-Fei Tu. Immunopharmacology and inflammation Caruifolin D from artemisia absinthium L. inhibits neuroinflammation via reactive oxygen species-dependent c-jun N-terminal kinase and protein kinase c/NF-κB signaling pathways. Eur J Pharmacol. 2015; 767:82-93.
65. Jemaa HB, Khlifi S, Hmed HB, Karmous H, Benzarti I, Elati A, Aouidet A. Antidiabetic, Antihyperlipidemic and Antioxidant Effects of Artemisia herba alba Extract on Experimental Diabetes. Int J Pharmacol. 2015; 11(6):552-560.
66. Qnais E, Raad D, Bseiso Y. Analgesic and Anti-Inflammatory Effects of an Extract and Flavonoids from Artemisia Herba-Alba and Their Mechanisms of Action. Neurophysiol. 2014; 46(3):238-246.
67. Abu-Darwish MS, Cabral C, Gonçalves MJ, Cavaleiro C, Cruz MT, Efferth T, Salgueiro L. Artemisia herba-alba essential oil from Buseirah (South Jordan): Chemical characterization and assessment of safe antifungal and anti-inflammatory doses. J Ethnopharmacol. 2015; 174:153-160.
68. Bertella A, Benlahcen K, Abouamama S, Pinto DC, Maamar K, Kihal M, Silva, AM. Artemisia herba-alba Asso. essential oil antibacterial activity and acute toxicity. Ind Crops Prod. 2018; 116:137-143.
69. Bouabid K, Lamchouri F, Toufik H, Faouzi MEA. Phytochemical investigation, in vitro and in vivo antioxidant properties of aqueous and organic extracts of toxic plant: Atractylis gummifera L. J Ethnopharmacol. 2020; 253:112640.
70. Bouabid K, Lamchouri F, Toufik H, Boulfia M, Senhaji S, Faouzi MEA. In vivo anti-diabetic effect of aqueous and methanolic macerated extracts of Atractylis gummifera. Bangladesh J Pharmacol. 2019; 14(2):67-73.
71. Jiménez-Medina E, Garcia-Lora A, Paco L, Algarra I, Collado A, Garrido F. A new extract of the plant calendula officinalis produces a dual in vitro effect: cytotoxic anti-tumor activity and lymphocyte activation. BMC Cancer. 2006; 6(1):119.
72. Efstratiou E, Hussain AI, Nigam PS, Moore JE, Ayub MA, Rao JR. Antimicrobial activity of Calendula officinalis petal extracts against fungi, as well as Gram-negative and Gram-positive clinical pathogens. Compl Ther Clin Pract. 2012; 18(3):173-176.
73. Zhou H, Jian R, Kang J, Huang X, Li Y, Zhuang C, Yan F, Lele Z, Fan X, Wu T,Wu, X.. Anti-inflammatory Effects of Caper (Capparis spinosa L.) Fruit Aqueous Extract and the Isolation of Main Phytochemicals. J Agric Food Chem. 2010; 58(24):12717-12721.
74. Vahid H, Rakhshandeh H, Ghorbani A. Antidiabetic properties of Capparis spinosa L. and its components. Biomed Pharmacother. 2017; 92:293-302.
75. Boga C, Forlani L, Calienni R, Hindley T, Hochkoeppler A, Tozzi S, Zanna N. On the antibacterial activity of roots of Capparis spinosa L. Nat Prod Res. 2011; 25(4):417-421.
76. Agrawal A, Mohan M, Kasture S, Foddis C, Frau M.A, Loi M C, Maxia A. Antidepressant activity of *Ceratonia siliqua* L. fruit extract, a source of polyphenols. Nat Prod Res. 2011; 25(4):450-456.
77. Custódio L, Fernandes E, Escapa AL, López-Avilés S, Fajardo A, Aligué R, Fernando A, Romano A.. Antioxidant activity and *in vitro* inhibition of tumor cell growth by leaf extracts from the carob tree (*Ceratonia siliqua*). Pharm Biol. 2009; 47(8):721-728.
78. Tahiri O, Atmani-Kilani D, Sanchez-Fidalgo S, Aparicio-Soto M, Alarcón-de-la-Lastra C, Barrajón-Catalán, Enrique BC, Vicente M, Atmani, D. The flavonol-enriched Cistus albidus chloroform extract possesses in vivo anti-inflammatory and anti-nociceptive activity. J Ethnopharmacol. 2017; 209:210-218.
79. Kaushik P, Goyal P, Chauhan A, Chauhan G. In Vitro Evaluation of Antibacterial Potential of Dry Fruit Extracts of *Elettaria cardamomum* Maton (*Chhoti Elaichi*). Iran J Pharm Res. IJPR. 2010; 9(3):287.
80. Jamal A, Javed K, Aslam M, Jafri MA. Gastroprotective effect of cardamom, Elettaria cardamomum Maton. fruits in rats. J Ethnopharmacol. 2006; 103(2):149-153.
81. Ghlissi Z, Kallel R, Sila A, Harrabi B, Atheymen R, Zeghal K, Bougatef A, Sahnoun Z.. Globularia alypum methanolic extract improves the burn wound healing process and inflammation in rats and possesses antibacterial and antioxidant activities. Biomed Pharmacother. 2016; 84:1488-1495.
82. Jouad H, Maghrani M, Eddouks M. Hypoglycaemic effect of Rubus fructicosis L. and Globularia alypum L. in normal and streptozotocin-induced diabetic rats. J Ethnopharmacol. 2002; 81(3):351-356.
83. van Dooren I, Faouzi MEA, Foubert K, Theunis M, Pieters L, Cherrah Y, Apers S.. Cholesterol-lowering effect in the gall bladder of dogs by a standardized infusion of Herniaria hirsuta L. J Ethnopharmacol. 2015; 169:69-75.
84. Atmani F, Slimani Y, Mimouni M, Aziz M, Hacht B, Ziyyat A. Effect of aqueous extract from Herniaria hirsuta L. on experimentally nephrolithiasic rats. J Ethnopharmacol. 2004; 95(1):87-93.
85. Nasiri Lari Z, Hajimonfarednejad M, Riasatian M, Zohreh A, Iraji A, Vojoud M, Heydari M, Shams M. Efficacy of inhaled Lavandula angustifolia Mill. Essential oil on sleep quality, quality of life, and metabolic control in patients with diabetes mellitus type II and insomnia. J Ethnopharmacol. 2020; 251:112560.
86. Sadraei H, Id *, Asghari G, Rahmati M. Study of antispasmodic action of Lavandula angustifolia Mill hydroalcoholic extract on rat ileum. J Herbmed Pharmacol J Herbmed Pharmacol. 2019; 8(1):56-63.
87. Sanna MD, Les F, Lopez V, Galeotti N. Lavender (Lavandula angustifolia Mill.) Essential Oil Alleviates Neuropathic Pain in Mice With Spared Nerve Injury. Front

Pharmacol. 2019; 10:472.
88. Karan NB. Influence of lavender oil inhalation on vital signs and anxiety: A randomized clinical trial. Physiol Behav. 2019; 211:112676.
89. Marrelli M, Araniti F, Statti G, Conforti F. Metabolite profiling and biological properties of aerial parts from Leopoldia comosa (L.) Parl.: Antioxidant and anti-obesity potential. South Afr J Bot. 2019; 120:104-111.
90. Kaithwas G and Majumdar DK. Therapeutic effect of Linum usitatissimum (flaxseed/linseed) fixed oil on acute and chronic arthritic models in albino rats. Inflammopharmacol. 2010; 18(3):127-136.
91. Rafieian-kopaei M, Shakiba A, Sedighi M, Bahmani M. The Analgesic and Anti-Inflammatory Activity of Linum usitatissimum in Balb/c Mice. J Evid-Based Compl Altern Med. 2017; 22(4):892-896.
92. Beroual K, Agabou A, Abdeldjelil MC, Boutaghane N, Haouam S, Hamdi-Pacha Y. Evaluation of crude flaxseed (Linum usitatissimum L.) oil in burn wound healing in New Zealand rabbits. Afr J Trad Compl Altern Med. 2017; 14(3):280-286.
93. Franco E de S, de Aquino CMF, Medeiros PL de, Evêncio LB, Góes AJ da S, Maia MB de S. Effect of a Semisolid Formulation of *Linum usitatissimum* L. (Linseed) Oil on the Repair of Skin Wounds. Evid-Based Compl Altern Med. 2012; 2012:1-7.
94. Palla AH, Khan NA, Bashir S, ur-Rehman N, Iqbal J, Gilani A-H. Pharmacological basis for the medicinal use of Linum usitatissimum (Flaxseed) in infectious and non-infectious diarrhea. J Ethnopharmacol. 2015; 160:61-68.
95. Cáceres MI, Ricciardi GA, Torres AM, Ricciardi BV, Ferrero S, Dellacassa E. *In vitro* Anti-snake Venom Activities of *Aloysia citriodora* Palau: New Possibilities for a Known Aromatic Plant. J Essent Oil Bear Plants. 2017; 20(1):132-140.
96. Oukerrou MA, Tilaoui M, Mouse HA, Leouifoudi I, Jaafari A, Zyad A. Chemical Composition and Cytotoxic and Antibacterial Activities of the Essential Oil of *Aloysia citriodora* Palau Grown in Morocco. Adv Pharmacol Sci. 2017; 2017:1-10.
97. Lenoir L, Joubert-Zakeyh J, Texier O, Lamaison J-L, Vasson M-P, Felgines C. Aloysia triphylla infusion protects rats against dextran sulfate sodium-induced colonic damage. J Sci Food Agric. 2012; 92(7):1570-1572.
98. Ponce-Monter H, Fernández-Martínez E, Ortiz MI, Ramírez-Montiel ML, Cruz-Elizalde D, Pérez-Hernández N, Cariño-Cortés R. Spasmolytic and anti-inflammatory effects of Aloysia triphylla and citral, in vitro and in vivo studies. J Smooth Muscl Res. 2010; 46(6):309-319.
99. Boudjelal A, Henchiri C, Siracusa L, Sari M, Ruberto G. Compositional analysis and in vivo anti-diabetic activity of wild Algerian Marrubium vulgare L. infusion. Fitoter. 2012; 83(2):286-292.
100. De Jesus RAP, Cechinel-Filho V, Oliveira AE, Schlemper V. Analysis of the antinociceptive properties of marrubiin isolated from *Marrubium vulgare*. Phytomed. 2000; 7(2):111-115.
101. Stulzer HK, Tagliari MP, Zampirolo JA, Cechinel-Filho V, Schlemper V. Antioedematogenic effect of marrubiin obtained from Marrubium vulgare. J Ethnopharmacol. 2006; 108(3):379-384.
102. Meyre-Silva C, Yunes RA, Schlemper V, Campos-Buzzi F, Cechinel-Filho V. Analgesic potential of marrubiin derivatives, a bioactive diterpene present in Marrubium vulgare (Lamiaceae). Il Farmacol. 2005; 60(4):321-326.
103. Paula de Oliveira A, Santin JR, Lemos M,Klein Junior LC, Couto AG, da Silva Bittencourt M, Cechinel Filho V, Faloni de Andrade S.. Gastroprotective activity of methanol extract and marrubiin obtained from leaves of M*arrubium vulgare* L. (Lamiaceae). J Pharm Pharmacol. 2011; 63(9):1230-1237.
104. Farid O, Zeggwagh NA, Ouadi F EL, Eddouks M. *Mentha pulegium* Aqueous Extract Exhibits Antidiabetic and Hepatoprotective Effects in Streptozotocin-Induced Diabetic Rats. Endocrine, Metab Immune Disord - Drug Targets. 2019; 19(3):292-301.
105. Gülçin İ, Gören AC, Taslimi P, Alwasel SH, Kılıc O, Bursal E. Anticholinergic, antidiabetic and antioxidant activities of Anatolian pennyroyal (Mentha pulegium)-analysis of its polyphenol contents by LC-MS/MS. Biocatal Agric Biotechnol. 2020; 23:101441.
106. Mahboubi M and Haghi G. Antimicrobial activity and chemical composition of Mentha pulegium L. essential oil. J Ethnopharmacol. 2008; 119(2):325-327.
107. Bhuvaneshwari L, Arthy E, Anitha C, Dhanabalan K, Meena M. Phytochemical analysis & Antibacterial activity of Nerium oleander. Anc Sci Life. 2007; 26(4):24.
108. Namian P, Talebi T, Ghasemi Germi K, Shabani F. Screening of biological activities (antioxidant, antibacterial and antitumor) of Nerium oleander leaf and flower extracts. vacuum, 2013; 10(11).
109. Burits M and Bucar F. Antioxidant activity of Nigella sativa essential oil. Phyther Res. 2000; 14(5):323-328.
110. Al-Ghamdi M. The anti-inflammatory, analgesic, and antipyretic activity of Nigella sativa. J Ethnopharmacol. 2001; 76(1):45-48.
111. Salem ML. Immunomodulatory and therapeutic properties of the Nigella sativa L. seed. Int Immunopharmacol. 2005; 5(13-14):1749-1770.
112. Al-Hader A, Aqel M, Hasan Z. Hypoglycemic Effects of the Volatile Oil of Nigella sativa Seeds. Int J Pharmacogn. 1993; 31(2):96-100.
113. Althaiban MA. Antiulcer potential of olive leaves extract in gastric ulcer induced by indomethacin in male rats: antioxidant and anti-inflammatory effects. Pharmacophore, 2018; 9(6):57-64.
114. Al-Quraishy S, Othman MS, Dkhil MA, Abdel Moneim AE. Olive (Olea europaea) leaf methanolic extract prevents HCl/ethanol-induced gastritis in rats by attenuating inflammation and augmenting antioxidant enzyme activities. Biomed Pharmacother. 2017; 91:338-349.
115. Showraki N, Mardani M, Emamghoreishi M, Andishe-Tadbir A, Aram A, Mehriar P, Omidi M, Masood S, Koohi-hosseinabadi O, Tanideh, N. Topical Olive Leaf Extract Improves Healing of Oral Mucositis in Golden Hamsters. J Dent. 2016; 17(4):334.
116. Somova LI, Shode FO, Ramnanan P, Nadar A. Antihypertensive, antiatherosclerotic and antioxidant activity of triterpenoids isolated from Olea europaea, subspecies africana leaves. J Ethnopharmacol. 2003; 84(2-3):299-305.
117. Eidi A, Eidi M, Darzi R. Antidiabetic effect of *Olea europaea* L. in normal and diabetic rats. Phyther Res. 2009; 23(3):347-350.
118. Bouyahya A, Dakka N, Lagrouh F, Abrini J, Bakri Y. Anti-dermatophytes Activity of *Origanum compactum* Essential Oil at Three Developmental Stages. Phytothér. 2019; 17(4):201-205.
119. Bouyahya A, Abrini J, Bakri Y, Dakka N. Screening phytochimique et évaluation de l'activité antioxydante et antibactérienne des extraits d'Origanum compactum. Phytothér. 2017; 15(6):379-383.
120. Bouyahya A, Abrini J, Dakka N, Bakri Y. Essential oils of Origanum compactum increase membrane permeability, disturb cell membrane integrity, and suppress quorum-sensing phenotype in bacteria. Artic J Pharm Anal. 2019.
121. Abdel-Massih RM, Fares R, Bazzi S, El-Chami N, Baydoun E. The apoptotic and anti-proliferative activity of Origanum majorana extracts on human leukemic cell line. Leuk Res. 2010; 34(8):1052-1056.
122. Busatta C, Vidal RS, Popiolski AS, Mossi AJ, Dariva C, Rodrigues MRA, Corazza FC, Corazza ML,Vladimir

Oliveira J, Cansian RL. Application of Origanum majorana L. essential oil as an antimicrobial agent in sausage. Food Microbiol. 2008; 25(1):207-211.

123. Abouhosseini TM, Hajizadeh MA, Maggi F, Benelli G. Anxiolytic and antidepressant activities of *Pelargonium roseum* essential oil on Swiss albino mice: Possible involvement of serotonergic transmission. Phyther Res. 2018; 32(6):1014-1022.
124. Negi PS and Jayaprakasha GK. Antioxidant and Antibacterial Activities of Punica granatum Peel Extracts. J Food Sci. 2003; 68(4):1473-1477.
125. Chidambara Murthy KN, Reddy VK, Veigas JM, Murthy UD. Study on Wound Healing Activity of *Punica granatum* Peel. J Med Food. 2004; 7(2):256-259.
126. Lee C-J, Chen L-G, Liang W-L, Wang C-C. Anti-inflammatory effects of Punica granatum Linne *in vitro* and *in vivo*. Food Chem. 2010; 118(2):315-322.
127. Jafri M., Aslam M, Javed K, Singh S. Effect of Punica granatum Linn. (flowers) on blood glucose level in normal and alloxan-induced diabetic rats. J Ethnopharmacol. 2000; 70(3):309-314.
128. Amaral GP, Mizdal CR, Stefanello ST, Mendez ASL, Puntel RL, de Campos M M.A., Félix Alexandre AS, Fachinetto, R.. Antibacterial and antioxidant effects of Rosmarinus officinalis L. extract and its fractions. J Trad Compl Med. 2019; 9(4):383-392.
129. Karadağ AE, Demirci B, Çaşkurlu A, Demirci F, Okur ME, Orak D, sipahi H, Başer KHC. In vitro antibacterial, antioxidant, anti-inflammatory and analgesic evaluation of Rosmarinus officinalis L. flower extract fractions. South Afr J Bot. 2019; 125:214-220.
130. da Silva Bomfim N, Kohiyama CY, Nakasugi LP, Samuel Botião Nerilo, Simone Aparecida Galerani Mossini, Jéssica Cristina Zoratto Romoli, Jane Martha Graton Mikcha, Benício Alves de Abreu Filho, Miguel Machinski Jr. Antifungal and antiaflatoxigenic activity of rosemary essential oil (*Rosmarinus officinalis* L.) against *Aspergillus flavus*. Food Addit Contam Part A. 2020; 37(1):153-161.
131. Raghav SK, Gupta B, Agrawal C, Goswami K, Das HR. Anti-inflammatory effect of Ruta graveolens L. in murine macrophage cells. J Ethnopharmacol. 2006; 104(1-2):234-239.
132. Preethi KC, Kuttan G, Kuttan R. Anti-tumour activity of Ruta graveolens extract. Asian Pac J Cancer Prev. 2006; 7(3):439.
133. Longaray DAP, Moschen-Pistorello IT, Artico L, Atti-Serafini L, Echeverrigaray S. Antibacterial activity of the essential oils of Salvia officinalis L. and Salvia triloba L. cultivated in South Brazil. Food Chem. 2007; 100(2):603-608.
134. Baricevic D, Sosa S, Della Loggia R, Tubaro A, Simonovska B, Krasna A, Zupancic A. Topical anti-inflammatory activity of Salvia officinalis L. leaves: the relevance of ursolic acid. J Ethnopharmacol. 2001; 75(2-3):125-132.
135. Grzegorczyk I, Matkowski A, Wysokińska H. Antioxidant activity of extracts from in vitro cultures of *Salvia officinalis* L. Food Chem. 2007; 104(2):536-541.
136. Kontogianni VG, Tomic G, Nikolic I, Nerantzaki AA, Sayyad N, Stosic-Grujicic S, Stojanovic I, P.Gerothanassisa I, Tzakos, A. G. Phytochemical profile of Rosmarinus officinalis and Salvia officinalis extracts and correlation to their antioxidant and anti-proliferative activity. Food Chem. 2013; 136(1):120-129.
137. Zhang Y, Wang Y, Zhu X, Cao P, Wei S, Lu Y. Antibacterial and antibiofilm activities of eugenol from essential oil of Syzygium aromaticum (L.) Merr. & L. M. Perry (clove) leaf against periodontal pathogen *Porphyromonas gingivalis*. Microb Pathog. 2017; 113:396-402.
138. Beltrán-Villalobos KL, Déciga-Campos M, Aguilar-Mariscal H,González-Trujano ME, Martínez-Salazar MF, de los Ángeles Ramírez-Cisneros M, Yolanda Riosd M, Javier F, López-Muñoz . Synergistic antinociceptive interaction of Syzygium aromaticum or Rosmarinus officinalis coadministered with ketorolac in rats. Biomed Pharmacother. 2017; 94:858-864.

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