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Ethnobotanical study of medicinal and aromatic plants used by the population National Park of El Kala (north-eastern Algeria)

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Abstract

An ethnobotanical study of medicinal plants was conducted in the National Park of El Kala (north-eastern Algeria) in the object to inventory of medicinal plants and gather all information on the therapeutic uses practised by local population in the studied region. Using 1 176 questionnaires form, ethnobotanical field surveys were conducted in nine towns of National Park of El Kala (N.P.E.K) and brought a sample of 60.03% women and 39.97% men, aged 18 to over 60 years with very high rate of illiteracy of 25.85%. Among this population, 69.62% prefer traditional medicine and 30.38% prefer modern medicine. The results of this study have enumerated 111 medicinal plants belonging to 56 families. The most dominate family is Lamiaceae. The foliage constituted the most used part (32.39%) and the majority of remedies are prepared as an infusion (38.96%). The mastic tree (*Pistacia lentiscus* L.) is the most medicinal plant used by local people whose interest therapeutic is to relieve burns, intestinal inflammation, stomach aches and pains, cough and bronchitis, eyes diseases and hemorrhoid. The most treated diseases are gastrointestinal disease (20%), followed by circulatory and respiratory disease (10.64% for each one) and dermatological disorder (10.21). These results are a very important source of information for the studied area and for the national medicinal flora, which could be a source and database for the phytochemical and pharmacological research.

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Introduction

Algeria with its 237 639 100 ha, its different bioclimatic, ecological regions and its remarkable species diversity, it is moderately classed with countries known for their taxonomic diversity, ecosystem, landscape and cultural diversity. Its privileged biogeographic position between the Mediterranean and sub-Saharan Africa enriched a floristic potential composed of Mediterranean elements, Palearctic, Ethiopian and endemic species. This mixing of species constitutes for our country a truly rich flora which is estimated at around 3 139 species of wild plants, including more than 600 species that have medicinal properties (Mokkadem, 1999; Benkiki, 2006). Generally, Algeria floristic richness is concentrated in the mountains and protected areas such as national parks. Now our country has ten national parks. Eight parks located in the northern part of the country (El Kala, Chera, Djurdjura Theniet El Had, Belezma, Gouraya, Taza and Tlemcen), the other two, located in the deep south (Tassili and Ahaggar), with a surface area rate 0.07% and 23.73% respectively of the national territory (Chalabi, 2002).

The National Park of El Kala (N.P.E.K) is the most populated Park in the North of Algeria with a population estimated at 140 000 inhabitants. This is a protected area composed of a multitude of ecosystems (marine, dune, lake and forest), which was originally classified as a Biosphere Reserve by UNESCO on 17 December 1990. It contains a complex considered unique in the Mediterranean, with six wetlands (lakes Tonga, Lake Oubeira, Bog Black Lake, Alder forest of Ain Khiar, blue lakes and El Mellah, and the marsh of Bouredim) of world renamed as RAMSAR on areas wetlands of international importance. It has an exceptional natural wealth represented by a multitude of remarkable species with 1 403 species of vascular plants, 840 species of animals, 175 species of mushrooms, 114 species of lichens, 66 species of algae, 93 species of phytoplankton and 08 marine species. In general, it represents one third of the Algerian flora (Chalabi, 2002; De Belaire, 2005;GDNPEK, 2015). This area is also rich in diverse flora, it represents one third of the Algerian flora, which might have considered an important source of ethno botanical practice. The population of the National Park of El Kala uses a large range of medicinal plants for treatment of various diseases as a natural remedy. But, this practice with time is under threat of extinction, by the intervention of several causes, migration of rural inhabitants to cities, and migration of traditional medicinal healers to other jobs. However, until now only one study has been made to inventory, identify and preserve the traditional knowledge of herbal practice of this studied area. But this study was insufficient and in- depth in relation to the number and the medicinal use of the discovered species (only 73 species). Algeria like all countries of the Maghreb, and several herbal remedies used individually or in combination is recommended to treat various diseases (Quezel and Santa, 1962). While, the only way to collect information on ethnobotanical practice is direct contact by conversation. But this method becomes difficult with time and wrong because there is no collection in writing documents that are available with this valuable knowledge. Except that their information is transmitted verbally from a generation to another by the older people (Sofowora, 1993 ; Asase *et al.*, 2010 ; Nadembega. *et al.*, 2011).

In this study we tried to inventory the medicinal plants and identifying ways of use and exploitation of the latter in traditional medicine. It is in this context that the present work is part and has the following objectives: to collect as much information about the therapeutic uses practised in this region, to analyze the results concerning the relationships between medicinal species and types of diseases treated, to identify all the diseases treated, to preserve and create a national catalog of medicinal plants used in this region and to know the value of the most used medicinal plants by the local population and to highlight its importance and therapeutic interest by ethnopharmacology based on drug discovery and biological studies.

Materials and methods

Presentation of the study environment "Area of the

National Park of El Kala (N.P.E.K)"

The National Park of EL KALA (N.P.E.K) is located in the extreme north-eastern Algeria; it is fully included in the Wilaya of El Taref. Corresponding almost to one third (78 438 ha) of the total area of its territory. It is limited: in the North by the Mediterranean Sea, in the South, by the foothills of the mountains Medjerda, in the East, by the Algerian-Tunisian border and in the West, by the end of the alluvial plain of Annaba. Its geographical coordinates are 36 ° 52 North and longitudes 8 ° 27 at the city of El Kala. There are nine (09) towns namely: El Kala, Oum Teboul, El Aioun, Ramel Souk, Ain El Assel, Bougous (totally enclosed), El Tarf, Bouteldja and Brrihane (partially included) (Fig. 1.).

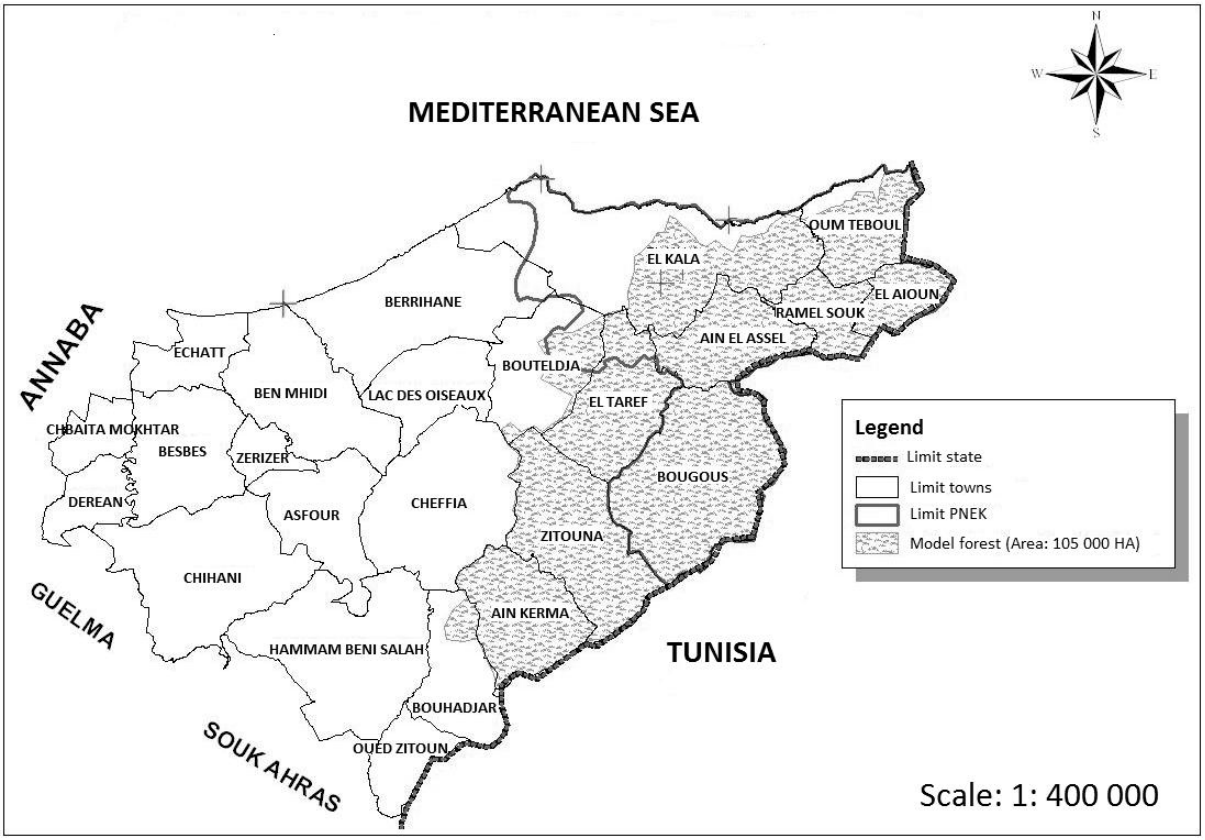

Fig. 1. Borders of the studied area of the National Park of El Kala (N.P.E.K) (Abbaci, 2009).

The climate of the area is Mediterranean, is characterized by a hot, dry summer and a cold and wet winter, with an annual rainfall of 1 200 mm, and average temperatures of 33 ° C in summer and 13 ° C in winter (Bouazouni, 2004 ; Akroum, 2014). The total population of the province in 2013 is estimated at 430 000 inhabitants, with a density of 129 inhabitants per km². Forestry in N.P.E.K occupied an important place with 54000 ha represented essentially of Cork oak (*Quercussuber* L.) with 34 000 ha, Alder (*Alnus glutinosa* Mill.) with 3 000 ha, Zeen oak (*Quercus canariensis* Willd.) with 2 715 ha, Aleppo pine (*Pinus halpensis* Mill.) with 20 ha and Mastic tree (*Pistacia lentiscus* L.).

Method of study

Ethnobotanical survey

Ethnobotanical surveys were conducted using 1 176 questionnaires record that were used to investigate with traditional practitioners, herbalists and users of medicinal plants in the nine towns of N.P.E.K (Table 01). Data collection is performed on the nine towns of N.P.E.K over two field seasons (September 2015 to August 2017) and 5 fieldworkers (1 botanist, 2 ecologists and 2 chemists. Among these workers, one who knows well the region and the dialect of the population) following the standard protocols for the collection of ethnobotanical data (Alexiades, 1996 ; Martin, 2004 ; Salhi *et al*., 2010), allowed us to have

information on the informant and the used medicinal: The informant: gender, age, educational level, occupation, income per month (Algerian Dinar) and preferred care (medical and therapeutic).

The medicinal plant: the common local name, the part used of plant, the diseases treated and the method of preparation.

Plant identification and herbaria

The plants' samples which were collected at full flowering, and / or at fructifying in the studied area for the preparation of voucher specimens were identified by Mr. Abdessalam GRIRA, Dr. Nabila SOUILAH and some reference books. And these voucher specimens were deposited in the herbarium of the Laboratory of the General Direction of National Park of El Kala (El Taref).

Data analysis

The use of medicinal plants by: sex, age, level of study, occupation and income per month (Dinar Algerian: DA).

The use of medicinal plants according: to the origin of the information in traditional medicine, to preferred care, to the organs of the plant used and to the method of preparation.

Fidelity Level (FL): is used to determine the most frequently used plant species for treating a particular ailment category by the informants of the study area. The FL is calculated using the following formula (Martin, 1995): FL= (Np/N) X 100.

Np:the number of use-reports cited for a given species for a particular ailment category

N: is the total number of use-reports cited for any given species

Species use Value (UV):The relative importance of each plant species known locally to be used as herbal remedy is termed as UV, and it was calculated using the following formula (Barnert& Messmann, 2008):

UV = ΣU/ N.

U:the number of use-reports cited by each informant for a given plant species.

N:the total number of informants interviewed for a given plant.

Informant consensus factor (ICF):is used to see whether there is an agreement in the use of plants in the ailment categories between the plant users in the study area. The ICF was calculated using the following formula (Bağci, 2000): ICF= (Nur- Nt) / (Nur -1).

Nur: refers to the number of use-reports for a particular ailment category.

Nt: refers to the number of taxa used for a particular ailment category by allinformants.

Floristic Analysis of medicinal plants used in the region of N.P.E.K: Ranking species belonging to the Super Class of Spermaphyta and Pteridophyta and to the aromatic plants.

Monograph aromatic medicinal plants used in the region of N.P.E.K

Results and discussion

Analysis of data informants

The use of medicinal plants varies by gender. Women use more herbs than men. Indeed, 60.03% of women use traditional medicine against 39.97% of the male population (Table 02).

This can be explained by the use of medicinal plants by the female population in other areas than therapy and by their responsibility as mothers, it is they who give first aid especially for their children.

These results confirm other realised ethnobotanical fieldwork, case of work Adzodie & Belhamiche (2014) which showed that women are more expert and practitioner for using traditional herbal because of their responsibility as mothers, who give first aid for their children.

Table 1. Distributions of investigations in relation to towns of N.P.E.K.

Towns	Number of investigation
Ain khiar (town of El Taref)	61
Ain El Assel	86
Al Aioun	132
Berrihane	129
Bougous	33
Bouteldja	107
Brabtia (town of El Kala)	61
El Frine (town of Ain El Assel)	26
El Kala	92
El Taref	123
Oued Djenane (town of Al Aioun)	112
Oum Teboul	149
Ramel Souk	65
Total	1 176

The use of medicinal plants is common among all age groups, predominantly among people aged of 50 to 60 years (26.02%). However, for the age group 30 to 40, 40 to 50 and over 60 years there has been an almost balanced average rate of 19.81%, 20.49% and 21.18% respectively. And for younger people, the use of medicinal plants (0.85%) does not represent a great therapeutic value (Table 02).

Table 2. Classification of informants according to various factors.

Factor	Categories	% of informants
Gender	Male	39.97
	Female	60.03
Age	Less than 20 year	0.85
	[20- 30] year	11.65
	[30- 40] year	19.81
	[40- 50] year	20.49
	[50- 60] year	26.02
	More than 60 year	21.18
Level of study	Illiterate	25.85
	Primary level	11.73
	Middle level	18.88
	Secondary level	24.32
	University level	19.22
Occupation	Herbalist	23.38
	Healer	01.36
	Others	75.26
Income per month (DA)	Unemployed	30.44
	Less than 15 000	09.60
	[15 000- 25 000]	12.33
	[25 000- 35 000]	21.43
	[35 000- 50 000]	20.24
	More than 50 000	05.96
Origin of the information	By a family number	63.82
	Other people	19.52
	Books	10.11
	Occasionally	13.58
	Other	11.69
Preferred care	Phytotherapy	62.92
	Medical	30.38

These results confirm the work done by Benalia & Miloudi (2016) in the same studied region, who show that the age group 40 to 50 years dominates over others with a rate of 27.06%, and the age group less than 20 years show the lowest rate with 0.85%. Knowledge of the properties and uses of medicinal plants are generally acquired with age and with long experience passed from one generation to another. The transmission of this knowledge is in danger now because it is not always ensured (Anyinam, 1995). The results do show that people who belong to the class of age 50 to 60 have more knowledge in medicinal plants compared to other age groups. The experience with age is the main source of information about the use of plants in traditional medicine. There is a loss of information on medicinal plants, which reflects the

mistrust of some people, especially young people, who don't believe at all in this traditional medicine.

In the study area, the vast majority of users of medicinal plants are illiterate and the others have a secondary level, with a percentage of 25.85% and 24.32% respectively. While people, with middle and university level have a slightly higher percentage of use of medicinal plants than the previous ones (18.88% and 19.22% respectively). While those with a primary level of study, use very little medicinal plants (11.73%) (Table 02). These results do not show a significant difference between all levels of study, they are reflected in the richness of the area in medicinal plants and the preservation of the culture of the local population in the use of traditional medicine, which became one of the local customs of the studied area.

Table 3. List of medicinal plants of NPEK used as traditional healthcare medicine by local population.

Medicinal plant	Family	Common name	Vernacular name	N of ailment categories	N	UV
Adiantum capillus-veneris L.	Pteridaceae**	Maidenhair	/ziətə/	1	2	1
Ajuga iva (L.) schreb	Lamiaceae	Ivette Musky*	/ʃəndgʊrə/	2	3	1
Allium cepa L.	Amaryllidaceae	Onion*	/lebsæcl/	5	13	1.62
Allium sativum L.	Amaryllidaceae	Garlic*	/tʊm/	2	14	2.8
Alnus glutinosa (L.) Gaertn.	Betulaceae	Glutinous Alder*	/lekfʃ/	3	3	3
Aloysia citriodora Palau	Verbenaceae	Lemon Verbena*	/lʊizə/	2	2	2
Angelica officinalis L.	Apiaceae	Angelic*	/ʊdn el helʊf/	2	2	2
Apium graveolens L.	Apiaceae	Celery*	/kræfes/	1	1	1
Arbutus unedo L.	Ericaceae	Strawberry Tree	/len3/	3	3	1.5
Artemisia absinthium L.	Asteraceae	Wormwood*	/hʃiʃət meriəm/ or /ʃiba/	5	21	1.17
Artemisia herba-alba Asso.	Asteraceae	Wormwood*	/ʃih/	2	11	1
Asphodelus microcarpus L.	Xanthorrhoeaceae	Asphodel	/berweg/	4	4	1
Borago officinalis L.	Boraginaceae	Borage*	/lhærʃa/	2	3	3
Brassica oleracea L.	Brassicaceae	Wild Cabbage	/lekremb/	2	9	1.5
Capsella bursa-pastoris (L.) Medik.	Brassicaceae	Shepherd's Purse	/kis eræi/	1	1	1
Centaurium erythraea Rafn.	Gentianaceae	European Centaury*	/mæræret læhneʃ/	2	2	2
Ceratonia siliqua L.	Fabaceae	Carob tree*	/el kærʊb/	2	3	1
Chamaerops humilis L.	Arecaceae	European Fan Palm	/edʊm/	1	1	1
Chamaemelum nobile (L.) All.	Asteraceae	Roman Chamomile*	/bebʊn3/	5	14	1.27
Charybdis maritima (L.) Septa.	Asparagaceae	Sea Squill	/bæslet elfær/	1	2	1
Chichorium intybus L.	Asteraceae	Common Chicory*	/ lhendbə/	3	4	1
Cinnamomum verum J. Presl	Lauraceae	Cinnamon*	/kærfə/	2	2	2
Cistus ladanifer L.	Cistaceae	Gum Cistus*	/el ml'iə/	1	8	1
Citrullus colocynthis (L.) Schard.	Cucurbitaceae	Bitter Cucumber	/el hæntæl/	3	4	4
Citrus limon (L .) Osbeck	Rutaceae	Lemon*	/leimʊn/	3	15	1.87
Citrus sinensis (L.) Osbeck	Rutaceae	Orange Tree*	/tʃina/	1	3	1
Convolvulus sepium L.	Convolvulaceae	Hedge Bindweed	/ləbləb/	1	1	1
Coriandrum sativum L.	Apiaceae	Coriander	/el kʊsbʊr/	2	2	2
Cuminum cyminum L.	Apiaceae	Cumin*	/kəmʊn/	1	3	1
Cucurbita pepo L.	Cucurbitaceae	Pumpkin	/eslwit/	1	2	1
Cynara scolymus L.	Asteraceae	Artichoke	/el kʊrʃəf/	4	14	1
Daphne gnidium L.	Thymelaeaceae	Daphne Were*	/ʃarʊak/ or /lezæz/	3	31	1
Dittrichia viscosa (L.) Greuter.	Asteraceae	Viscous Inule*	/megremen/	3	3	1.5

Dryopteris filix-mas (L.) Schott	Dryopteridaceae**	Male Fern	/ɒrk el fersig/	1	2	1
Ecalyptus globulus Labill.	Myrtaceae	Australian Fever Tree*	/kəlitʊs/	4	60	1
Ecballium elaterium (L.) A. Rich.	Cucurbitaceae	Squirting Cucumber	/fəgʊs ləhmir/	4	5	5
Echium vulgare L.	Boraginaceae	Common Viperine*	/hʃiʃat elhæia/	1	1	1
Ficus carica L.	Moraceae	Fig Tree	/el kærmʊz/	2	6	1.2
Foeniculum vulgare Mill.	Apiaceae	Sweet Fennel*	/besbes/	1	11	1
Fraxinus excelsior L.	Oleaceae	Ash*	/fernən/	5	4	2
Fraxinus ornus L.	Oleaceae	Manna Ash*	/dærdær/	2	3	3
Genista tricuspidata Desf.	Fabaceae	Broom*	/el gendʊl/	3	3	3
Geranium cicutarium L.	Geraniaceae	Common Stork's-bill*	/lɔ:trʃə/	2	2	2
Globularia alypum L.	Plantaginaceae	Globe Daisy	/ezrægæ/	1	1	1
Glycyrrhiza glabra L.	Fabaceae	Licorice*	/ɒrk esʊs/	2	2	2
Hedera helix L.	Araliaceae	Ivy	/el ʊwei/	2	2	2
Heliotropium bacciferum Forssk	Boraginaceae	Turn-sole*	/ræmræm/	2	16	1
Hypericum perforatum L.	Hypericaceae	Common Saint-John's-wort*	/mesmʊn/	2	2	2
Jasminum officinale L.	Oleaceae	Common White Jasmine*	/liəsmin/	1	1	1
Juglans regia L.	Juglandaceae	Walnut*	/swək el ha:r/	1	1	1
Juniperus oxycedrus L.	Cupressaceae	Oxycedre Juniper*	/el a:ra:r/	4	11	1.57
Laurus camphora L.	Lauraceae	Camphor-Tree*	/kæfʊr/	1	99	1
Laurus nobilis L.	Lauraceae	Bay Laurel*	/rænd/	4	2	1.27
Lavandula stoechas L.	Lamiaceae	Lavender*	/el hælhælə/ or /ɒm lemhegen/ or /lekzəmə/ or /ɒrk esfirə/	3	19	1.57
Lens culinaris Medik.	Fabaceae	Lentil	/lædes/	2	2	2
Linum usitatissimum L.	Linaceae	Flax*	/zeriət elketən/	2	5	1
Malva sylvestris L.	Malvaceae	Common Mallow*	/kɒbeizə/	2	11	1
Marrubium vulgare L.	Lamiaceae	White Horehound*	/me'riʊə/	1	1	1
Menthaverdis L.	Lamiaceae	Green Mint*	/na:na:/	3	63	1.14
Mentha pulegium L.	Lamiaceae	Mint*	/fleijʊ/	2	31	2.06
Mespilus germanica L.	Rosaceae	Medlar*	/za:rʊr/ or /lmʊz/	1	31	1
Myrtus communis L.	Myrtaceae	Myrtle*	/rihen/	3	102	1.29
Nasturtium officinale R. Br.	Brassicaceae	Watercress*	/heb erʃəd/	2	2	2
Nerium oleander L.	Apocynaceae	Oleander	/deflə/	1	4	1
Nigella sativa L.	Ranunculaceae	Small Garden Fennel*	/hæbət el bærækə/	2	2	2
Nuphar luteum (L.) Sm.	Nymphaeaceae	White Water-lily	/ninfir/	1	1	1
Ocimum basilicum L.	Lamiaceae	Basil*	/læhbæk/	2	33	1.5
Olea europaea L.	Oleaceae	Olive Tree*	/zitʊn/	6	92	1.59
Opuntia ficus-indica (L.) Mill.	Cactaceae	Prickly Pear	/el hendi/	2	11	1
Papaver rhoeas L.	Papaveraceae	Corn Poppy	/ʊm lemhegen/	2	3	1.5
Petroselinum crispum (Mill.) Fuss	Apiaceae	Parsley*	/ma:dnʊs/	2	15	1
Phillyrea media L.	Oleaceae	/	/el fileər/	1	1	1
Phoenix dactylifera L.	Arecaceae	Dates	/etmær/	1	3	1
Pimpinella anisum L.	Apiaceae	Anise*	/hebet hlaʊə/	1	2	1
Pinus halepensis Mill.	Pinaceae	Aleppo Pine*	/snaʊbər/	2	23	1.15

Pinus pinea L.	Pinaceae	Parasol Pine*	/snaʊbər/	3	3	3
Piper nigrum L.	Piperaceae	Black Pepper*	/felfel lekhæl/	5	5	5
Pistacia lentiscus L.	Anacardiaceae	Mastic tree*	/dærw/ or /el gedʊm/	5	165	1.46
Plantago major L.	Plantaginaceae	Ratstail Lantain	/ləsən el həml/	2	2	2
Populus nigra L.	Salicaceae	Black Poplar	/esæfsæf/	1	1	1
Punica granatum L.	Lythraceae	Pomegranate Tree*	/rɒmen/	1	35	1
Quercus coccifera L.	Fagaceae	Cork Oak	/el kærmiz/ or /kemʃrid/	1	3	1
Quercus suber L.	Fagaceae	Kermes Oak	/el kærmiz/ or /kemʃrid/	1	14	1
Rhamnus alaternus L.	Rhamnaceae	Mediterranean Buckthorn	/ʊd el kir/	2	16	1
Ricinus communis L.	Euphorbiaceae	Castor Bean*	/karʊa/	2	4	1
Rosa canina L.	Rosaceae	Dog-Rose*	/neb el kelb/	1	1	1
Rosmarinus officinalis L.	Lamiaceae	Rosemary*	/leklil/	4	46	1
Rubus ulmifolius J. Presl & C. Presl	Rosaceae	Bramble*	/el ælig/	2	30	1
Rumex acetosa L.	Polygonaceae	Common Sorrel	/el hʊmæidæ/	1	1	1
Ruta chalepensis L.	Rutaceae	Commun Rue*	/fiʒəl/	4	27	1
Salvia officinalis L.	Lamiaceae	Sage*	/swək enbi/	2	3	1.5
Senna alexandrina Mill.	Fabaceae	Senna*	/sene el meki/	1	1	1
Smilax aspera L.	Smilacaceae	Mediterranean Smilax	/el feʃeər/	1	1	1
Solanum lycopersicum L.	Solanaceae	Tomato	/etmætæm/	2	6	1
Spergularia rubra (L.) J. Presl. & C. Presl.	Caryophyllaceae	Red Sandspurry	/kesæræt læhʒær/	1	7	1
Spinacia oleracea L.	Amaranthaceae	Spinach	/eselk/	1	4	1
Syzygium aromaticum (L.) Merr. & L. M. Perry	Myrtaceae	Cloves*	/taib/	2	9	1
Taraxacum officinale F. H. Wigg.	Asteraceae	Dandelion*	/te'fef/	2	2	2
Teucrium chamaedrys L.	Lamiaceae	Commun Germander*	/bæ'lʊt elærd/	2	2	2
Teucrium fruticans L.	Lamiaceae	Cat tyme Hulwort*	/hʃiʃat lærʊəh/	4	4	1
Thapsia garganica L.	Apiaceae	Smooth Thapsia*	/bʊne'fa:/	1	1	1
Thymus algeriensis Boiss. et Reut.	Lamiaceae	Wild Thyme*	/ezitræ/	3	73	1.24
Thymus vulgaris L.	Lamiaceae	Garden Thyme*	/za:tər/	4	11	1
Tirmania nivea L.	Pezizaceae***	Desert Truffle	/el kemə/ or /eterfæs/	1	1	1
Traganum nudatum Delile.	Amaranthaceae	/	/dɒmræn/	1	16	1
Trigonelle foenum-graecum L.	Fabaceae	Fenugreek*	/el hælbə/	2	12	1.09
Urtica dioica L.	Urticaceae	Stinging Nettle	/el hʊ'rækɒ/	3	16	1
Verbena officinalis L.	Verbenaceae	Vervain*	/lʊizə/	3	15	1
Vinca major L.	Apocynaceae	Greater Periwinkle	/el ke'deb/	1	2	2
Vitis vinifera L.	Vitaceae	Grape- Vine	/leneb/	2	14	1
Zingiber officinale Roscoe.	Zingiberaceae	Ginger*	/ezn3ebil/	2	9	1.5

* Aromatic plant, ** Pteridophyta, *** Fungi.

These results are contradicting with the results obtained by Amrouni (2009), in the region of Idough (North East of Algeria), which show that the level of education plays a role in the classification of user herbs. Medicinal plants are much more used by local people who practise other works (75.26%), as they allow them to avoid or minimize hardware costs required by the physician and pharmacist. While herbalists at the level of the towns represent a medicinal plant utilization rate of 23.38%, resulting

in the local availability of the majority of medicinal plants in the wild or cultivation in homes, which minimizes the local population fees and the purchase of local medicinal plants. But for the herbal healers, the rate of the use of medicinal plants is 1.36%, this result in the preservation of the natural remedies from medicinal plants for them only, and not reporting, not to get into competition with other healers (Table 02). These results are consistent with results of Maiza (2009).

Table 4. Fidelity level (FL) of medicinal plants cited for 20 or more times.

Medicinal plant	N	Np	FL (%)	Medicnal use
Daphne gnidium L.	31	25	80.64	Circulatory disease: against hypertension
Ecalyptus globulus Labill.	60	58	96.97	Respiratory disease: nasal instillation
Lavandula stoechas L.	63	22	34.92	Genital disease: against vaginal infection
Menthaverdis L.	55	34	61.82	Analgesic and sedative: calming and headache
Mespilus germanica L.	31	31	100	Gastrointestinal disease : diarrhea
Myrtus communis L.	79	58	96.67	Respiratory disease: inflammation of the throat
Ocimum basilicum L.	22	20	90.90	Circulatory disease: against hypertension
Olea europaea L.	58	44	75.86	Dermatological disorder: against eczema
Pinus halepensis Mill.	20	11	55	Rheumatic disease: against rheumatism
Pistacia lentiscus L.	114	99	86.84	Dermatological disorders: against burn
Punica granatum L.	35	35	100	Gastrointestinal disease: against stomach ulcer and diarrhea
Rosmarinus officinalis L.	46	22	47.78	Gastrointestinal disease: carminative
Rubus ulmifolius J. Presl & C. Presl	30	21	70	Dermatological disorders :against infection of skin
Ruta chalepensis L.	27	20	40.07	Dermatological disorder: measles
Thymus algeriensis Boiss. et Reut.	59	38	64.41	Gastrointestinal disease: stomachic et carminative

According to income, we note that the highest rate of use of medicinal plants is recorded among the unemployed (30.44%) and the lowest rate is recorded among the population group that has an income higher than 50 000 DA per month. This allows the unemployed to avoid or minimize the fees charged by the consultation among doctors and buying drugs from pharmacists. Then we notice that people who have incomes below 15 000 DA and between 15 000 to 25 000 DA per month, the percentage of use of medicinal plants vary between 12.33% and 9.60% respectively. These results expressed that these people work only a few hours a week in the state, which allow them to practice at the same time other undeclared parallel work, to ensure the self-sufficiency of their daily needs through the vocation to the agriculture and fisheries, and therefore their income become a little bit higher, that allow them to prefer medical care compared to herbal medicine. For people with incomes that vary between 25 000 to 35 000 DA per month, and between 35 000 to 50 000 DA per month, the use of medicinal plants percentages range between 21.43% and 20.24% respectively (Table 02). These results are interpreted that these people do not have time to do other work apart. Finally, these results are consistent with results obtained in the work of Kerdous (2002) in Annaba region, Amrouni (2009) in Idough region and Benalia & Miloudi (2016) in the same region. Based on the results obtained, 63.82% of the local population in general refers to the experiences of family members, to use medicinal plants as remedies against well-defined diseases. This reflects the image of relative transmission of traditional experiences and practices from one generation to another. It also notes that 19.52% of the local population refers to the experiences of others either herbalists or healers. While 10.11% of persons referring to themselves by consulting books of traditional medicine, and 13.58% occasionally following TV programs. And 11.69% refer to other sources of information based on their own experience with the existence of many medicinal

plants in their surroundings (Table 02). These results confirm those obtained in the same region by Benalia & Miloudi (2016). According to Pourchez (2011), women are carriers of valuable medicinal knowledge. These skills have been built from a common history inherited from colonies, poverty or engaged women from other regions.

69.62% of people in the region of N.P.E.K think that medicinal plants allow healing of the treated diseases. While 30.38% believe that medicinal plants only allow an improvement in the health status and may cause side effects, toxicity reports and even a worsening of the disease, which is why they are moving towards care medical (Table 02). From these results we concluded that traditional medicine is not an alternative to conventional medicine.

Table 5. Informant consensus factor (ICF) for categorized ailment.

Ailment categories	No. of use reports (Nur)	No. of species (Nt)	ICF	Most frequently used plants
Circulatory diseases	234	26	0.89	*Myrtus communis* L.
Digestive diseases	343	48	0.86	*Myrtus communis* L.
Skin diseases	206	27	0.87	*Pistacia lentiscus* L.
Respiratory diseases	180	30	0.84	*Ecalyptus globulus* Labill.
Analgesic and sedative	90	16	0.83	*Menthaverdis* L.
Genital diseases	71	9	0.88	*Lavandula stoechas* L.
Rheumatic diseases	40	15	0.64	*Ecalyptus globulus* Labill. and*Pinus halpensis* Mill.
Kidney diseases	68	16	0.78	*Rubus ulmifolius* Schott.
Antiseptic	6	5	0.2	*Ruta chalepensis* L.
Biliousness	9	5	0.5	*Daphne gnidium* L.
Eye diseases	24	3	0.91	*Pistacia lentiscus* L.
Mouth diseases	28	9	0.7	*Chamaemelum nobile* (L.) All.
Anemia and tired	9	5	0.5	*Urtica dioica* L.
Fever and headaches	41	12	0.72	*Vitis vinifera* L.
Auditory diseases	5	3	0.5	*Allium cepa* L.
Diabetes	77	6	0.93	*Olea europaea* L.
Others	27	8	0.73	*Pistacia lentiscus* L.

It is the primary source of medical care which meet the growing needs of the population and the many challenges that health systems are facing and are characterized by the poor performance of preventive and curative services, the high cost of services in hospitals and the high cost of medicines, insufficient staff, social and cultural constraints related to the collection, the treatment and prevention of diseases ... etc. (Houngnihin, 2009).

Analysis of data plants

The use of medicinal plants according to the organs of the plant used

The use of medicinal plants according to the organs of the plant used, are thirteen parts: the leaf, the stem, the flower, the fruit, the seed, the root, the bark, the bulb, the rhizome, the aerial part, the buds, the all part and the thallus. The percentage utilization of these portions (Fig. 2.) shows that the leaf is the most used (32.39%). While the aerial part is in second position with a percentage of 14.79%. The fruit occupies the third position with a rate of 11.97%. The seed and the flower occupy a middle position with a respective rate of 9.86% and 9.15%, followed by the root and the bark with a rate of 6.35% for each one. All the remaining parts used namely: all plant, stem represent a respective rate of 2.82%, 2.11%, rhizome and bulb represent a rate of 1.4% for each one, while

the buds and the thallus are represented a rate of 0.7% for each one. These results are consistent with a little work obtained by Benkhnigue *et al.* (2011), which show that the leaf and seed are the most used organs in traditional medicine, followed by fruit. While Benalia and Miloudi (2016), show that the leaf is the most used organ, followed by fruit and root. The frequency of high use of leaves can be explained by the ease and speed of harvest (Bitsindou, 1986), and also by the fact that they are the site of photosynthesis and sometimes storage of secondary metabolites responsible for biological properties of plants (Bigendako-Polygenis & Lejoly, 1990).

Table 6. Monograph of the 6 first families' aromatic and medicinal plants in the studied area.

Anacardiaceae	*Pistatcia lentiscus* L.
	-U.P: Leaves, fruits, roots and oils. -M.P: Infusion, ointment, syrup and steam. -D.T.R: Digestive diseases (intestinal inflammation), respiratory diseases, eye diseases, skin (burning) and other (hemorrhoid). -U.S.B: The leaves have emmenagogue, astringent, diuretic, analgesic and antipyretic (Bellakhdar, 1978 and 1997; El Ouafi 1997).
Apiaceae	*Angelica officinalis* L.
	-U.P: stems -M.P: Decoction -D.T.R: Digestive diseases (digestive disorders) and anemia and tired -U.S.B: The rhizome is used externally as an ointment, in soothing friction during rheumatism, arthritis and skin diseases. Internally, it is used in dyspepsia, stomach ulcers and as an expectorant (Kaddem, 1990; Schauenberg & Paris, 2005).
	Apium graveolens L.
	-U.P: Leaves and stems -M.P: Infusion -D.T.R: Kidney diseases. -U.S.B: The plant is diuretic and acts on the kidneys and bladder. It causes uterine contractions and abortion in animals (Schauenberg & Paris, 2005).
	Coriandrum sativum L.
	-U.P: Leaves and seeds. -M.P: Infusion and decoction. -D.T.R: Circulatory (hypertension) and kidney diseases. -U.S.B: Fruits contain an essential oil. Infusion fruits are stomachic, antispasmodic and carminative (Schauenberg & Paris, 2005).
	Cuminum cyminum L.
	-U.P: Seeds. -M.P: Decoction. -D.T.R: Digestive against abdominal pain bloating. -U.S.B: Stimulates digestion, antispasmodic, increases appetite, protects the cardiovascular system, balance the menstrual cycle and promotes lactation (Dahandapani *et al.*, 2002).
	Foeniculum vulgare Mill.
	-U.P: Aerial parts and seeds. -M.P: Infusion and decoction. -D.T.R: Digestive diseases (bloating and nausea). -U.S.B: The seeds are used in infusion and dyeing (Kaddem, 1990 ; Schauenberg & Paris, 2005).
	Petroselinum crispum (Mill.) Fuss.
	-U.P: Aerial parts. -M.P: Infusion. -D.T.R: Circulatory diseases (improves blood circulation), kidney diseases and biliousness. -U.S.B: Parsley is a condiment plant diuretic, stomachic, carminative, emmenagogue, expectorant and aphrodisiac. It can become abortive. The infusion of seeds and leaves is used, as well as fresh juices, in dropsy, jaundice, cough, asthma, amenorrhea and dysmenorrhea (Kaddem, 1990 ; Schauenberg & Paris, 2005).
	Pimpinella anisum L.
	-U.P: Seeds. -M.P: Decoction. -D.T.R: Digestive (bloating, colic and difficult digestion) and respiratory diseases. -U.S.B: The essence of the plant is a diuretic, stomachic, expectorant, antispasmodic, carminative, stimulant of all

	glands (Kaddem, 1990; Schauenberg & Paris, 2005).
	Thapsia garganica L.
	-U.P: Juice of the plant. -M.P: Pressing the leaves and stems. -D.T.R: Rheumatic diseases -U.S.B: Bark and roots are used as repellents (Rebbas & Bounar, 2014).
	Artemisia absinthium L.
	-U.P: Leaves -M.P: Infusion and steam in boiling water -D.T.R: Genital diseases, circulatory diseases (hypertension) , diabetes and fever and headache -U.S.B: The aerial parts, in infusion, are used roundworms, pinworms, anemia, gastritis and liver failure (Mimoudi, 1988). It's an excellent bitter tonic; it is slightly antipyretic, antiseptic, diuretic, emmenagogue and anthelmintic, and stomachic against dyspepsia, gastralgia and liver failure. The leaves are used in dyeing and extract (Kaddem, 1990; Schauenberg & Paris, 2005).
	Artemisia herba-alba Asso.
	-U.P: Aerial parts -M.P: Infusion -D.T.R: Digestive and circulatory system -U.S.B: The decoction of aerial parts used for bloating, bowel and heartburn. In high doses, wormwood is abortive, neurotoxic and hemorrhagic (El Haji, 1995).
	Chamaemelum nobile (L.) All.
	-U.P: Flowers -M.P: Infusion -D.T.R: Digestive diseases (bloating), oral and skin (dermatosis). -U.S.B: The flowering tops are used in infusion internally as stomachic, anti-inflammatory, antispasmodic, bactericidal, anthelmintic, analgesic; and externally as healing and bactericides (Kaddem, 1990).
	Chichorium intybus L.
	-U.P: Leaves and roots -M.P: Infusion, decoction, drying of roots and grinding powder and formation of an ointment with water. -D.T.R: Skin, biliousness (unclog the liver, jaundice) and circulatory diseases. -U.S.B: The chicory is a plant tonic, stomachic and diuretic. The infusion is prepared from the leaves or the dried root (Schauenberg & Paris, 2005).
	Dittrichia viscosa (L.) Greuter.
	-U.P: Aerial parts -M.P: Infusion -D.T.R: Rheumatic diseases, digestive diseases (abdominal pain) and hemorrhoid. -U.S.B: analgesic (against headaches and abdominal pain), anti-rheuamtic, diuretic, wormer, and diabete (Kaddem, 1990).
	Taraxacum officinale F.H.Wigg.
	-U.P: Leaves and roots -M.P: Infusion and decoction -D.T.R: Hemorrhoid. -U.S.B: The whole plant is officinale, we prepared extracts, dyeing and solutions. It is cholagogue, bitter tonic, diuretic and stomachic (Schauenberg & Paris, 2005).
	Ceratonia siliqua L.
	-U.P: Fruits -M.P: Soaking in water overnight -D.T.R: Digestive tract against diarrhea and diuretic effect. -U.S.B: The powdered fruit is eaten either raw or in aqueous decoction. It is anti-diarrheal, astringent, anti-catarrhal, diuretic and expectorant (Kaddem, 1990).
	Genista tricuspidata Desf.
	-U.P: Flowers and fruits -M.P: Infusion -D.T.R: Digestive diseases (bloating), kidney diseases (diuretic) and rheumatic diseases (swelling of the joints) -U.S.B: Diuretic and laxative (Schauenberg and Paris, 2005).
	Glycyrrhiza glabra L.
ASTERACEAE	-U.P: Root -M.P: Decoction -D.T.R: Digestive and respiratory system and cough. -U.S.B: A saponoside (glycyrrhizin), and flavonoids of steroid hormones (estrogen) that activate the work of the ovaries. It is an antispasmodic plant, gastric ulcers, antitussive, expectorant and diuretic (Schauenberg and Paris, 2005).

	Senna Alexandrina Mill.
	-U.P: Seed -M.P: Decoction -D.T.R: Digestive diseases. -U.S.B: Laxative, purgative, anti-bacterienne (Schmelzer and Gurib-Fakim, 2008).
	Trigonella foenum-graecum L.
	-U.P: Seed -M.P: Decoction and powder with honey -D.T.R: digestive, diabetes, analgesic. -U.S.B: The pulverized fenugreek seeds are used as a poultice against boils, cellulitis, some ganglion, aphrodisiac inflammation, tuberculosis and hypoglycemic (Kaddem, 1990 Schauenberg and Paris, 2005).
	Ajuga iva (L.) schreb
	-U.P: Aerial parts -M.P: Infusion -D.T.R: Digestive diseases (intestinal colic) and kidney diseases. -U.S.B: Astringent, appetizer and diuretic (Mouhib & El Omari, 1988). Is not toxic, but seems endowed with a sedative power (Bennaghmouch *et al.,* 2001).
	Lavandula angustifolia Mill.
	-U.P: Leaves and flowers -M.P: Infusion and steam in boiling water -D.T.R: Respiratory diseases (respiratory tract diseases) and skin (burn and healing), genital. -U.S.B: Flowers contain a colorless very fragrant essential oil. The main application is in cosmetics and perfumery (Schauenberg and Paris, 2005).
	Marrubium vulgare L.
	-U.P: Aerial parts -M.P: Ointment -D.T.R: Skin diseases. -U.S.B: It is used in infusion as stomachic, antitussive, respiratory disease and expectorant (Schauenberg and Paris, 2005).
	Mentha pulegium L.
	-U.P: Aerial parts -M.P: Infusion -D.T.R: Digestive diseases, respiratory diseases and analgesic. -U.S.B: The fresh leaves are applied as a poultice to stop milk secretion (Sijelmassi, 1993). In high doses, the essential oil is abortive (Hmamouchi, 2001).
	Mentha virdis L.
Lamiaceae	-U.P: Aerial parts -M.P: Infusion -D.T.R: Digestive diseases (facilitates digestion) and analgesic and skin (eczema). -U.S.B: The leaves are chewed against bad breath (Benchaâbane & Abbad, 1997).
	Ocimum basilicum L.
	-U.P: Aerial parts -M.P: Infusion -D.T.R: Skin and digestive (difficult digestion and pain of stomach) and circulatory diseases. -U.S.B: The plant infusion is an antispasmodic, tonic stomachic, carminative and galactogenic (Schauenberg & Paris, 2005).
	Rosmarinus officinalis L.
	-U.P: Leaves -M.P: Infusion -D.T.R: Circulatory diseases, digestive diseases (intestinal gas), respiratory diseases (asthma) and analgesic (sedative). -U.S.B: The plant is an excellent stimulant and antispasmodic, it acts on bile secretion. His absorption in moderation poisoning, sometimes fatal (Schauenberg & Paris, 2005).
	Salvia officinalis L.
	-U.P: Leaves, stems and bark -M.P: Infusion and decoction -D.T.R: Respiratory diseases and antiseptic (disinfectant on wounds) and analgesic. -U.S.B: The Sage stops lactation, it is carminative, antispasmodic, stimulating, anti-diarrhea and has an estrogen action. The infusion of the plant is indicated in the case of nervous diseases, tremors and depression. Is disinfectant in amenorrhea and dysmenorrhea (Kaddem, 1990; Schauenberg & Paris, 2005).
	Teucrium chamaedrys L.
	-U.P: Leaves

	-M.P: Infusion -D.T.R: Digestive (intestinal gas) and gnital diseases (menstruel cycle pain). -U.S.B: It is stimulating, diuretic and choleretic (Schauenberg & Paris, 2005).
	Teucrium fruticans L.
	-U.P: Root -M.P: Magic (necklace) -D.T.R: Genital diseases, anemia and tired and fever and headache. -U.S.B: The plant is used in gastrointestinal, inflammation, diabetes and rheumatism (Bellakhdar, 1997).
	Thymus algeriensis Boiss. And Reut.
	-U.P: Aerial part -M.P: Infusion -D.T.R: Digestive, circulatory and respiratory diseases. U.S.B: antiseptic, stomachic, anti-diarrheal and carminative (Kaddem, 1990; Schauenberg & Paris, 2005).
	Thymus vulgaris L.
	-U.P: Aerial part -M.P: Infusion -D.T.R: Digestive diseases, respiratory, circulatory disease and analgesic. -U.S.B: Thymol plant is a powerful antiseptic; it is an effective deodorant and deworming (roundworms and pinworms). The thyme oil is stomachic, anti-diarrheal, carminative, relieves the acute bronchitis, laryngitis and whooping cough. The plant is used in infusion, fluid extract and a liniment on ulcers and wounds (Kaddem, 1990; Schauenberg & Paris, 2005).
Oleaceae	*Fraxinus excelsior* L.
	-U.P: Bark and leaves -M.P: Infusion -D.T.R: Digestive (laxative and purgative), kidney (diuretic), rheumatic diseases and fever and headache. -U.S.B: Diuretic and purgative (Schauenberg & Paris, 2005).
	Fraxinus ornus L.
	-U.P: Bark and leaves -M.P: Infusion -D.T.R: Kidney diseases, digestive diseases (laxative) and analgesic. -U.S.B: Diuretic and purgative (Schauenberg & Paris, 2005).
	Jasminumofficinale L.
	-U.P: Flowers -M.P: Infusion -D.T.R: Analgesic (relaxing and sedative). -U.S.B: Circulatory diseases (hypertension), analgesic and headache (Minker, 2013).
	Olea europaea L.
	-U.P: leaves, fruits and oil -M.P: Infusion and syrup -D.T.R: Skin, fever and headache, diabetes, auditory, rheumatic and circulatory diseases (hypertension). -U.S.B: Used for fatigue, herpes and other viral infections, skin and arthritis (Winston & Kuhn's, 2012). Laxative, against colic, and constipation, promotes the expulsion of the kidney stones and calm the pain of the ears (Kaddem, 1990).

The use of medicinal plants according to the method of preparation

To facilitate the administration of the active proprieties, several preparations modes are employed: infusion, decoction, ointment, powder of the crushed and dried plant, maceration, inhalation, poultice, juice, oil, evaporation and necklace. The infusion is the method of preparation most used with a rate of 38.96%. The second method is the decoction with a rate of 26.62%. Followed by a rate of 9.74% and 7.14% for the preparation of ointment form and maceration respectively. While the remainder represents a cumulative rate of 17.54% (Fig. 3.). These results are consistent with work obtained by Amrouni (2009) and Benalia & Miloudi (2016), which show that the infusion is the most frequently method of preparation because the local population believe in the infusion mode and find it adequate to warm the body and disinfect the plant (Lahsissène *et al.,* 2010). On the other hand, the infusion permits to collect the most active substances and to attenuate or eliminate the toxic effect of certain recipes (Salhi *et al.,* 2010).

The use of medicinal plants according to diseased treated

The results obtained, show that the most disease

treated is the gastrointestinal disease with a rate of 20%, followed by circulatory disease and respiratory disease with a rate of 10.64 % for each one. While dermatological disorders represent a rate of 10.21 %. The sets of the remained treated diseases namely, rheumatic disease, fever and headache, kidney diseases, analgesic and sedative, biliousness, genital disease, other diseases, mouth diseases, antiseptic, diabetes, anemia and tiredness, eye disease, auditory diseases and nose diseases, is representing a cumulative rate of 48.51% (Fig. 4.). After obtaining these results, we decided to go at the General Direction of Public Health of the Wilaya of El Tarf (Town El Kala), to explain to us the main causes of the most common diseases treated by traditional medicine.

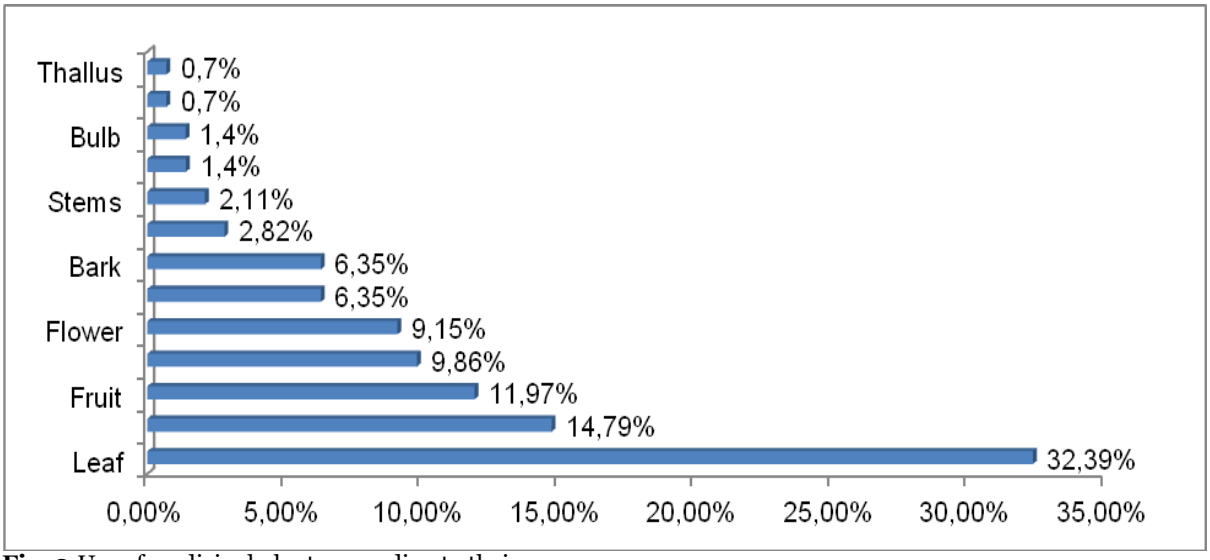

Fig. 2. Use of medicinal plants according to their organs.

The explanation of the doctor responsible Mr. Ismail MENSAR, shows that the diseases treated by traditional medicine are the same in modern medicine (digestive disease, respiratory, circulatory and skin), but with a very high rate in modern medicine for hereditary anemia caused by the marriage between families (consanguinity). These results are explained by the nature of the diet of the studied area, as excessive consumption of pasta, grilled fish and meat, tobacco and alcohol (that cause digestive and circulatory diseases), the environmental friendly factor like: the wettest climate in the region (causes respiratory diseases), and rich flora and fauna of the region that cause skin diseases and other diseases by the pollen grains, the contact of plants, the insect bites that cause suffering from allergies, the asthma, the eczema ... etc. andhereditary and genetic factors.

Species use value (UV)

The high UV observed for *Ecballium elaterium* (5), *Piper nigrum* (5), *Citrullus colocynthis* (4), *Alnus glutinosa* (3), *Borago officinalis* (3), *Fraxinus ornus* (3), *Genista tricuspidata* (3), *Pinus pinea* (3), *Allium sativum* (2.8) and *Mentha pulegium* (2.07) indicated their extensive usage in the traditional medicine in the studied region. The lowest UV was observed for 63 species with a rate of 1 (Table 03). Local population frequently uses these plants for many ailment categories. For example, *Ecballium elaterium* is indicated forrheumatic diseases, jaundice, nasal instillation and hemorrhoid. *Piper nigrum* seeds are used for ulcer of mouth, anemia and tired, circulatory, digestive and respiratory diseases while *Citrullus colocynthis* is used for rheumatic diseases, intestinal inflammation, jaundice and skin infection. High UV indicated that there are many uses for plant by the local population to treat various ailment categories (Barnert & Messmann, 2008). Based on 1 176 questionnaires carried out in the studied area, the most used plant in is the mastic tree (14.03 %), followed by myrtle (8.67 %), lavender (8.42 %), olive

(7.82 %), thyme (6.21 %), green mint (5.36 %) and eucalyptus (5.10 %). From these results, we found that the highest values of medicinal plants used are plants that represent a very wide range in the studied area, which remains for local population the first choice to treat several diseases. The mastic tree alone represents a very important forest heritage spread over an area of 20 hectares of the NPEK (Adzodie & Belhamiche, 2014). These results confirmed the results obtained by Benalia & Miloudi (2016) in the same region, that show that the mastic tree represents the most used plant by the local population.

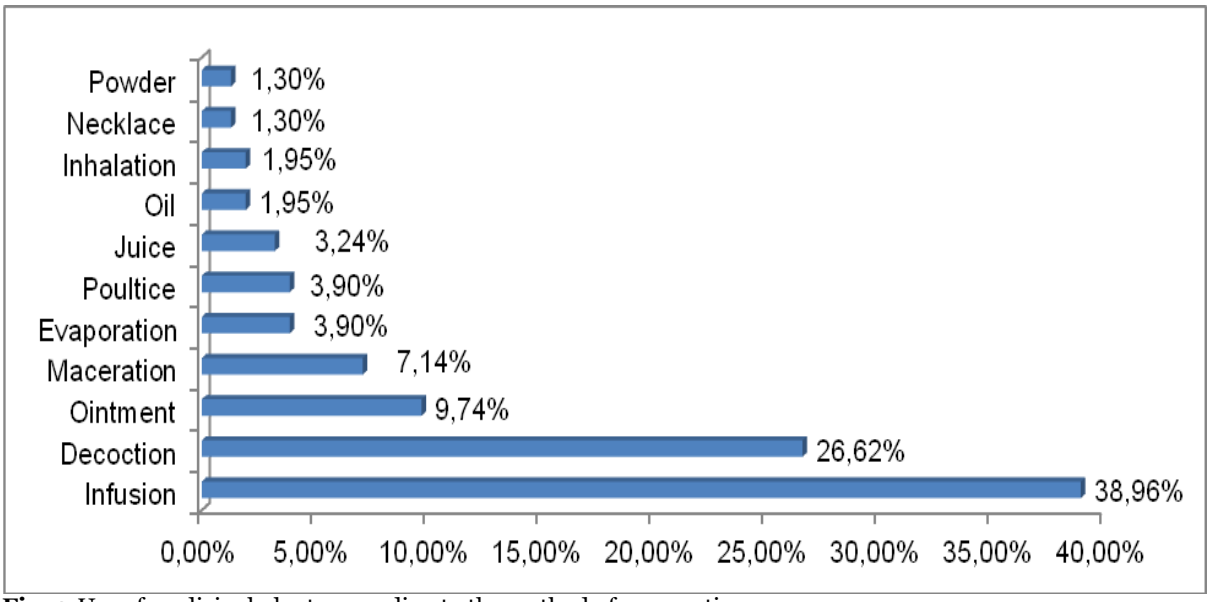

Fig. 3. Use of medicinal plants according to the method of preparation.

Fidelity level (FL)

Fidelity level (FL) is ranged from 1.09 % to 100 % for species in the studied area. The highest value of FL of 100% was reported for 38 species of which 8 species, namely *Convolvulus sepium, Cuminum cyminum, Foeniculum vulgare, Mespilus germanica, Punica granatum, Quercus coccifera, Quercus suber* and *Senna alexandrina* are used for gastrointestinal disease (Table 04).

Among 26 species used for respiratory diseases, only 5 species scored 100 % FL (*Adiantum capillus-veneris, Cistus ladaniferus, Citrus sinensis, Laurus nobilis* and *Syzygium aromaticum*). This may be due to the fact that this species is specifically used for these diseases. Generally, high fidelity level is obtained from species for which almost all use it for the same therapeutic diseases. While the lowest value of FL (1.09%) is obtained from the species of *Olea europaea* and this low value shows that these species are used for treating many different diseases (Heinrich *et al.*, 1998).

Informant consensus factor (ICF)

To calculate the informant consensus factor (ICF), all registered diseases are divided into 17 major disease categories and each species is divided according to these major categories. The ICF calculated is ranged between 0.99 and 0.2 (Table 05). The ailment category of diabetes diseases shows the highest value (0.93) with six species and the most species frequently used is *Olea europaea*, followed by eye diseases (0.91) with 3 species, circulatory diseases (0.89) with 26 species, genital diseases (0.88) with 9 species, skin diseases (0.87) with 27 species and digestive diseases (0.86) with 48 species. While the ICF for antiseptic plants used (0.2) was the less compared with other disease categories. The highest value of ICF indicates that the local population disagrees on the species to be used in the treatment of category ailment. This high value traducing by a well-defined selection criterion in studied area or by the information, is transmitted between the local populations.

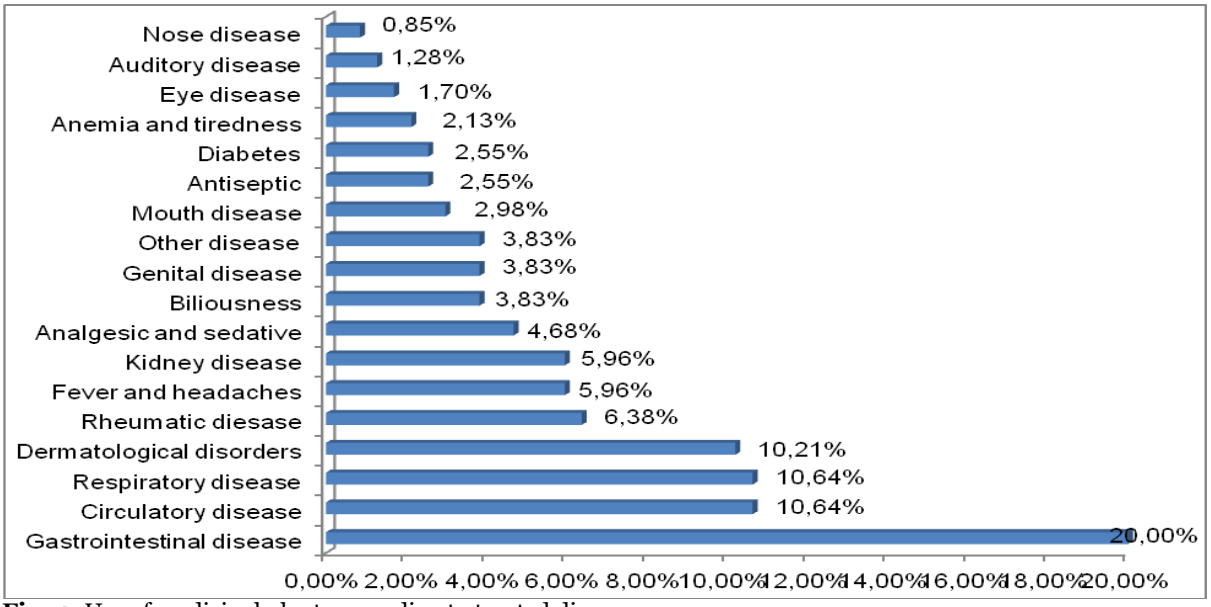

Fig. 4. Use of medicinal plants according to treated diseases.

The lowest value of ICF indicates that the plants are chosen randomly or the local population does not exchange information about their use (Kaya, 2006).

Floristic Analysis of medicinal plants used in the region of N.P.E.K

The floristic analysis of listed species shows that 110 species belong to the Sub Phylum Tracheophyta. They are distributed in 108 species belonging to Super Class of Spermaphyta and two species that belong to the Super Class of Pteridophyta. With the presence of one species of Fungi (Table 03).

The Super Class of Spermaphyta is divided into 89 genus and 53 botanical families, only two of which belong to the Class of Gymnosperms, the Cupressaceae (01 species) and Pinaceae (02 species).

The Class of the Angiosperms is represented by 105 species, which are divided between 13 species in the Clade of Monopore and 92 species in the clade of Three-pored. Of the 53 families interviewed, five families dominate sharply this flora, they total alone 38 species, are: Lamiaceae (12 species), Apiaceae (08 species), Asteraceae (07 species), Fabaceae (06 species) and Oleaceae (05 species) (Fig. 5.). The floristic analysis of the Super Class Pteridophyta shows the presence of two families divided into two (Figure 05).

The total number of aromatic species is 73 species (with a rate of 65.76% of the total number of medicinal plants in the region), distributed in 23 orders, 64 genus and 30 families. Three species belong to the clade of Monopore (Cupressaceae and Pinaceae) and 70 species belong to the clade of Three-pored. Among 30 families, only four families clearly dominate the aromatic flora with 35 species representing a rate of 47.94 % of total aromatic plants. These families are: Lamiaceae (12 species), Apiaceae (08 species), Asteraceae (06 species), Fabaceae (05 species) and Oleaceae (04 species). According to De Belair (1990) there are 850 species in PNEK; the El K

ala region is home to nearly a third of Algeria's flora. It is formed by 550 species, classified in the Super Class of Spermaphyta and 300 species classified in the Super Class of Petridophyta. Botanically, the Class of Angiospermes dominate, while the Class of Gymnospermes are represented only by two families Cupressaceae and Pinaceae. Botanical families including Lamiaceae, Apiaceae, Asteraceae, Fabaceae, Myrtaceae and Rutaceae are known to have the highest number of species and medicinal plant species in the NPEK (Ouelmouhoub, 2005 ; Benalia & Miloudi, 2016). The Lamiaceae is also known to have the highest number of medicinal and aromatic

species, more than the other botanical family in the region of NPEK (Benalia & Miloudi, 2016). But the same study show that there are only 73 medicinal species while our research shows a very high diversity with 111 medicinal plants, which confirms that this zone is very rich by the flora.

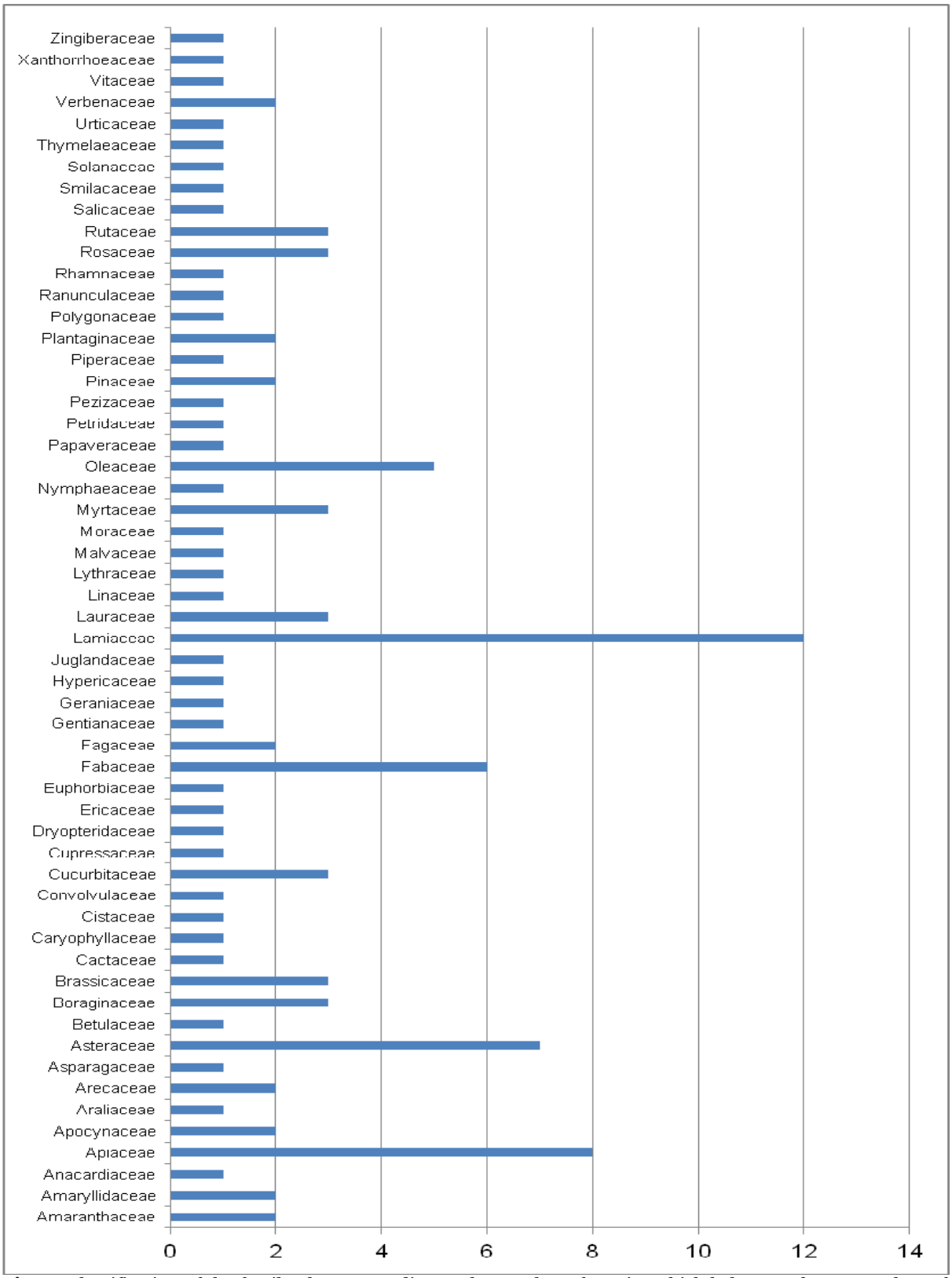

Fig. 5. Classification of the family plants according to the number of species which belong to the Super Class of Spermaphyta and to the Super Class of Pteridophyta.

Monograph aromatic medicinal plants used in the region of N.P.E.K

The monographs of 35 aromatic species of dominant families and the one species dominant by the used (*Pistacia lentiscus*), are presented in alphabetical order beginning with: families, genus and species. Indeed for each species we have specified the following: U.P = Used Part, M.P = Method of Preparation, D.T.R = Diseases Treated in the Region and U.S.B = Use Supplemented with Bibliography (Table 06).

Conclusion

The ethnobotanical study conducted at the National Park of El Kala region (N.P.E.K), allowed us to highlight the importance of natural remedies by traditional herbal medicine.

The results of ethnobotanical surveys regarding the information of the informants tell us that women use traditional medicine much more compared to men with a rate of 60.03% and 39.97% respectively. Regarding age, it was noted that the 50 to 60 age group is the highest rate of use of medicinal plants with 26.02%, while the age group below 20 years represents the lowest rate with 0.85%. For the level of the education, illiterate use much more herbal medicine with a high rate of 25.85% and for the primary level people represent the lowest rate with 11.73%. Depending on the occupation, it was noted that informants who practise other professions use moreherbs with a rate of 75.26% compared to herbalists and healers representing a rate of 23.38% and 1.36% respectively. Regarding income per month, it was noticed that the unemployed represent the highest rate with 30.44% and those who have more than 50 000 DA income represents the lowest rate with 5.96%. Depending on the origin of traditional medicine information, the highest level is represented by knowledge acquired by family members with a percentage of 63.82%, and the lowest percentage was noticed by knowledge acquired from books with 10.11%. So for the preferences of care of the local population we noticed that the phyto-therapeutic treatments are the most preferred over medical care with a rate of 69.62 and 30.38% respectively.

The results obtained concerning the information provided by informants regarding medicinal plants, show that the foliage is the most used part with a rate of 38.86%, the method of preparing an infusion is the most practiced with a rate of 42.25% followed by decoction with a rate of 23.24%. Regarding the most treated diseases are those of the digestive disorders (19.15%), respiratory system (12.34%), skin and circulatory system (10.64% for each one).

The high use value (UV) observed for 10 species with a rate between 05 to 2.067 (*Ecballium elaterium* and *Piper nigrum* with a rate of 05 UV) indicated that there are many uses for plant by the local population to treat various ailment categories. The lowest UV was observed for 63 species with a rate of 1.

The highest value of fidelity level (FL) of 100% was reported for 38 species. Generally, high fidelity level is obtained from species for which almost all use it for the same therapeutic diseases. While the lowest value of FL (1.09%) is obtained from the species of *Olea europaea*. And this low value shows that these species are used for treating many different diseases.

The informant consensus factor (ICF) is ranged between 0.99 and 0.2. The ailment category of diabetes diseases shows the highest value (0.93) with six species and the most species frequently used is *Olea europaea*. The highest value of ICF indicates that the local population disagrees on the species to be used in the treatment of category ailment. The lowest value of ICF indicates that the plants are chosen randomly or the local population does not exchange information about their use.

In addition, these results were acquired from the 1 176 surveys conducted on the area, helped us, to draw up an ethno-floristic catalog of 111 species, including 108 species that belong to the Super Class of Spermaphyta, and 2 species belong to the Super Class

of Pteridophyta. With the presence of one species of Fungi.

The floristic analysis of the Super Class of Spermaphytha shows that plants are divided into 89 genus and 53 botanical families; of which only 2 families belonging to the Class of Gymnosperms with the presence of 3 species (one species of the Cupressaceae and two species of Pinaceae), and 51 families belong to the Class of Angiosperms, with the presence of 105 species (13 species in clade of the Monopored and 92 species in clade of the Three-pored). Of the 53 families interviewed, 06 families dominate sharply this flora: they total alone 46 species of the effective (13 species of Lamiaceae, 09 species for Apiaceae, 07 species of Asteraceae, 06 species of Fabaceae and 05 species of Oleaceae).

The flora analysis of Super Class of Pteridophyta shows the presence 02 families (Dryopteridaceae and Pteridaceae) divided into 02 species.

Depending on the number of repetition of medicinal plants used by the local population, it was found that the medicinal herbs are the most used by the local population. To know that the most used plant is the mastic tree, followed by myrtle, lavender, eucalyptus and thyme (with a number of repetition 114, 79, 63, 60 and 59 respectively).

On the basis of questionnaires carried out, medicinal aromatic herbs represent a rate of 65.76% of all plants. With a total number of aromatic species of 73, divided into 64 genus and 30 families. Among these species, 03 belong to the clade Monopored (Cupressaceae and Pinaceae) and 61 belong to the clade of Three-pored. Of the 30 families interviewed, only five families clearly dominate the aromatic flora with 35 species representing a rate of47.94% of total aromatic plants. Families are: Lamiaceae with 12 species, Apiaceae with 08 species, Asteraceae with 06 species, Fabaceae with 05 species and Oleaceae with 04 species.

Finally, it appears from these ethnobotanical research conducted in the area of the National Park of El Kala that the traditional use of medicinal plants still persists in that region and this despite the revolution in medical technology. While this inventory is a source of information that contributes to a knowledge of medicinal plants and to a backup of the local People knowledge. It can also be a database for recovery of medicinal plants to discover new active ingredients used in pharmacology.

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