International Journal of Pharmacology, Phytochemistry and Ethnomedicine
ISSN: 2297-6922, Vol. 14, pp 16-39
doi:10.18052/www.scipress.com/IJPPE.14.16
CC BY 4.0. Published by SciPress Ltd, Switzerland, 2019

Submitted: 2019-03-17
Revised: 2019-10-25
Accepted: 2019-11-19
Online: 2019-11-28

Ethnopharmacological Documentation of Medicinal Plants Used in the Traditional Treatment of Hypertension in Tarfaya Province, Morocco

Elhassan Idm'hand[a*], Fouad Msanda[b], Khalil Cherifi[c]

Laboratory of Biotechnology and Valorization of Natural Resources, Faculty of sciences, Ibn Zohr University, Agadir, Morocco

[a*]idmhand-h@hotmail.com, [b]fmsanda@gmail.com, [c]kcherifi@yahoo.com

Keywords: Medicinal plants; Ethnopharmacology; Chemical constituents; Hypertension; Morocco.

Abstract. The use of plants to treat chronic diseases is part of an ancient Moroccan tradition. This study will present the first relevant documentation on medicinal plants used in the treatment of hypertension in Tarfaya province. This study aimed to collect and document information on medicinal plants traditionally used by the local population of Tarfaya province for the treatment of hypertension. Ethnobotanical surveys were conducted using 150 questionnaires in the study area. Documented data were evaluated using the quantitative ethno-botanical indices of frequency citation (FC) and Relative Frequency of Citation (RFC). The results obtained allowed to inventory 52 species of medicinal plants belonging to 29 families traditionally used against hypertension. The species were rich in diverse chemical constituents. The most cited families are Lamiaceae (9 species), Apiaceae (5 species), Compositae (3 species), Leguminosae (3 species) and Myrtaceae (3 species). Ten plants are reported for the first time as used in the treatment of hypertension. The most cited plant species are *Allium sativum* (RFC = 0.28), *Allium cepa* (RFC = 0.2), *Olea europaea* (RFC = 0.18), *Searsia tripartita* (RFC = 0.16), *Ammodaucus leucotrichus* (RFC = 0.15) and *Myrtus communis* (RFC = 0.15). Leaves were the most used organs. The decoction was the dominant method of preparation. This study showed that the inhabitants of Tarfaya use a wide variety of plants for the treatment of hypertension. This work is a source of information that can serve as a basis for phytochemists and pharmacologists interested in research on plants with antihypertensive effect.

Introduction

Cardiovascular diseases are the largest cause of mortality worldwide, in both developed and developing countries. The number of adults with increased blood pressure from 594 million in 1975 to 1.13 billion in 2015, with the increase in low-and-middle income countries [1]. Many people in developing countries do not seek treatment for hypertension that could significantly reduce the risk of death or disability due to heart disease or stroke [2]. In these countries, social factors such as low level of education, lack of housing and unemployment with other risk factors have led to an increased prevalence of hypertension [3]. Population growth, the harmful use of alcohol, the increase in saturated fat consumption, the reduction of fiber consumption, obesity, reduced physical activity, the stress of modern life, have a negative impact on behavioral risk factors, which could influence the development of hypertension [3, 4].

A person with a pressure equal to or more than 140/90 mm Hg suffers from high blood pressure [5, 6]. Its frequency increases with age, but nowadays it affects younger population too. When not properly controlled, its consequences can be very serious such as stroke, and other cardiovascular complications [7].

In fact, one of three people in the world suffers from hypertension [6]. Hypertension in Morocco affects more than 34% of adults over the age of 20 and 53.8% of people over 40 and 72.2% of those aged 65 and over [4].

Currently, there are several types of antihypertensive drugs with various mechanisms of action. Although they are effective, some of them have side effects and in some cases they are unavailable to people in rural areas who have difficulty accessing medications [7]. Therefore, the

use of traditional medicine for the treatment of hypertension is a very common practice in African countries and several investigations have targeted the discovery of new hypotensive agents from plants [2]. The best use of medicinal plants is through ethnobotanical surveys which make it possible to draw up a list of plant species used in traditional medicine by the population [8]. This type of knowledge has a real cultural value and may eventually allow the development of new pharmaceutical drugs. Ethnobotanical surveys conducted in different regions of Morocco have shown that several plant species are used in the traditional treatment of hypertension [4, 9-12]. Therefore, an ethnobotanical survey was carried out in the province of Tarfaya to collect as much information as possible about how to use and exploit plants in the traditional treatment of hypertension in order to valorize them, to keep and use them in a rational way.

Materials and Methods

Study area

The province of Tarfaya is located in southern Morocco. It is bounded on the north by the province of Tan-Tan, on the south by the province of Laayoune, on the east by the province of Smara, on the west by the Atlantic Ocean. This region covers an area of 15450 km2 with a population of 13082 inhabitants **(Fig. 1)**.

The province is characterized by a semi-arid climate marked by the scarcity of rainfall. Rainfall amounts are generally low and unevenly distributed over the province. This rainfall is generally less than 60 mm / year. In the province, temperatures are moderate and influenced by the proximity of the Atlantic Ocean, generally around 30 ° C in summer and 20 ° C in winter, and there are not large annual variations.

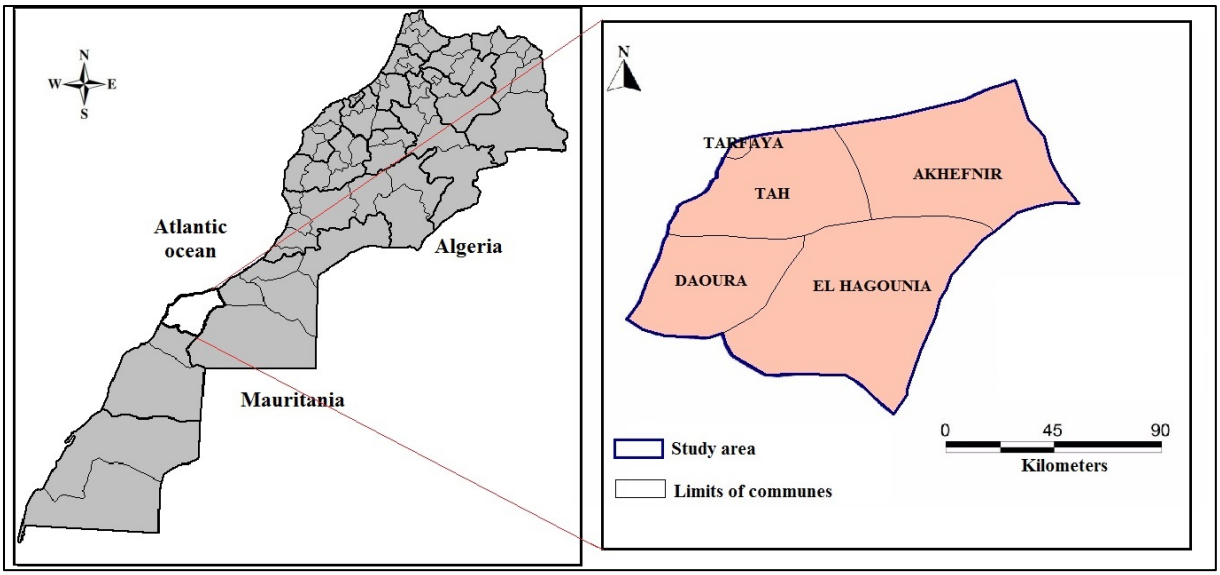

Fig. 1. Location of study area

In terms of vegetation, the province is characterized by some isolated tufts or solitary trees; The appearance is that of a landscape left bare, covered only by some herbs that grow after the occasional rainfall.

The province of Tarfaya has significant economic potential, particularly in the sectors of sea fishing, livestock, tourism and renewable energy. While its potential in agriculture is very limited because of the unfavorable weather conditions. On the other hand, Overgrazing is practiced in the province because of the nomadic life that has marked the lives of the local population. The herd consists mainly of goats, sheep and camels.

Ethnobotanical survey

This work was carried out on the basis of ethnobotanical surveys to gather as much information as possible on the floristic diversity and therapeutic uses of medicinal plants used in the treatment of hypertension in the province of Tarfaya.

In a random sample of 150 people, the population of Tarfaya province was surveyed between August 2018 and December 2018. Using a questionnaire, the surveys collected information on the profile of the people surveyed (age, sex, level of education, family situation, and origin of the information) and to collect precise information on the therapeutic practices used by the population of this province in the treatment of hypertension, in particular the vernacular name of each species, the parts of the plant used and the method of preparation. The time spent on each interview was approximately one hour and all interviewees were informed about the purpose of this study.

In addition, medicinal plants have been identified by the bootanists of the Laboratory of Biotechnology and Valorization of Natural Resources (LBVRN), Faculty of Sciences, Ibn Zohr University, Agadir, with the help of the standard floras of the area and the online database (www.theplantlist.org). Voucher specimens were prepared for all plants and deposited at the herbarium of our laboratory.

The information on the ethnobotany records was transferred to a database, processed and analyzed to obtain standardized data. The phytotherapeutic importance of each species was assessed by calculating the Relative Frequency of Citation (RFC = number of citations of a species / total number of respondents).

$$RFC = FC / N \quad (0 < RFC < 1)$$

Results and Discussion

Demographic features

Ethnobotanical surveys conducted in the field made it possible to interview 150 people (**Table 1**), 56.7 % of whom were female compared to 43.3% of men. Similarly, the results show that it is women who use medicinal plants much more than men. These results confirm the results of other ethnobotanical studies conducted nationally [9-14]. This is an indicator of women's attachment to traditional knowledge [9, 11].

Analysis of the data obtained showed that the age of the respondents varied between 22 and 80 years, with a majority of the age group [41-50] at 34%. Then come the age groups [51-60], [31-40], [21-30] and finally those over 61, with a rate of 26%, 18.7%, 11.3% and 10% respectively. On the one hand, this could be explained by the ignorance of the traditional medicinal uses of plants by the younger generation. On the other hand, the loss of memory and ancestral know-how among the elderly. The knowledge of the uses of medicinal plants and their properties are generally acquired after a long experience accumulated and transmitted from one generation to another. The transmission of this knowledge is in danger at present because it is not always assured [15]. Previous studies have shown that the use of medicinal plants is greater among age groups between 30 and 60 years of age and have reported that these age groups are more prone to heart disease [4, 10, 12].

In this region, the majority of users of medicinal plants are illiterate with a rate of 53.3%. This reflects the low level of schooling of the local population. People with primary education level have a percentage of 32.6% while people with secondary and university level use very little medicinal plants with a rate of respectively 11.3% and 2.7%.

Most of the respondents, 69.3%, reported having acquired knowledge in a hereditary way. Herbalists are ranked as the second source of information (22.7%). These percentages reflect the image of the transmission of traditional practices from one generation to another.

Table 1. Demographic profile of the informants included in the survey (N = 150)

Item	Demographic feature	Number of people	Percent (%)
Gender	Male	65	43.3 %
	Female	85	56.7%
Age	21-30	17	11.3%
	31-40	28	18.7%
	41-50	51	34%
	51-60	39	26%
	61 and above	15	10%
Education	Illiterate	77	53.3%
	Primary education	52	32.6%
	Secondary education	17	11.3%
	Universitaire	4	2.7%

Diversity of medicinal plants and their applications

The study of medicinal plants made it possible to identify 52 species belonging to 29 families (**Table 2**). The most represented families are Lamiaceae (9 species) and Apiaceae (5 species), followed by Compositae, Leguminosae and Myrtaceae (3 species). The remaining families have only one or two species. The high representativeness of these families has also been noted in ethnobotanical surveys conducted in other regions of the country [4, 10].

In our study, the most cited species for the treatment of hypertension are *Allium sativum* (RFC = 0.28), *Allium cepa* (RFC = 0.2), *Olea europaea* (RFC = 0.18) , *Searsia tripartite* (RFC = 0.16), *Ammodaucus leucotrichus* (RFC = 0.15), *Myrtus communis* (RFC = 0.15), *Carum carvi* (RFC = 0.14), *Pistacia lentiscus* (RFC = 0.13), *Petroselinum crispum* (RFC = 0.13), *Citrullus colocynthis* (RFC = 0.13), *Lepidium sativum* (RFC = 0.13), *Mentha pulegium* (RFC = 0.13), *Acacia senegal* (RFC = 0.13), *Ziziphus lotus* (RFC = 0.13), *Solanum lycopersicum* (RFC = 0.13), *Dysphania ambrosioides* (RFC = 0.12), *Tetraclinis articulata* (RFC = 0.12) *Ajuga iva* and *Coriandrum sativum* (RFC = 0.12). Some of the plants have been reported by recent ethnobotanical surveys in the treatment of hypertension in Morocco [4, 10, 11] in Algeria [16], in Nigeria [17] and in Pakistan [18]. These plants include *Olea europaea*, *Myrtus communis*, *Carum carvi*, *Petroselinum crispum*, *Citrullus colocynthis* and *Mentha pulegium*. The antihypertensive activity of some plants has also been experimentally proven. This is the case of *Allium sativum* [19, 20] of *Coriandrum sativum* [21], of *Lepidium sativum* [22], of *Pistacia lentiscus* [23] and *Olea europaea* [24].

The comparison of our results with those of other ethnobotanical surveys in neighboring regions showed that ten plant species (*Acacia senegal*, *Adansonia digitata*, *Ammodaucus leucotrichus*, *Atriplex halimus*, *Lawsonia inermis*, *Mesembryanthemum cryptanthum*, *Saussurea costus*, *Searsia tripartita*, *Solanum lycopersicum* and *Ziziphus lotus*) have been cited for the first time to treat hypertension.

Table 2. Plants use to treat hypertension in Tarfaya province

No	Botanical name & voucher no.	family	Vernacular name	Parts used	Preparation	FC	RFC	Reported Literatures
1	*Acacia senegal* (L.) Willd. LBVRN 180	Leguminosae	Aalelk	Gum	Decoction	22	0.13	No reference
2	*Adansonia digitata* L. LBVRN139	Malvaceae	Tajmakht	Fruit	Infusion	14	0.08	No reference
3	*Ajuga iva* (L.) Schreb. LBVRN142	Lamiaceae	Chendgora	Aerial part	Decoction	21	0.12	[4, 11]
4	*Allium cepa* L. LBVRN145	Amaryllidaceae	Lbesla	Bulb	Raw	35	0.2	[11, 17]
5	*Allium sativum* L. LBVRN140	Amaryllidaceae	Touma	Bulb	Raw	48	0.28	[11, 12, 25]
6	*Aloysia citriodora* Palau LBVRN146	Verbenaceae	Lwiza	Leaf	Decoction	15	0.09	[9, 12]
7	*Ammodaucus leucotrichus* Coss. LBVRN144	Apiaceae	Kamoun Sooufi	Seed	Decoction	25	0.15	No reference
8	*Artemisia absinthium* L. LBVRN141	Compositae	Chiba	Aerial part	Decoction	15	0.09	[9]
9	*Artemisia herba-alba* Asso LBVRN143	Compositae	Chih	Leaf	Powder	16	0.09	[9, 11, 12]
10	*Atriplex halimus* L. LBVRN147	Amaranthaceae	Lgtef	Leaf	Decoction	16	0.09	No reference
11	*Capparis spinosa* L. LBVRN148	Capparaceae	LKebar	Fruit	Maceration	15	0.09	[11]
12	*Carum carvi* L. LBVRN179	Apiaceae	Elkarwiya	Seed	Powder	24	0.14	[9, 11]
13	*Citrullus colocynthis* (L.) Schrad. LBVRN149	Cucurbitaceae	Lhdej	Fruit	Maceration	23	0.13	[11, 18]
14	*Coriandrum sativum* L. LBVRN150	Apiaceae	Kasbour	Seed	Decoction	18	0.11	[9, 11]
15	*Cynodon dactylon* (L.) Pers. LBVRN182	Poaceae	Njem	Aerial part	Decoction	15	0.09	[11]
16	*Dysphania ambrosioides* (L.) Mosyakin & Clemants LBVRN131	Amaranthaceae	Lmkhinza	Leaf	Infusion	21	0.12	[9, 11]
17	*Eucalyptus globulus* Labill. LBVRN132	Myrtaceae	Kalitus	Leaf	Decoction	13	0.08	[11, 12]
18	*Glycyrrhiza glabra* L. LBVRN133	Leguminosae	Arq souss	Stem	Decoction	15	0.09	[9]
19	*Herniaria glabra* L. LBVRN181	Caryophyllaceae	Harass lhjar	Aerial part	Decoction	18	0.11	[9, 11]
20	*Hibiscus sabdariffa* L. LBVRN134	Malvaceae	Bissam	Chalices of flowers	Infusion	20	0.12	[2, 17]
21	*Laurus nobilis* L. LBVRN135	Lauraceae	Wrak sidna Musa	Leaf	Decoction	14	0.08	[12]
22	*Lavandula dentata* L. LBVRN136	Lamiaceae	Lokhzama	Aerial part	Powder	18	0.11	[4, 9, 12]
23	*Lawsonia inermis* L. LBVRN137	Lythraceae	Lhana	Leaf	Infusion	13	0.08	No reference
24	*Lepidium sativum* L. LBVRN138	Brassicaceae	Hab rchad	Seed	Decoction	22	0.13	[4]
25	*Linum usitatissimum* L. LBVRN160	Linaceae	Zarriaat lkettane	Seed	Powder	14	0.08	[9]
26	*Mentha pulegium* L. LBVRN176	Lamiaceae	Fliyou	Seed	Decoction	22	0.13	[4, 11]
27	*Mentha spicata* L. LBVRN171	Lamiaceae	Likama	Stem	Infusion	19	0.11	[9, 11]
28	*Mesembryanthemum cryptanthum* Hook.f. LBVRN170	Aizoaceae	Afzo	Seed	Powder	13	0.08	No reference
29	Myrtus communis L. LBVRN161	Myrtaceae	Rihan	Leaf	Decoction	25	0.15	[9, 11]
30	*Nerium oleander* L LBVRN178	Apocynaceae	Defla	Leaf	Infusion	19	0.11	[9]
31	*Nigella sativa* L. LBVRN169	Ranunculaceae	Sanouj	Seed	Powder	15	0.09	[4, 9, 11]
32	*Ocimum basilicum* L. LBVRN162	Lamiaceae	Lahbak	Aerial part	Decoction	19	0.11	[4]
33	*Olea europaea* L. LBVRN167	Oleaceae	Zitoun	Leaf	Decoction	30	0.18	[4, 11, 12]
34	*Origanum compactum* Benth. LBVRN168	Lamiaceae	Zaatar	Leaf	Infusion	19	0.11	[4, 12]

35	*Origanum majorana* L. LBVRN166	Lamiaceae	Merdedouch	Leaf	Infusion	21	0.12	[11]
36	*Peganum harmala* L. LBVRN163	Nitrariaceae	Lharmel	Seed	Powder	13	0.08	[9, 11]
37	*Petroselinum crispum* (Mill.) Fuss LBVRN164	Apiaceae	Maadanous	Seed	Decoction	23	0.13	[11, 12]
38	*Phoenix dactylifera* L. LBVRN165	Arecaceae	Tmer	Fruit	Infusion	16	0.09	[11]
39	*Pimpinella anisum* L. LBVRN154	Apiaceae	Habbat hlawa	Seed	Decoction	15	0.09	[9, 11]
40	*Pistacia lentiscus* L. LBVRN153	Anacardiaceae	Adru	Leaf	Decoction	23	0.13	[4]
41	*Rosmarinus officinalis* L. LBVRN155	Lamiaceae	Azir	Leaf	Decoction	20	0.12	[4, 11, 12]
42	*Rubia tinctorum* L. LBVRN156	Rubiaceae	Lfouwa	Root	Decoction	15	0.09	[4, 9]
43	*Salvia officinalis* L. LBVRN152	Lamiaceae	Salmiya	Leaf	Infusion	18	0.11	[4, 9]
44	*Saussurea costus* (Falc.) Lipsch. LBVRN157	Compositae	Lkist lhandi	Root	Powder	12	0.07	No reference
45	*Searsia tripartita* (Ucria) Moffett LBVRN177	Anacardiaceae	Zewaya	Fruit	Juice	27	0.16	No reference
46	*Solanum lycopersicum* L. LBVRN158	Solanaceae	Maticha	Fruit	Juice	22	0.13	No reference
47	*Syzygium aromaticum* (L.) Merr. & L.M.Perry LBVRN159	Myrtaceae	Qronfel	Clove	Maceration	20	0.12	[4, 9, 11, 12]
48	*Tetraclinis articulata* (Vahl) Mast. LBVRN151	Cupressaceae	laaraar	Leaf	Powder	21	0.12	[9, 11, 12]
49	*Trigonella foenum-graecum* L. LBVRN174	Leguminosae	Lhalba	Seed	Powder	11	0.06	[4, 12]
50	*Urtica dioica* L. LBVRN173	Urticaceae	Lhoriga	Aerial part	Decoction	20	0.12	[11, 12]
51	*Zea mays* L. LBVRN175	Poaceae	Zghb kbal	Stigma	Decoction	13	0.08	[11]
52	*Ziziphus lotus* (L.) Lam. LBVRN172	Rhamnaceae	Ssder	Leaf	Infusion	15	0.09	No reference

Single-species remedies are mostly represented in relation to multi-species remedies. This preponderance is to the advantage of the patients because the mixing of plants is sometimes toxic that 30% of the fatal accidents in Africa are due to intoxications due to plants [26]. Indeed, these intoxications are sometimes the result of confusion with another plant or a lack of knowledge of the side effects of the plant as well as ignorance of the methods of their use, including the methods of preparation and recommended doses. The use of medicinal plants must be rationalized to take advantage of them and avoid risks. Therefore, we need more studies to achieve these goals.

Through pharmacological and phytochemical assays, the activities claimed by the present ethnobotanical study were already confirmed for several species listed by our respondents (**Table 3**). These results, which confirm the biological activity of these plants, explain the knowledge and practices in herbal medicine acquired by the inhabitants of the province. In fact, this research opens up new and interesting perspectives in the search for new therapeutic means, which can thus bring effective solutions by the manufacture of medicines sold in pharmacy for people suffering from hypertension

Table 3. Chemical constituents and pharmacological activities of the cited medicinal species

No	Botanical name	Family	Chemical constituents	References	Pharmacological activities	References
1	*Acacia senegal*	Leguminosae	Galactose, arabinose, rhamnose, glucuronic acid and 4-O-Me-Glucuronic acid	[27]	Effective role in preventing weight gain, antiatherosclerotic and Cardioprotective	[28, 29]
2	*Adansonia digitata*	Malvaceae	Glutamic acid, aspartic acid, oleic acid, linoleic acid and palmitic acid	[30]	Analgesic, antioxidant, hepatoprotective	[31-33]
3	*Ajuga iva*	Lamiaceae	Dienestrol , eucalyptol , o-xylene , 1-octadecanol ; 3-carene , (E)-2,3,6-trimethoxypentafulvene-1-carbonitrile , (-)-spathulenol , nonanal	[34]	Antioxidant, antibacterial, antiviral and hypoglycaemic	[35, 36]
4	*Allium cepa*	Amaryllidaceae	Quercetin, cycloalliin, S-methyl-L-cysteine, S-propyl-L-cysteine Sulfoxide, N-acetylcysteine, alliuocide, dimethyl trisulfide, S-methyl-L-cysteine sulfoxide, quercetin-3,4'-di-O-β-D-glucoside, quercetin-4'-O-β-D-glucoside, and isorhamnetin-4'-O-β-D-glucoside	[37, 38]	Antioxidant, antimicrobial and antidiabetic	[37, 39]
5	*Allium sativum*	Amaryllidaceae	diallyl trisulfide, diallyl disulfide, allyl methyl trisulfide, allyl (E)-1-propenyl disulfide, allyl methyl disulfide, alliin, allicin, (E)-ajoene, allyl sulf ide, (Z)-ajoene and 1,2-vinyldithiin	[40, 41]	Anti-tubercular, antimicrobial, anti-inflammatory, antibacterial, antiprotozoal, anticancer, antifungal, antihelminthic and cholesterol-lowering effects	[42, 43]
6	*Aloysia citriodora*	Verbenaceae	β-spathulenol, Ar-curcumene, trans-caryophyllene oxide, neral, alpha-pinene, sabinene, 6-methyl-5-hepten-2-one, para-cymene, limonene, 1,8-cineo, cis-sabinene hydrate, cis-thujone, citronellal, piperitone, geranial, geranyl acetate, beta-caryophyllene, ar-curcumene, epi-cubebol, spathulenol, caryophyllene oxide and tau-cadinol	[44, 45]	Antioxidant, anxiolytic, neuroprotective, anticancer, anesthetic, antimicrobial, and sedative	[46, 47]
7	*Ammodaucus leucotrichus*	Apiaceae	Perillaldehyde, limonene, perilla alcohol, methyl perillate and shybinol	[48, 49]	Antihyperglycemic, antibacterial and antimicrobial	[50-52]
8	*Artemisia absinthium*	*Compositae*	*(E)-β-farnesene, (Z)-en-yn-dicycloether, (Z)-β-ocimene, alpha-pinene, sabinene, beta-pinene, alpha-phellandrene, p-cymene and chamazulene. Alpha-phellandrene, and chamazulene*	*[5, 53]*	Antibacterial, anticancer, antioxidant, anthelmintic and antifungal	[54-56]
9	*Artemisia herba-alba*	*Compositae*	*Camphor, α-thujone, chrysanthenone, trans-sabinyl acetate, 1,8-cineole and β-thujone,*	*[57, 58]*	Antibacterial, anticancer, antiinflammatory and antioxidant	[59, 60]
10	*Atriplex halimus*	*Amaranthaceae*	*3′,5′-dimethoxymyricetin-3-O-β-d-xylopyranosyl-7-O-fucopyranosyl-(1 → 3)-β-d-glucopyranoside , 3′-methoxyquercetin-7-O-β-d-fucopyranosyl-(1 → 3)-β-d-glucopyranosyl-3-O-β-xylopyranosyl-(1 → 4)-β-xylopyranoside , 3′-methoxyquercetin-7-O-α-l-rhamnopyranosyl-3-O-α-arabinofuranosyl-(1 → 6)-β-d-glucopyranoside, 3′,5′-dimethoxymyricetin-7-O-fucopyranosyl-(1 → 3)-β-d-glucopyranoside, myricetin, quercetin, isorhamnetin glycosides, simple phenolic acids and esters.*	*[61]*	Antioxidant and antidiabetic	[62, 63]
11	*Capparis spinosa*	Capparaceae	Capparilоside A, stachydrin, Hypoxanthine, uraci, 1H-indole-3-acetonitrile, 4-O-β-(60 -O-β-glucopyranosyl) glucopyranoside, 1H-indole-3-acetonitrile 4-O-β-glucopyranoside, indole-3 acetonitrile glycosides, capparine A, capparine B, flazin, guanosine, 1H-indole-3-carboxaldehyde, 4-hydroxy-1H-indole-3-carboxaldehyde, apigenin, kaempferol and thevetiaflavone	[64]	Antioxidant, anti-diabetic, anti-obesity, anti-hypertensive, antimicrobial, anti-inflammatory and antihepatotoxi	[64-66]

12	*Carum carvi*	Apiaceae	γ-Terpinene, γ-Terpinene-7-al, 9-epi-(E)-Caryophyllene, cumin aldehyde, α-Terpinene-7-al, p-Cymene and limonene (4.40%), α-Pinene, β-Pinene, myrcene, limonene, cuminaldehyde, bornyl acetate, myristicin, elemicine, germacrene B and dillapiol	[67]	Antioxidant, antibacterial, antiaflatoxigenic, diuretic and molluscicidal	[68-71]
13	*Citrullus colocynthis*	Cucurbitaceae	2-O-β-D-glucopyranosyl-Cucurbitacin I, 2-O-β-D-glucopyranosyl-Cucurbitacin L, isosaponarin, isovitexin, catechin, myricetin, quercetin, kaempferol, gallic acid, p-Hydroxy benzoic acid, chlorogenic acid, caffeic acid, vanillic acid, p-Coumeric acid, sinapic acid and ferulic acid	[72]	Antibacterial, antifungal, antioxidant, cytotoxic, antidiabetic, antilipidemic, insecticide, antimicrobial and anti-inflammatory	[72, 73]
14	*Coriandrum sativum*	Apiaceae	Pinocembrin, apigenin, pseudobaptigenin, galangin-5-methyl ether, quercetin, baicalein trimethyl ether, kaempferol dimethyl ether, pinobanksin-5-methylether-3-O-acetate, pinobanksin-3-O-pentenoate, pinobanksin-3-O-phenylpropionate, pinobanksin-3-O-pentanoate, apigenin-7-O-glucuronoide, quercetin-3-O-glucoside, apigenin-3-O-rutinoside, rutin, isorhamnetin-3-O-rutinoside, quercetin dimethyl ether-3-O-rutinoside, daidzein, luteolin, pectolinarigenin, apigenin-C-glucoside, kaempferol-3-7-dimethyl ether-3-O-glucoside, apigenin-7-O-(6-methyl-beta-D-glucoside), 2E-decenal, decanal, 2E-decen-1-ol, n-decanol, 2E-tridecen-1-al , 2E-dodecenal, dodecanal , undecanol, and undecanal	[74, 75]	Antimicrobial, antioxidant, hypoglycemic, hypolipidemic, anxiolytic, analgesic, anti-inflammatory, anti-convulsant and anti-cancer	[76-78]
15	*Cynodon dactylon*	Poaceae	Phenylmethanol, propenoic acid, sesquiterpene, 2-Methoxy-4-prop-2-enylphenyl acetate, 4',5,7-Trihydroxyisoflavone, procyanidin and 3,7,11,15-Tetramethyl-2-hexadecen-1-ol	[79]	Anticancer, antioxidant and antimalarial	[80, 81]
16	*Dysphania ambrosioides*	Amaranthaceae	cispiperitone oxide , p-cymene, isoascaridole, α-terpinene, 4-hydroxy-4(α or β)-isopropyl-2-methyl-2-cyclohexen-1-one, 1-methyl-4β- isopropyl-1-cyclohexene-4α,5α,6α-triol, (1S,2S,3R,4S)-1-methyl-4-(propan-2-yl)cyclohexane-1,2,3,4-tetrol, (1R,2S,3S,4S)- 1,2,3,4-tetrahydroxy-p-menthane, (1R,2S)-3-p-menthen-1,2-diol , (1R,4S)-p-menth-2-en-1-ol and 1,4-dihydroxy-p-menth-2-ene	[82, 83]	Antioxidant, cytotoxic, antifungal, antiaflatoxigenic antimicrobial and anti-diabetic	[84, 85]
17	*Eucalyptus globulus*	Myrtaceae	1,8-cineole, spathulenol and α-Terpineol	[86, 87]	Antioxidant and antibacterial	[87, 88]
18	*Glycyrrhiza glabra*	Leguminosae	Glycyrrhizin, glabridin, saponin glycyrrhizin, 30-hydroxyglycyrrhizin , glycyrrhizin-20-methanoate , 24-hydroxyglucoglycyrrhizin, rhaoglycyrrhizin , 11-deoxorhaoglycyrrhizin , rhaoglucoglycyrrhizin , rhaogalactoglycyrrhizin , 11-deoxo-20α-glycyrrhizin , 20α-galacturonoylglycyrrhizin 20α-rhaoglycyrrhizin,	[89, 90]	Antimicrobial, Anti-inflammatory, hepatoprotective, sedative, neuroprotective, antidepressive antioxidant and antiviral	[91, 92]
19	*Herniaria glabra*	Caryophyllaceae	Apiorutin, rutin, narcissin and licoagroside B	[93]	Antihypertensive and antiscalant	[94-96]
20	*Hibiscus sabdariffa*	Malvaceae	Delphinidin 3-sambubioside, 3-caffeoylquinic acid, sambubioside, cyanidine-3- sambubioside, gossypetine, hibiscetin, protocatechuic acid, eugenol, β-sitoesterol and ergoesterol	[97, 98]	Anti-inflammatory, anthocyanidin, antioxidant and antimicrobial	[99, 100]

21	*Laurus nobilis*	Lauraceae	α-terpinyl acetate, α-pinene, β-elemene, sabinene , β-phellandrene, bornyl acetate, and camphene,1,8-cineole, methyl eugenol, β-linalool, β-pinene, sabineneand terpinene-4-ol, α-terpineol and oleic acid	[101, 102]	Antimicrobial, antibacterial, antibiofilm and antifungal	[103, 104]
22	*Lavandula dentata*	Lamiaceae	Hexan-1-ol, a-Pinene, camphene, b-Pinene, oct-1-en-3-ol, p-Cymene, d-Limonene, 1,8-Cineole, cis-Thujan-4-ol, cis-Linalool oxide, camphenilone, isoverbenone, isobornyl formate, carvone, terpinolene (51.13 %) and camphor	[105, 106]	Anti-inflammatory	[107]
23	*Lawsonia inermis*	Lythraceae	Lacoumarin, fraxetin, scopoletin, esculetin, daphneside, daphnorin, agrimonolide 6-O-β-D-glucopyranoside, apiin, cosmosiin, isoscutellarin, lawsochrysin, rhoifolin and catechin	[108]	Anti-oxidant, anti-inflammatory, anticancer, antibacterial , anti-ulcer and antimicrobial,	[108, 109]
24	*Lepidium sativum*	Brassicaceae	5,6-dimethoxy-2',3'-methylenedioxy-7-C-β-d-gluco-pyranosyl, 7-hydroxy-4',5,6-trimethoxyisoflavone, 7-hydroxy-5,6-dimethoxy-2',3'-methylenedioxyisoflavone, kaempferol-3-O-(2-O-sinapoyl)-β-D-galactopyranosyl-(1 → 2)-β-D-glucopyranoside-7-O-α-L-rhamnopyranoside and quercetin-3-O-(6-O-benzoyl)-β-D-glucopyranosyl-(1 → 3)-β-D-galactopyranoside-7-O-α-L-rhamnopyranoside	[110, 111]	Hypoglycaemic, antihypertensive, prokinetic and laxative	[22, 112, 113]
25	*Linum usitatissimum*	Linaceae	Caffeic acid, p-coumaric acid, ferulic acid, and secoisolariciresinol diglucoside	[114]	Antioxidant, immunomodulatory, anti-inflammatory, antimicrobial, antiprotozoal, insecticidal, analgesic, anti-hyperlipidemia, anti-hyperglycemic and anti-tumor	[115]
26	*Mentha pulegium*	Lamiaceae	α-pinene, 1,8-Cineole, camphor, menthone, pulegone, rosmarinic acid, ellagic acid, eriodictyol, naringenin and chlorogenic acid	[116, 117]	Antioxidant, insecticidal and antimicrobial	[118, 119]
27	*Mentha spicata*	Lamiaceae	Carvone, limonene , muurolene , myrcene, 1,8-cineole, germacrene D, β-pinene and β-caryophyllene	[120, 121]	Antioxidant, anti-inflammatory antimicrobial and antiproliferative	[122, 123]
28	*Mesembryanthemum cryptanthum*	Aizoaceae	-	No reference	-	No reference
29	Myrtus communis	Myrtaceae	1,8-cineole, methyl eugenol, α-terpineol, geranyl acetate, α-terpinyl acetate, methyleugenol, linalool, β-caryophyllene, α-humulene, Trans-caryophyllene oxide, and humulene epoxide II.	[124, 125]	Antioxidant, antimicrobial, antidiarrheal, antidiabetic, antispasmodic, vasodilator, antiulcer, anticancer, anxiolytic, sedative-hypnotic, and anti-inflammatory	[124, 126]
30	*Nerium oleander*	Apocynaceae	Oleanderocioic acid, quercetin-5-O-[a-L-rhamnopyranosyl-(1→6)]-b-D-glucopyranoside and kaempferol-5-O-[a-L-rhamnopyranosyl-(1 → 6)-b-D-glucopyranoside, and oleandigoside	[127]	Hepatoprotective, anti-diabetic and antioxidant	[128, 129]
31	*Nigella sativa*	Ranunculaceae	Linoleic acid, oleic acid, palmitic acid, myristic, myristoleic, palmitoleic, margaric, margaroleic, stearic, linolenic, arachidic, eicosenoic, behenic, lignoceric, p-cymene and thymol	[130, 131]	Antioxidant, anti-Inflammatory, anti-hyperlipidemic, anti-microbial, anti-cancer, anti-diabetic, anti-hypertensive analgesic and antipyretic	[132-134]
32	*Ocimum basilicum*	Lamiaceae	p-Allyl-anisole, nerol, z-citral, linalool, epi-α-cadinol, α-bergamotene, eugenol, chavicol and α-terpineol	[135-137]	Antioxidant, antifungal and antimicrobial	[136, 138]
33	*Olea europaea*	Oleaceae	oleuropein, verbascoside, luteolin-7-O-glucoside, apigenin-7-O-glucoside, hydroxytyrosol, tyrosol, hydroxytyrosol, rutin and luteolin	[139, 140]	Antidiabetic, antioxidant and antimicrobial	[141, 142]

34	*Origanum compactum*	Lamiaceae	b-Myrcene, a-Phellandrene, a-Terpinene, Limonene, 1,8-Cineole, b-Phellandrene, g-Terpinene, 3-Octanone, P-Cymene, Terpinolene, 1-Octen-3-ol, Trans-thuyanol, Camphre, Linalol, Cis-thuyanol, Terpinene-4-ol, b-Caryophyllene, Pulegone, a-Humulene, Neral, a-Terpineol, Borneol, b-Bisabolene, d-Cadinene, g-Cadinene, P-Cymene-8-ol, Piperitenone, Caryophyllene, oxide, Thymol and Carvacrol.	[143, 144]	Antibacterial, antioxidant and antileishmanial, antimicrobial, antifungal, antibacterial, anti-mutagenic, cytotoxic, anticancer, anti-dermatophytes and anti-corrosion	[143, 145]
35	*Origanum majorana*	Lamiaceae	Terpinen-4-ol, cis-sabinene hydrate, p-cymene, γ-terpinene, trans-sabinene and linalool	[146, 147]	Antifungal, antioxidant and antibacterial	[148-150]
36	*Peganum harmala*	Nitrariaceae	Tetradecanoic, pentadecanoic, tridecanoic, hexadecanoic, heptadecanoic, octadecanoic acids, 12-methyl tetradecanoic, 5,9,13-trimethyl tetradecanoic and 2-methyl octadecanoic	[151]	Antibacterial and antifungal, anti-oxidant, anti-cancer and anti-inflammatory	[60, 152]
37	*Petroselinum crispum*	Apiaceae	1,3,8-p-menthatriene, β-phellandrene, apiol, myristicin, terpinolene, malonyl-apiin and acetyl-apiin	[153, 154]	Antifungal, antioxidant and antibacterial	[155, 156]
38	*Phoenix dactylifera*	Arecaceae	3,4-dimethoxytoluene, 2,4-dimethoxytoluene, β-caryophyllene, p-cresyl methyl ether, caryophyllene oxide, carvacrol, linalool, and thymol	[157, 158]	Antioxidant, anti-Inflammatory, ntimicrobial, anticancer and antitumora	[159-161]
39	*Pimpinella anisum*	Apiaceae	Trans-anetole, estragole, γ-hymachalen, para-anisaldehyde and methyl cavicol, gamma-himachalene, trans-pseudoisoeugenyl 2-methylbutyrate, p-anisaldehyde and methylchavicol	[162, 163]	Ntimicrobial, antifungal, antiviral, antioxidant, muscle relaxant, analgesic and anticonvulsant	[162]
40	*Pistacia lentiscus*	Anacardiaceae	Tannic acid, gallic acid, digalloyl quinic acid derivative, quercetin, p-coumaric acid, β-sitosterol, cycloartenol and 24-methylene-cycloartenol	[164, 165]	Antioxidant, anticancer, genotoxic, antigenotoxic and antimutagenic	[164, 166, 167]
41	*Rosmarinus officinalis*	Lamiaceae	1,8-cineole, α-pinene, camphor , camphene and β-pinene	[168, 169]	Anti-inflammatory, antioxidant, anti-biofilm, muscle relaxant and antimicrobial	[168-170]
42	*Rubia tinctorum*	Rubiaceae	Mollugin, 1-hydroxy-2-methylanthraquinone, 2-ethoxymethyl-anthraquinone, rubiadin, 1, 3-dihydroxyanthraqunone, 7-hydroxy-2-methylanthraquinone, lucidin, 1-methoxymethylanthraquinone and lucidin-3-O-primeveroside	[171]	Antifungal and antimicrobial	[172, 173]
43	*Salvia officinalis*	Lamiaceae	Camphor, α-thujone, 1,8-cineole, viridiflorol, β-thujone and β-caryophyllene	[174, 175]	Synergistic antifungal, antimicrobial, insecticida allelopatic, anti-aroliferative, anti-inflammatory and antioxidant	[174, 176, 177]
44	*Saussurea costus*	Compositae	Lactone, elemol, γ-costol, vulgarol B, valerenol and terpinen-4-ol, arbusculin B, α-cyclocostunolide, costunolide, dehydrocostuslactone, parthenolide, zaluzanin D, and eupatoriopicrin	[178, 179]	Anti-inflammatory, anti-ulcer, anti-allergic anticancer and hepatoprotective	[180, 181]
45	*Searsia tripartita*	Anacardiaceae	-	No reference	-	No reference
46	*Solanum lyco persicum*	Solanaceae	α-tocopherol, linoleic acid, oleic acid, α-linolenic acid	[182]	Antioxidant and anti-inflammatory	[183, 184]
47	*Syzygium aromaticum*	Myrtaceae	Eugenol, eugenyl acetate, caryophyllene, furan, tetrahydro-3-methyl and 2-propanone, methylhydrazone	[185, 186]	Antioxidant and antibacterial	[185, 187]
48	*Tetraclinis articulata*	Cupressaceae	Bornyl acetate, camphor, α-pinene, camphene, linalool, cedrol, carvacrol and α-acorenol	[188, 189]	Antioxidant and anti-inflammatory	[188, 189]
49	*Trigonella foenum-graecum*	Leguminosae	(2E)-Hexenal, n-Hexadecanoic acid, (E)-b-Ionone, Thymol, 6,10,14-trimethyl-2-Pentadecanone, Carvacrol, (E)-Nerolidol, (2E,6Z)-Nonadienal, linoleic acid, linolenic acid and oleic acid	[190, 191]	Antioxidant, anti-arthritic, haemato-protective and anticancer	[192-194]

50	*Urtica dioica*	Urticaceae	5-O-caffeoylquinic acid, rutin, isoquercitrin, kaempferol 3-O-glucoside, secoisolariciresinol, 9,9'-bisacetyl-neo-olivil, carvacrol, carvone, naphthalene, (E)-anethol, hexahydrofarnesyl acetone, geranyl acetone, ionone and phytol	[195, 196]	Anti-diabetic, cardiovascular, antiinflammatory and antibacterial	[197, 198]
51	*Zea mays*	Poaceae	Tricin, salcolin A, salcolin B, C-glycoside, chrysoeriol 6-C-beta-boivinopyranosyl-7-O-beta-glucopyranoside, and a known flavone C-glycoside	[199, 200]	Aphrodisiac, antimalarial and antiplasmodial	[201, 202]
52	*Ziziphus lotus*	Rhamnaceae	Oleic acid, linoleic, palmitic, elaidic acid, threonine, glutamic acid, leucine, arginine and aspartic acid	[203, 204]	Antiradical, antioxidant and antimicrobial	[203, 205]

Plant parts used, mode of preparation and administration

A total of 11 parts of plants are used including leaf, seed, aerial part, fruit, bulb, root, Stem, gum, clove, chalices of flowers and stigma. The percentage of use of these different parts shows that the most used part of the plant is the leaf, with a percentage of 32.7% **(Fig. 2)**. Several previous ethnobotanical studies have shown the predominance of leaves in the preparation of various herbal remedies [206-208]. The high frequency of use of leaves can be explained by the ease of identification and the speed of harvest [209], but also by the fact that they are the site of photosynthesis and storage of plants bioactive phytochemicals [210, 211]

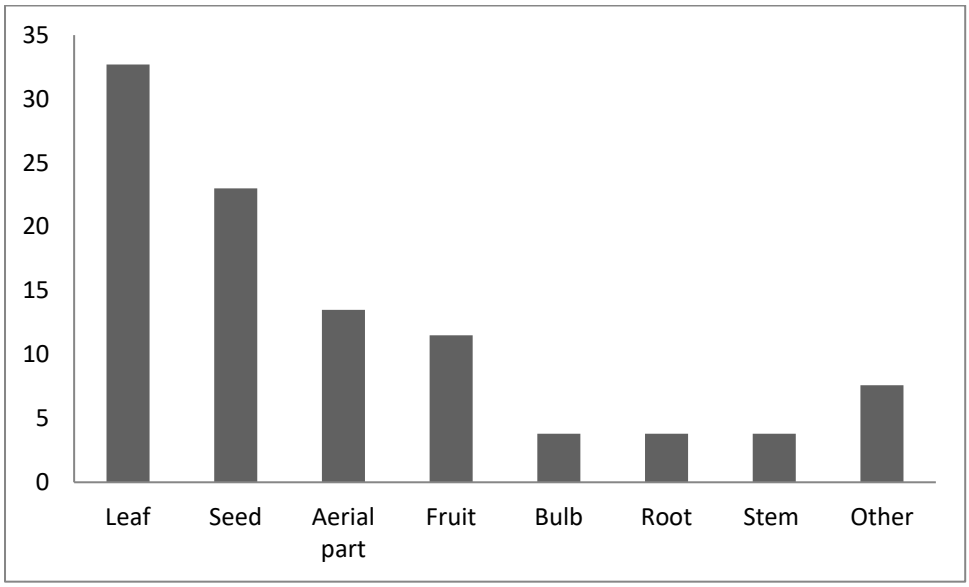

Fig. 2. Plant parts used (%)

The most common methods of use are classified as follows: decoction, infusion, powder and maceration with respectively 46.1%; 21.1%; 19.2%; 5.8% **(Fig. 3)**. Our results are in agreement with other studies conducted throughout Morocco [212, 213]. Herbal medicine is a rational use of medicinal plants. Rigorous selection of the most effective method of preparation to ensure the preservation of all properties while allowing the extraction and assimilation of active ingredients [214, 215]

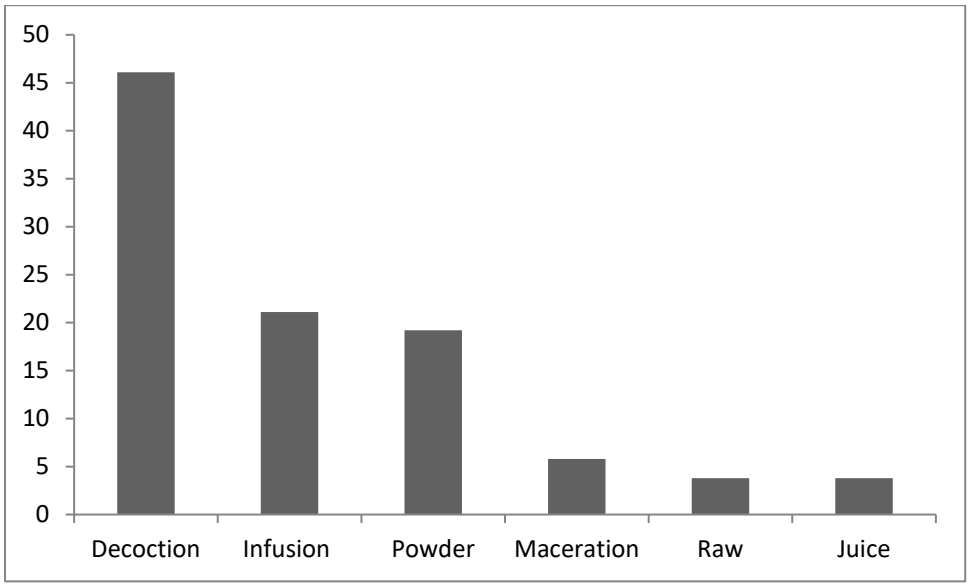

Fig. 3. Methods of preparation of plants (%)

Conclusion

This study allowed us to inventory and identify 52 species of plants belonging to 29 families used in the province of Tarfaya to treat hypertension. Among the most commonly used species are *Allium sativum*, *Allium cepa*, *Olea europaea*, *Searsia tripartita*, *Ammodaucus leucotrichus*, *Myrtus communis* and *Carum carvi*. The results of the study also showed that the frequency of plant use is very much related to the profile of the people surveyed. The illiterates predominate with a rate of 53.3%. Women and men have knowledge and practices in herbal medicine with an advantage for women. The rate among young people aged 21 to 30 is 11.3%, while it is around 34% for people aged 41 to 50. This study also showed that the therapeutic remedies are mainly prepared by the decoction and that the leaf and the seed are the most used parts.

Ultimately, the results of this study could constitute a database for the valorization of medicinal plants in order to discover new natural active ingredients that can be used in pharmacology for the treatment of hypertension.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgment

The authors would like to acknowledge local community members living in the study area for sharing their ancestral knowledge throughout the present study.

References

[1] WHO, Cardiovascular diseases (CVDs) [fact sheet]. Available: http://www.who.int/mediacentre/factsheets/fs317/en/.

[2] M. Diallo, et al., Prevalence, management and ethnobotanical investigation of hypertension in two Guinean urban districts, Journal of ethnopharmacology. 231 (2019) 73-79.

[3] H. De Wet, et al., The use of indigenous medicine for the treatment of hypertension by a rural community in northern Maputaland, South Africa, South African Journal of Botany. 103 (2016) 78-88.

[4] A. Douira, L. Zidane, Étude ethnobotanique des plantes médicinales utilisées dans le traitement du diabète, et des maladies cardiaques dans la région d'Izarène (Nord du Maroc), Journal of Applied Biosciences. 86(1) (2015) 7940–7956.

[5] A. Mohammadi, et al., Seasonal variation in the chemical composition, antioxidant activity, and total phenolic content of Artemisia absinthium essential oils, Pharmacognosy research. 7(4) (2015) 329.

[6] D. Davids, et al., Ethnobotanical survey of medicinal plants used to manage high blood pressure and type 2 diabetes mellitus in Bitterfontein, Western Cape Province, South Africa, Journal of ethnopharmacology. 194 (2016) 755-766.

[7] B. Ayinde, et al., Hypotensive effects of 3, 4-dihydroxybenzyaldehyde isolated from the stem bark of Musanga cecropioides, Journal of Pharmacognosy and Phytotherapy. 2(1) (2010) 004-009.

[8] J. Ngene, et al., Importance dans la pharmacopée traditionnelle des plantes à flavonoïdes vendues dans les marchés de Douala est (Cameroun), Journal of Applied Biosciences. 88(1) (2015) 8194–8210.

[9] M. Eddouks, et al., Ethnopharmacological survey of medicinal plants used for the treatment of diabetes mellitus, hypertension and cardiac diseases in the south-east region of Morocco (Tafilalet), Journal of ethnopharmacology. 82(2-3) (2002) 97-103.

[10] H. Jouad, et al., Ethnobotanical survey of medicinal plants used for the treatment of diabetes, cardiac and renal diseases in the North centre region of Morocco (Fez–Boulemane), Journal of Ethnopharmacology. 77(2-3) (2001) 175-182.

[11] A. Tahraoui, et al., Ethnopharmacological survey of plants used in the traditional treatment of hypertension and diabetes in south-eastern Morocco (Errachidia province), Journal of ethnopharmacology. 110(1) (2007) 105-117.

[12] A. Ziyyat, et al., Phytotherapy of hypertension and diabetes in oriental Morocco, Journal of ethnopharmacology. 58(1) (1997) 45-54.

[13] Z. Aziz, A. Lotfi, Ethnobotanical Survey of Medicinal and Aromatic Plants Used by the People of Targuist in the North of Morocco, Der Pharma Chemica. 10(5) (2018).

[14] F. Jamila, E. Mostafa, Ethnobotanical survey of medicinal plants used by people in Oriental Morocco to manage various ailments, Journal of ethnopharmacology. 154(1) (2014) 76-87.

[15] C. Anyinam, Ecology and ethnomedicine: exploring links between current environmental crisis and indigenous medical practices, Social Science & Medicine. 40(3) (1995) 321-329.

[16] S. Djidel, et al., Medicinal plants used traditionally in the Algerian folk medicine for gastrointestinal disorders and hypertension: total polyphenols, flavonoids and antioxidant activity, XIII International Conference on Medicinal and Aromatic Plants 854, 2009, pp. 59-65.

[17] A. Gbolade, Ethnobotanical study of plants used in treating hypertension in Edo State of Nigeria, Journal of ethnopharmacology. 144(1) (2012) 1-10.

[18] N. Ahmed, et al., Ethnomedicinal knowledge and relative importance of indigenous medicinal plants of Cholistan desert, Punjab Province, Pakistan, Journal of ethnopharmacology. 155(2) (2014) 1263-1275.

[19] K. Al-Qattan, et al., The antihypertensive effect of garlic (Allium sativum) in the rat two-kidney–one-clip Goldblatt model, Journal of ethnopharmacology. 66(2) (1999) 217-222.

[20] C. Pantoja, et al., Diuretic, natriuretic and hypotensive effects produced by Allium sativum (garlic) in anaesthetized dogs, Journal of ethnopharmacology. 31(3) (1991) 325-331.

[21] Q. Jabeen, et al., Coriander fruit exhibits gut modulatory, blood pressure lowering and diuretic activities, Journal of ethnopharmacology. 122(1) (2009) 123-130.

[22] M. Maghrani, et al., Antihypertensive effect of Lepidium sativum L. in spontaneously hypertensive rats, Journal of ethnopharmacology. 100(1-2) (2005) 193-197.

[23] A. Villar, et al., Hypotensive effect of Pistacia lentiscus L, International Journal of Crude Drug Research. 25(1) (1987) 1-3.

[24] E. Susalit, et al., Olive (Olea europaea) leaf extract effective in patients with stage-1 hypertension: comparison with Captopril, Phytomedicine. 18(4) (2011) 251-258.

[25] S. Ullah, et al., Ethnomedicinal plant use value in the Lakki Marwat District of Pakistan, Journal of ethnopharmacology. 158 (2014) 412-422.

[26] Y. Sylla, et al., Etude ethnobotanique des plantes utilisées contre le paludisme par les tradithérapeutes et herboristes dans le district d'Abidjan (Côte d'Ivoire), International Journal of Biological and Chemical Sciences. 12(3) (2018) 1380-1400.

[27] L. Lopez-Torrez, et al., Acacia senegal vs. Acacia seyal gums–Part 1: Composition and structure of hyperbranched plant exudates, Food Hydrocolloids. 51 (2015) 41-53.

[28] R. Babiker, et al., Effect of Gum Arabic (Acacia Senegal) supplementation on visceral adiposity index (VAI) and blood pressure in patients with type 2 diabetes mellitus as indicators of cardiovascular disease (CVD): a randomized and placebo-controlled clinical trial, Lipids in health and disease. 17(1) (2018) 56.

[29] H. Ram, et al., Antiatherosclerotic and cardioprotective potential of acacia senegal seeds in diet-induced atherosclerosis in rabbits, Biochemistry research international. 2014 (2014).

[30] M.A. Osman, Chemical and nutrient analysis of baobab (Adansonia digitata) fruit and seed protein solubility, Plant foods for human nutrition. 59(1) (2004) 29-33.

[31] B.V. Owoyele, A.O. Bakare, Analgesic properties of aqueous bark extract of Adansonia digitata in Wistar rats, Biomedicine & Pharmacotherapy. 97 (2018) 209-212.

[32] E.A. Irondi, et al., Blanching influences the phenolics composition, antioxidant activity, and inhibitory effect of Adansonia digitata leaves extract on α-amylase, α-glucosidase, and aldose reductase, Food science & nutrition. 5(2) (2017) 233-242.

[33] A. Hanafy, et al., Evaluation of hepatoprotective activity of Adansonia digitata extract on acetaminophen-induced hepatotoxicity in rats, Evidence-Based complementary and Alternative medicine. 2016 (2016).

[34] O. Chouitah, et al., Essential Oil from the Leaves of Ajuga iva: Chemical Composition and Antimicrobial Activity, Journal of Essential Oil Bearing Plants. 20(3) (2017) 873-877.

[35] S. Medjeldi, et al., Biological activities, and phytocompounds of northwest Algeria Ajuga iva (L) extracts: Partial identification of the antibacterial fraction, Microbial pathogenesis. 121 (2018) 173-178.

[36] J. El Hilaly, B. Lyoussi, Hypoglycaemic effect of the lyophilised aqueous extract of Ajuga iva in normal and streptozotocin diabetic rats, Journal of Ethnopharmacology. 80(2-3) (2002) 109-113.

[37] M. Marrelli, et al., Biological Properties and Bioactive Components of Allium cepa L.: Focus on Potential Benefits in the Treatment of Obesity and Related Comorbidities, Molecules. 24(1) (2019) 119.

[38] M. Mollavali, et al., Nitrogen form and mycorrhizal inoculation amount and timing affect flavonol biosynthesis in onion (Allium cepa L.), Mycorrhiza. 28(1) (2018) 59-70.

[39] M.S.H. Akash, et al., Spice plant Allium cepa: Dietary supplement for treatment of type 2 diabetes mellitus, Nutrition. 30(10) (2014) 1128-1137.

[40] P. Satyal, et al., The chemical compositions of the volatile oils of garlic (Allium sativum) and wild garlic (Allium vineale), Foods. 6(8) (2017) 63.

[41] N. Martins, et al., Chemical composition and bioactive compounds of garlic (Allium sativum L.) as affected by pre-and post-harvest conditions: A review, Food chemistry. 211 (2016) 41-50.

[42] S.S. Nair, et al., Allium sativum constituents exhibit anti-tubercular activity in vitro and in RAW 264.7 mouse macrophage cells infected with Mycobacterium tuberculosis H37Rv, Pharmacognosy magazine. 13(Suppl 2) (2017) S209.

[43] A. Yetgin, et al., Comparison of Antimicrobial Activity of Allium sativum Cloves from China and Taşköprü, Turkey, Advances in pharmacological sciences. 2018 (2018).

[44] M.A. Oukerrou, et al., Chemical composition and cytotoxic and antibacterial activities of the essential oil of Aloysia citriodora palau grown in Morocco, Advances in pharmacological sciences. 2017 (2017).

[45] A. Gil, et al., Identification of the genotype from the content and composition of the essential oil of lemon verbena (Aloysia citriodora Palau), Journal of agricultural and food chemistry. 55(21) (2007) 8664-8669.

[46] R. Bahramsoltani, et al., Aloysia citrodora Paláu (Lemon verbena): A review of phytochemistry and pharmacology, Journal of ethnopharmacology. (2018).

[47] S.M.B. Hashemi, et al., Extraction of essential oil from Aloysia citriodora Palau leaves using continuous and pulsed ultrasound: kinetics, antioxidant activity and antimicrobial properties, Process Biochemistry. 65 (2018) 197-204.

[48] M. Touaibia, et al., Chemical Composition and Antimicrobial Activity of the Saharo-endemic Species: Ammodaucus leucotrichus subsp. leucotrichus Coss & Dur (Apiaceae), Phytothérapie. (2018).

[49] D. Dahmane, et al., Chemical composition, antioxidant and antibacterial activities of the essential oils of medicinal plant Ammodaucus leucotrichus from Algeria, Journal of EssEntial oil rEsEarch. 29(1) (2017) 48-55.

[50] F. El-Ouady, M. Eddouks, Glucose lowering activity of aqueous Ammodaucus leucotrichus extract in diabetic rats, Cardiovascular & hematological disorders drug targets. (2019).

[51] I.A. El-Haci, et al., Antimicrobial activity of Ammodaucus leucotrichus fruit oil from Algerian Sahara, Natural product communications. 9(5) (2014) 711-712.

[52] B.E. Ziani, et al., Detailed chemical composition and functional properties of Ammodaucus leucotrichus Cross. & Dur. and Moringa oleifera Lamarck, Journal of Functional Foods. 53 (2019) 237-247.

[53] M. Govindarajan, G. Benelli, Artemisia absinthium-borne compounds as novel larvicides: effectiveness against six mosquito vectors and acute toxicity on non-target aquatic organisms, Parasitology research. 115(12) (2016) 4649-4661.

[54] R. Dilshad, et al., Phytochemical screening and antibacterial potential of Artemisia absinthium L., Swertia chirayita and Sphaeranthus indicus, Pakistan journal of pharmaceutical sciences. 31(2) (2018).

[55] K. Tariq, et al., Anthelmintic activity of extracts of Artemisia absinthium against ovine nematodes, Veterinary parasitology. 160(1-2) (2009) 83-88.

[56] I. Koyuncu, Evaluation of anticancer, antioxidant activity and phenolic compounds of Artemisia absinthium L. Extract, Cellular and molecular biology (Noisy-le-Grand, France). 64(3) (2018) 25-34.

[57] F. Younsi, et al., Essential Oil Variability in Natural Populations of Artemisia campestris (L.) and Artemisia herba-alba (Asso) and Incidence on Antiacetylcholinesterase and Antioxidant Activities, Chemistry & biodiversity. 14(7) (2017) e1700017.

[58] M. Abu-Darwish, et al., Artemisia herba-alba essential oil from Buseirah (South Jordan): Chemical characterization and assessment of safe antifungal and anti-inflammatory doses, Journal of ethnopharmacology. 174 (2015) 153-160.

[59] R. Rafiq, et al., Antibacterial and Antioxidant Activities of Essential Oils from Artemisia herba-alba Asso., Pelargonium capitatum× radens and Laurus nobilis L, Foods. 5(2) (2016) 28.

[60] D. Khlifi, et al., Composition and anti-oxidant, anti-cancer and anti-inflammatory activities of Artemisia herba-alba, Ruta chalpensis L. and Peganum harmala L, Food and chemical toxicology. 55 (2013) 202-208.

[61] M. Clauser, et al., Phytochemical investigation on Atriplex halimus L. from Sardinia, Natural product research. 27(20) (2013) 1940-1944.

[62] N. Benhammou, et al., Antioxidant activity of methanolic extracts and some bioactive compounds of Atriplex halimus, Comptes Rendus Chimie. 12(12) (2009) 1259-1266.

[63] I. Chikhi, et al., Antidiabetic activity of aqueous leaf extract of Atriplex halimus L.(Chenopodiaceae) in streptozotocin–induced diabetic rats, Asian Pacific journal of tropical disease. 4(3) (2014) 181-184.

[64] H. Zhang, Z. Ma, Phytochemical and pharmacological properties of Capparis spinosa as a medicinal plant, Nutrients. 10(2) (2018) 116.

[65] N. Tlili, et al., Phenolic profile and antioxidant activity of Capparis spinosa seeds harvested from different wild habitats, Industrial Crops and Products. 76 (2015) 930-935.

[66] J. Jiménez-López, et al., Phytochemical profile and antioxidant activity of caper berries (Capparis spinosa L.): Evaluation of the influence of the fermentation process, Food chemistry. 250 (2018) 54-59.

[67] Z. Ghafari, et al., Antimicrobial activity and essential oil composition of Cuminum cyminum L. and Carum carvi L. seeds from Iran, Intl. J. Biosci. 6 (2014) 153-159.

[68] M. Razzaghi-Abyaneh, et al., Chemical composition and antiaflatoxigenic activity of Carum carvi L., Thymus vulgaris and Citrus aurantifolia essential oils, Food Control. 20(11) (2009) 1018-1024.

[69] S. Lahlou, et al., Diuretic activity of the aqueous extracts of Carum carvi and Tanacetum vulgare in normal rats, Journal of Ethnopharmacology. 110(3) (2007) 458-463.

[70] P. Kumar, D. Singh, Molluscicidal activity of Ferula asafoetida, Syzygium aromaticum and Carum carvi and their active components against the snail Lymnaea acuminata, Chemosphere. 63(9) (2006) 1568-1574.

[71] N. Thippeswamy, et al., Antioxidant and antibacterial properties of phenolic extract from Carum carvi L, journal of pharmacy research. 7(4) (2013) 352-357.

[72] A.I. Hussain, et al., Citrullus colocynthis (L.) Schrad (bitter apple fruit): A review of its phytochemistry, pharmacology, traditional uses and nutritional potential, Journal of ethnopharmacology. 155(1) (2014) 54-66.

[73] B. Marzouk, et al., Antibacterial and antifungal activities of several populations of Tunisian Citrullus colocynthis Schrad. immature fruits and seeds, Journal de Mycologie Médicale. 20(3) (2010) 179-184.

[74] F. Hussain, et al., Identification of Hypotensive Biofunctional Compounds of Coriandrum sativum and Evaluation of Their Angiotensin-Converting Enzyme (ACE) Inhibition Potential, Oxidative medicine and cellular longevity. 2018 (2018).

[75] J. Matasyoh, et al., Chemical composition and antimicrobial activity of the essential oil of Coriandrum sativum, Food Chemistry. 113(2) (2009) 526-529.

[76] A. Begnami, et al., Antimicrobial potential of Coriandrum sativum L. against different Candida species in vitro, Food Chemistry. 118(1) (2010) 74-77.

[77] N.B. Guerra, et al., Antioxidant compounds from coriander (Coriandrum sativum L.) etheric extract, Journal of Food Composition and Analysis. 18(2-3) (2005) 193-199.

[78] B. Laribi, et al., Coriander (Coriandrum sativum L.) and its bioactive constituents, Fitoterapia. 103 (2015) 9-26.

[79] D. Karthik, S. Ravikumar, Proteome and phytochemical analysis of Cynodon dactylon leaves extract and its biological activity in diabetic rats, Biomedicine & Preventive Nutrition. 1(1) (2011) 49-56.

[80] D. Khlifi, et al., LC–MS analysis, anticancer, antioxidant and antimalarial activities of Cynodon dactylon L. extracts, Industrial crops and products. 45 (2013) 240-247.

[81] A.A. Mozafari, et al., Phytochemical composition and in vitro antioxidant potential of Cynodon dactylon leaf and rhizome extracts as affected by drying methods and temperatures, Journal of food science and technology. 55 (2018) 2220-2229.

[82] M.H. Soares, et al., Chemical composition, antibacterial, schistosomicidal, and cytotoxic activities of the essential oil of Dysphania ambrosioides (L.) Mosyakin & Clemants (Chenopodiaceae), Chemistry & biodiversity. 14(8) (2017) e1700149.

[83] S.-Q. Hou, et al., Polyol monoterpenes isolated from Chenopodium ambrosioides, Natural product research. 31(21) (2017) 2467-2472.

[84] T. Zohra, et al., Extraction optimization, total phenolic, flavonoid contents, HPLC-DAD analysis and diverse pharmacological evaluations of Dysphania ambrosioides (L.) Mosyakin & Clemants, Natural product research. (2018) 1-7.

[85] R. Kumar, et al., Evaluation of Chenopodium ambrosioides oil as a potential source of antifungal, antiaflatoxigenic and antioxidant activity, International journal of food microbiology. 115(2) (2007) 159-164.

[86] G.R. Vilela, et al., Activity of essential oil and its major compound, 1, 8-cineole, from Eucalyptus globulus Labill., against the storage fungi Aspergillus flavus Link and Aspergillus parasiticus Speare, Journal of Stored Products Research. 45(2) (2009) 108-111.

[87] L. Harkat-Madouri, et al., Chemical composition, antibacterial and antioxidant activities of essential oil of Eucalyptus globulus from Algeria, Industrial Crops and Products. 78 (2015) 148-153.

[88] L. Boulekbache-Makhlouf, et al., Total phenolic content, antioxidant and antibacterial activities of fruits of Eucalyptus globulus cultivated in Algeria, Industrial crops and products. 41 (2013) 85-89.

[89] C. Schmid, et al., Saponins from European licorice roots (Glycyrrhiza glabra), Journal of natural products. 81(8) (2018) 1734-1744.

[90] A. Karkanis, et al., Phytochemical composition, health effects, and crop management of liquorice (Glycyrrhiza glabra L.): A medicinal plant, Food Reviews International. 34(2) (2018) 182-203.

[91] V.K. Gupta, et al., Antimicrobial potential of Glycyrrhiza glabra roots, Journal of Ethnopharmacology. 116(2) (2008) 377-380.

[92] G. Pastorino, et al., Liquorice (Glycyrrhiza glabra): A phytochemical and pharmacological review, Phytotherapy Research. 32(12) (2018) 2323-2339.

[93] S. Kozachok, et al., γ-Pyrone compounds: flavonoids and maltol glucoside derivatives from Herniaria glabra L. collected in the Ternopil region of the Ukraine, Phytochemistry. 152 (2018) 213-222.

[94] H. Rhiouani, et al., Effects of saponins from Herniaria glabra on blood pressure and renal function in spontaneously hypertensive rats, Therapie. 54(6) (1999) 735-739.

[95] H. Rhiouani, et al., Antihypertensive effect of Herniaria glabra saponins in the spontaneously hypertensive rat, Annales pharmaceutiques francaises, 2001, pp. 211-214.

[96] O. Horner, et al., Antiscalant properties of Herniaria glabra aqueous solution, Desalination. 409 (2017) 157-162.

[97] A. Piovesana, et al., Composition analysis of carotenoids and phenolic compounds and antioxidant activity from hibiscus calyces (Hibiscus sabdariffa L.) by HPLC-DAD-MS/MS, Phytochemical Analysis. 30(2) (2019) 208-217.

[98] G. Riaz, R. Chopra, A review on phytochemistry and therapeutic uses of Hibiscus sabdariffa L, Biomedicine & Pharmacotherapy. 102 (2018) 575-586.

[99] J. Zhen, et al., Phytochemistry, antioxidant capacity, total phenolic content and anti-inflammatory activity of Hibiscus sabdariffa leaves, Food chemistry. 190 (2016) 673-680.

[100] I. Borrás-Linares, et al., Characterization of phenolic compounds, anthocyanidin, antioxidant and antimicrobial activity of 25 varieties of Mexican Roselle (Hibiscus sabdariffa), Industrial Crops and Products. 69 (2015) 385-394.

[101] H. Fidan, et al., Chemical Composition and Antimicrobial Activityof Laurus nobilis L. Essential Oils from Bulgaria, Molecules. 24(4) (2019) 804.

[102] W. Dhifi, et al., Phytochemical composition and antioxidant activity of Tunisian Laurus nobilis, Pakistan journal of pharmaceutical sciences. 31(6) (2018) 2397-2402.

[103] L. Caputo, et al., Laurus nobilis: Composition of essential oil and its biological activities, Molecules. 22(6) (2017) 930.

[104] A. Merghni, et al., Antibacterial and antibiofilm activities of Laurus nobilis L. essential oil against Staphylococcus aureus strains associated with oral infections, Current Research In Translational Medicine. 64(1) (2016) 29-34.

[105] B. Touati, et al., Chemical composition of the leaf and flower essential oils of Tunisian Lavandula dentata L.(Lamiaceae), Chemistry & Biodiversity. 8(8) (2011) 1560-1569.

[106] D. Dris, et al., Lavandula dentata essential oils: chemical composition and larvicidal activity against Culiseta longiareolata and Culex pipiens (Diptera: Culicidae), African entomology. 25(2) (2017) 387-395.

[107] F. Algieri, et al., Anti-inflammatory activity of hydroalcoholic extracts of Lavandula dentata L. and Lavandula stoechas L, Journal of ethnopharmacology. 190 (2016) 142-158.

[108] R.B. Semwal, et al., Lawsonia inermis L.(henna): Ethnobotanical, phytochemical and pharmacological aspects, Journal of Ethnopharmacology. 155(1) (2014) 80-103.

[109] A. Pasandi Pour, H. Farahbakhsh, Lawsonia inermis L. leaves aqueous extract as a natural antioxidant and antibacterial product, Natural product research. (2019) 1-5.

[110] M. Sakran, et al., A new isoflavonoid from seeds of Lepidium sativum L. and its protective effect on hepatotoxicity induced by paracetamol in male rats, Molecules. 19(10) (2014) 15440-15451.

[111] Q.-L. Fan, et al., Two new acylated flavonol glycosides from the seeds of Lepidium sativum, Molecules. 19(8) (2014) 11341-11349.

[112] M. Eddouks, et al., Study of the hypoglycaemic activity of Lepidium sativum L. aqueous extract in normal and diabetic rats, Journal of Ethnopharmacology. 97(2) (2005) 391-395.

[113] M.H. Mehmood, et al., Prokinetic and laxative activities of Lepidium sativum seed extract with species and tissue selective gut stimulatory actions, Journal of Ethnopharmacology. 134(3) (2011) 878-883.

[114] H. Wang, et al., Comparison of phytochemical profiles and health benefits in fiber and oil flaxseeds (Linum usitatissimum L.), Food chemistry. 214 (2017) 227-233.

[115] R. Ansari, et al., A review on Pharmacological and clinical aspects of Linum usitatissimum L, Current drug discovery technologies. (2018).

[116] A. Bouyahya, et al., Chemical composition of Mentha pulegium and Rosmarinus officinalis essential oils and their antileishmanial, antibacterial and antioxidant activities, Microbial pathogenesis. 111 (2017) 41-49.

[117] O. Politeo, et al., Phytochemical Composition, Antioxidant Potential and Cholinesterase Inhibition Potential of Extracts from Mentha pulegium L, Chemistry & biodiversity. 15(12) (2018) e1800374.

[118] B. Teixeira, et al., European pennyroyal (Mentha pulegium) from Portugal: Chemical composition of essential oil and antioxidant and antimicrobial properties of extracts and essential oil, Industrial Crops and Products. 36(1) (2012) 81-87.

[119] F. Brahmi, et al., Chemical composition and in vitro antimicrobial, insecticidal and antioxidant activities of the essential oils of Mentha pulegium L. and Mentha rotundifolia (L.) Huds growing in Algeria, Industrial Crops and Products. 88 (2016) 96-105.

[120] R. Scherer, et al., Antioxidant and antibacterial activities and composition of Brazilian spearmint (Mentha spicata L.), Industrial crops and products. 50 (2013) 408-413.

[121] A. Chrysargyris, et al., Antioxidant and antibacterial activities, mineral and essential oil composition of spearmint (Mentha spicata L.) affected by the potassium levels, Industrial Crops and Products. 103 (2017) 202-212.

[122] S.K. Bardaweel, et al., Chemical composition, antioxidant, antimicrobial and Antiproliferative activities of essential oil of Mentha spicata L.(Lamiaceae) from Algerian Saharan atlas, BMC complementary and alternative medicine. 18(1) (2018) 201.

[123] P. Arumugam, et al., Anti-inflammatory activity of four solvent fractions of ethanol extract of Mentha spicata L. investigated on acute and chronic inflammation induced rats, Environmental toxicology and pharmacology. 26(1) (2008) 92-95.

[124] Y. Harassi, et al., Phytochemical analysis, cytotoxic and antioxidant activities of Myrtus communis essential oil from Morocco, Journal of Complementary and Integrative Medicine. (2019).

[125] M. Usai, et al., Chemical Composition of Myrtle (Myrtus communis L.) Berries Essential Oils as Observed in a Collection of Genotypes, Molecules. 23(10) (2018) 2502.

[126] M. Sisay, T. Gashaw, Ethnobotanical, ethnopharmacological, and phytochemical studies of Myrtus communis Linn: A popular herb in Unani system of medicine, Journal of evidence-based complementary & alternative medicine. 22(4) (2017) 1035-1043.

[127] B.S. Siddiqui, et al., Flavonoid and cardenolide glycosides and a pentacyclic triterpene from the leaves of Nerium oleander and evaluation of cytotoxicity, Phytochemistry. 77 (2012) 238-244.

[128] K.G. Singhal, G.D. Gupta, Hepatoprotective and antioxidant activity of methanolic extract of flowers of Nerium oleander against CCl4–induced liver injury in rats, Asian Pacific journal of tropical medicine. 5(9) (2012) 677-685.

[129] P. Dey, et al., Assessment of anti-diabetic activity of an ethnopharmacological plant Nerium oleander through alloxan induced diabetes in mice, Journal of ethnopharmacology. 161 (2015) 128-137.

[130] S. Cheikh-Rouhou, et al., Nigella sativa L.: Chemical composition and physicochemical characteristics of lipid fraction, Food chemistry. 101(2) (2007) 673-681.

[131] L.F. D'Antuono, et al., Seed yield, yield components, oil content and essential oil content and composition of Nigella sativa L. and Nigella damascena L, Industrial crops and products. 15(1) (2002) 59-69.

[132] L. Bordoni, et al., Antioxidant and Anti-Inflammatory Properties of Nigella sativa Oil in Human Pre-Adipocytes, Antioxidants. 8(2) (2019) 51.

[133] M. Al-Ghamdi, The anti-inflammatory, analgesic and antipyretic activity of Nigella sativa, Journal of ethnopharmacology. 76(1) (2001) 45-48.

[134] W. Kooti, et al., Phytochemistry, pharmacology, and therapeutic uses of black seed (Nigella sativa), Chinese journal of natural medicines. 14(10) (2016) 732-745.

[135] G. Yaldiz, et al., Biological value and chemical components of essential oils of sweet basil (Ocimum basilicum L.) grown with organic fertilization sources, Journal of the Science of Food and Agriculture. (2018).

[136] A.I. Hussain, et al., Chemical composition, antioxidant and antimicrobial activities of basil (Ocimum basilicum) essential oils depends on seasonal variations, Food chemistry. 108(3) (2008) 986-995.

[137] O. Politeo, et al., Chemical composition and antioxidant capacity of free volatile aglycones from basil (Ocimum basilicum L.) compared with its essential oil, Food Chemistry. 101(1) (2007) 379-385.

[138] N.H.A. El-Soud, et al., Chemical composition and antifungal activity of Ocimum basilicum L. essential oil, Open access Macedonian journal of medical sciences. 3(3) (2015) 374.

[139] J. Hayes, et al., Phenolic composition and in vitro antioxidant capacity of four commercial phytochemical products: Olive leaf extract (Olea europaea L.), lutein, sesamol and ellagic acid, Food Chemistry. 126(3) (2011) 948-955.

[140] A.F. Vinha, et al., Phenolic profiles of Portuguese olive fruits (Olea europaea L.): Influences of cultivar and geographical origin, Food chemistry. 89(4) (2005) 561-568.

[141] C.G. Guex, et al., ANTIDIABETIC EFFECTS OF Olea europaea L. LEAVES IN DIABETIC RATS INDUCED BY HIGH-FAT DIET AND LOW-DOSE STREPTOZOTOCIN, Journal of ethnopharmacology. (2019).

[142] O.-H. Lee, B.-Y. Lee, Antioxidant and antimicrobial activities of individual and combined phenolics in Olea europaea leaf extract, Bioresource technology. 101(10) (2010) 3751-3754.

[143] A. Bouyahya, et al., Correlation between phenological changes, chemical composition and biological activities of the essential oil from Moroccan endemic Oregano (Origanum compactum Benth), Industrial Crops and Products. 108 (2017) 729-737.

[144] A. Bouyahya, et al., Origanum compactum Benth: a review on phytochemistry and pharmacological properties, Med Aromat Plants. 5(04) (2016).

[145] A. Bouyahya, et al., Anti-dermatophytes Activity of Origanum compactum Essential Oil at Three Developmental Stages, Phytothérapie. (2018).

[146] R. Vera, J. Chane-Ming, Chemical composition of the essential oil of marjoram (Origanum majorana L.) from Reunion Island, Food Chemistry. 66(2) (1999) 143-145.

[147] I.H. Sellami, et al., Effect of growth stage on the content and composition of the essential oil and phenolic fraction of sweet marjoram (Origanum majorana L.), Industrial Crops and Products. 30(3) (2009) 395-402.

[148] S.-S. Chun, et al., Phenolic antioxidants from clonal oregano (Origanum vulgare) with antimicrobial activity against Helicobacter pylori, Process Biochemistry. 40(2) (2005) 809-816.

[149] B. Tripathy, et al., Phytochemical screening and antifungal activity of ethanol and petroleum-ether leaf extracts of Origanum majorana, International Journal of Pharmaceutical Research and Health Sciences. 4(4) (2016) 1320-1323.

[150] B. Oksal, et al., Antibacterial activity of essential oil obtained from Origanum majorana L. by solvent-free microwave extraction, Planta Medica. 78(11) (2012) PJ85.

[151] T.A. Moussa, O.A. Almaghrabi, Fatty acid constituents of Peganum harmala plant using Gas Chromatography–Mass Spectroscopy, Saudi journal of biological sciences. 23(3) (2016) 397-403.

[152] G. Nenaah, Antibacterial and antifungal activities of (beta)-carboline alkaloids of Peganum harmala (L) seeds and their combination effects, Fitoterapia. 81(7) (2010) 779-782.

[153] M. Snoussi, et al., Chemical composition and antibiofilm activity of Petroselinum crispum and Ocimum basilicum essential oils against Vibrio spp. strains, Microbial pathogenesis. 90 (2016) 13-21.

[154] D.L. Luthria, Influence of experimental conditions on the extraction of phenolic compounds from parsley (Petroselinum crispum) flakes using a pressurized liquid extractor, Food Chemistry. 107(2) (2008) 745-752.

[155] G. Linde, et al., Antifungal and antibacterial activities of Petroselinum crispum essential oil, Genetics and Molecular Research. 15(3) (2016) 15038538.

[156] H. Zhang, et al., Evaluation of antioxidant activity of parsley (Petroselinum crispum) essential oil and identification of its antioxidant constituents, Food Research International. 39(8) (2006) 833-839.

[157] B. Demirci, et al., Phoenix dactylifera L. spathe essential oil: Chemical composition and repellent activity against the yellow fever mosquito, Acta tropica. 128(3) (2013) 557-560.

[158] A. Hamedi, et al., Preliminary pharmacognostic evaluation and volatile constituent analysis of spathe of Phoenix dactylifera L.(Tarooneh), Pharmacognosy Journal. 5(2) (2013) 83-86.

[159] H. El Abed, et al., Antioxidant, Anti-Inflammatory, and Antitumoral Effects of Aqueous Ethanolic Extract from Phoenix dactylifera L. Parthenocarpic Dates, BioMed research international. 2018 (2018).

[160] F. Biglari, et al., Antioxidant activity and phenolic content of various date palm (Phoenix dactylifera) fruits from Iran, Food chemistry. 107(4) (2008) 1636-1641.

[161] M. Oves, et al., Antimicrobial and anticancer activities of silver nanoparticles synthesized from the root hair extract of Phoenix dactylifera, Materials Science and Engineering: C. 89 (2018) 429-443.

[162] A. Shojaii, M. Abdollahi Fard, Review of pharmacological properties and chemical constituents of Pimpinella anisum, ISRN pharmaceutics. 2012 (2012).

[163] A. Orav, et al., Essential oil composition of Pimpinella anisum L. fruits from various European countries, Natural product research. 22(3) (2008) 227-232.

[164] M. Yemmen, et al., Antioxidant activities, anticancer activity and polyphenolics profile, of leaf, fruit and stem extracts of Pistacia lentiscus from Tunisia, Cellular and molecular biology (Noisy-le-Grand, France). 63(9) (2017) 87-95.

[165] F. Mezni, et al., Diversity of sterol composition in Tunisian Pistacia lentiscus seed oil, Chemistry & biodiversity. 13(5) (2016) 544-548.

[166] A. Abdelwahed, et al., Study of antimutagenic and antioxidant activities of Gallic acid and 1, 2, 3, 4, 6-pentagalloylglucose from Pistacia lentiscus: Confirmation by microarray expression profiling, Chemico-biological interactions. 165(1) (2007) 1-13.

[167] W. Bhouri, et al., Study of genotoxic, antigenotoxic and antioxidant activities of the digallic acid isolated from Pistacia lentiscus fruits, Toxicology in Vitro. 24(2) (2010) 509-515.

[168] R.S. Borges, et al., Rosmarinus officinalis essential oil: A review of its phytochemistry, anti-inflammatory activity, and mechanisms of action involved, Journal of ethnopharmacology. (2018).

[169] M. Jardak, et al., Chemical composition, anti-biofilm activity and potential cytotoxic effect on cancer cells of Rosmarinus officinalis L. essential oil from Tunisia, Lipids in health and disease. 16(1) (2017) 190.

[170] G. Nieto, et al., Antioxidant and Antimicrobial Properties of Rosemary (Rosmarinus officinalis, L.): A Review, Medicines. 5(3) (2018) 98.

[171] Y. KAWASAKI, et al., The mutagenic constituents of Rubia tinctorum, Chemical and pharmaceutical bulletin. 40(6) (1992) 1504-1509.

[172] N.T. Manojlovic, et al., Antifungal activity of Rubia tinctorum, Rhamnus frangula and Caloplaca cerina, Fitoterapia. 76(2) (2005) 244-246.

[173] F. Kalyoncu, et al., Antimicrobial activity of common madder (Rubia tinctorum L.), Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 20(6) (2006) 490-492.

[174] M.R.B. Khedher, et al., Chemical composition and biological activities of Salvia officinalis essential oil from Tunisia, EXCLI journal. 16 (2017) 160.

[175] A.B. Cutillas, et al., Salvia officinalis L. essential oils from Spain: determination of composition, antioxidant capacity, antienzymatic, and antimicrobial bioactivities, Chemistry & biodiversity. 14(8) (2017) e1700102.

[176] E. Alexa, et al., Synergistic Antifungal, Allelopatic and Anti-Proliferative Potential of Salvia officinalis L., and Thymus vulgaris L. Essential Oils, Molecules. 23(1) (2018) 185.

[177] U.K. Kolac, et al., The anti-inflammatory and antioxidant effects of Salvia officinalis on lipopolysaccharide-induced inflammation in rats, Journal of medicinal food. 20(12) (2017) 1193-1200.

[178] G. Gwari, et al., Volatile constituents of Saussurea costus roots cultivated in Uttarakhand Himalayas, India, Pharmacognosy research. 5(3) (2013) 179.

[179] T. Julianti, et al., Antitrypanosomal sesquiterpene lactones from Saussurea costus, Fitoterapia. 82(7) (2011) 955-959.

[180] M.M. Pandey, et al., Saussurea costus: botanical, chemical and pharmacological review of an ayurvedic medicinal plant, Journal of Ethnopharmacology. 110(3) (2007) 379-390.

[181] B.-K. Lee, et al., Anti-allergic effects of sesquiterpene lactones from Saussurea costus (Falc.) Lipsch. determined using in vivo and in vitro experiments, Journal of ethnopharmacology. 213 (2018) 256-261.

[182] R.K. Saini, et al., Ripening improves the content of carotenoid, α-tocopherol, and polyunsaturated fatty acids in tomato (Solanum lycopersicum L.) fruits, 3 Biotech. 7(1) (2017) 43.

[183] H. Li, et al., Bioaccessibility, in vitro antioxidant activities and in vivo anti-inflammatory activities of a purple tomato (Solanum lycopersicum L.), Food chemistry. 159 (2014) 353-360.

[184] A. Riahi, C. Hdider, Bioactive compounds and antioxidant activity of organically grown tomato (Solanum lycopersicum L.) cultivars as affected by fertilization, Scientia Horticulturae. 151 (2013) 90-96.

[185] H. Barakat, Composition, antioxidant, antibacterial activities and mode of action of clove (Syzygium aromaticum L.) buds essential oil, British Journal of Applied Science & Technology. 4(13) (2014) 1934.

[186] G. Razafimamonjison, et al., Bud, leaf and stem essential oil composition of Syzygium aromaticum from Madagascar, Indonesia and Zanzibar, International Journal of Basic and Applied Sciences. 3(3) (2014) 224.

[187] M.F.R. Hassanien, Composition and Antiradical Power of Syzygium aromaticum Lipids, Chemistry of Natural Compounds. 50(4) (2014) 716-718.

[188] M. El Jemli, et al., Chemical composition, acute toxicity, antioxidant and anti-inflammatory activities of Moroccan Tetraclinis articulata L, Journal of traditional and complementary medicine. 7(3) (2017) 281-287.

[189] A. Djouahri, et al., Essential Oil Variability and Biological Activities of Tetraclinis articulata (Vahl) Mast. Wood According to the Extraction Time, Chemistry & biodiversity. 13(12) (2016) 1691-1706.

[190] M. Riasat, et al., The constituents of essential oil in leaves of Karaj accession of Trigonella foenum graecum, Natural product research. 31(14) (2017) 1709-1712.

[191] L.-B. Gu, et al., Extraction of fenugreek (Trigonella foenum-graceum L.) seed oil using subcritical butane: Characterization and process optimization, Molecules. 22(2) (2017) 228.

[192] B. Al-Dabbagh, et al., Antioxidant and anticancer activities of Trigonella foenum-graecum, Cassia acutifolia and Rhazya stricta, BMC complementary and alternative medicine. 18(1) (2018) 240.

[193] G. Sindhu, et al., Evaluation of anti-arthritic potential of Trigonella foenum graecum L.(Fenugreek) mucilage against rheumatoid arthritis, Prostaglandins & other lipid mediators. 138 (2018) 48-53.

[194] S.R. Pradeep, K. Srinivasan, Haemato-protective influence of dietary fenugreek (Trigonella foenum-graecum L.) seeds is potentiated by onion (Allium cepa L.) in streptozotocin-induced diabetic rats, Biomedicine & Pharmacotherapy. 98 (2018) 372-381.

[195] M. Franciškoviće, et al., Chemical Composition and Immuno-Modulatory Effects of Urtica dioica L.(Stinging Nettle) Extracts, Phytotherapy research. 31(8) (2017) 1183-1191.

[196] S. Gül, et al., Chemical composition and in vitro cytotoxic, genotoxic effects of essential oil from Urtica dioica L, Bulletin of environmental contamination and toxicology. 88(5) (2012) 666-671.

[197] M. El Haouari, J.A. Rosado, Phytochemical, Anti-Diabetic And Cardiovascular Properties Of Urtica dioica L.(Urticaceae): A Review, Mini reviews in medicinal chemistry. 19(1) (2019) 63-71.

[198] M.H. Abu Zarga, et al., Chemical composition, antimicrobial and antitumor activities of essential oil of Ammodaucus leucotrichus growing in Algeria, Journal of Biologically Active Products from Nature. 3(3) (2013) 224-231.

[199] Y.-J. Jung, et al., Lignan and flavonoids from the stems of Zea mays and their anti-inflammatory and neuroprotective activities, Archives of pharmacal research. 38(2) (2015) 178-185.

[200] R. Suzuki, et al., Two Flavone C-Glycosides from the Style of Zea m ays with Glycation Inhibitory Activity, Journal of natural products. 66(4) (2003) 564-565.

[201] M. Carro-Juárez, et al., Aphrodisiac Activity of the Aqueous Crude Extract of Purple Corn (Zea mays) in Male Rats, Journal of Evidence-Based Complementary & Alternative Medicine. 22(4) (2017) 637-645.

[202] J.E. Okokon, et al., Antimalarial and antiplasmodial activity of husk extract and fractions of Zea mays, Pharmaceutical biology. 55(1) (2017) 1394-1400.

[203] H. Ghazghazi, et al., Fatty acids composition of Tunisian Ziziphus lotus L.(Desf.) fruits and variation in biological activities between leaf and fruit extracts, Natural product research. 28(14) (2014) 1106-1110.

[204] M. Chouaibi, et al., Nutritional composition of Zizyphus lotus L. seeds, Journal of the Science of Food and Agriculture. 92(6) (2012) 1171-1177.

[205] C. Benammar, et al., Zizyphus lotus L.(Desf.) modulates antioxidant activity and human T-cell proliferation, BMC complementary and alternative medicine. 10(1) (2010) 54.

[206] M. Adnan, et al., Ethnomedicine use in the war affected region of northwest Pakistan, Journal of Ethnobiology and Ethnomedicine. 10(1) (2014) 16.

[207] M. Barkaoui, et al., Ethnobotanical survey of medicinal plants used in the traditional treatment of diabetes in Chtouka Ait Baha and Tiznit (Western Anti-Atlas), Morocco, Journal of ethnopharmacology. 198 (2017) 338-350.

[208] I. Teixidor-Toneu, et al., An ethnomedicinal survey of a Tashelhit-speaking community in the High Atlas, Morocco, Journal of ethnopharmacology. 188 (2016) 96-110.

[209] S. Akerreta, et al., First comprehensive contribution to medical ethnobotany of Western Pyrenees, Journal of ethnobiology and ethnomedicine. 3(1) (2007) 26.

[210] R. Raterta, et al., Assessment, inventory and ethnobotanical survey of medicinal plants in Batan and Sabtang Island (Batanes Group of Islands, Philippines), International Journal of Pure Applied Bioscience. 2 (2014) 147-154.

[211] T.F. Xavier, et al., Observation on the traditional phytotherapy among the Malayali tribes in Eastern Ghats of Tamil Nadu, South India, Journal of ethnopharmacology. 165 (2015) 198-214.

[212] A. Bouyahya, et al., Indigenous knowledge of the use of medicinal plants in the North-West of Morocco and their biological activities, European Journal of Integrative Medicine. 13 (2017) 9-25.

[213] H. Ouhaddou, et al., An ethnobotanical study of medicinal plants of the Agadir Ida Ou Tanane province (southwest Morocco), Journal of Applied Biosciences. 84(1) (2014) 7707-7722.

[214] N. Benlamdini, et al., Étude floristique et ethnobotanique de la flore médicinale du Haut Atlas oriental (Haute Moulouya), Journal of applied biosciences. 78(1) (2014) 6771-6787.

[215] M. RHATTAS, et al., Étude ethnobotanique des plantes médicinales dans le Parc National de Talassemtane (Rif occidental du Maroc), Journal of Applied Biosciences. 97 (2016) 9187-9211.