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Ethnobotany and Relative Importance of Some Endemic Plant Species at El-Jabal El-Akhdar Region (Libya)

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Abstract: The aim of the present study was to identify endemic plant species among the diverse flora of El-Jabal El-Akhdar ecosystem that are used economically and therapeutically. Current data revealed that the total number of endemic species surveyed in the region was 44 species, belonging to 28 families and 41 genera. The species were traditionally used for medicinal and non-medicinal purposes. Twenty one medicinal uses were recorded for 12 species mentioned in the present study and 7 non-medicinal uses were also mentioned. The therapeutic indications attributed to the species were classified under 8 body systems. The main indications for medicinal plant use were against common colds, asthma, kidney problems, skin inflammations, liver diseases and hypertension. Seven plant species were versatile in relation to their medicinal use, with a Relative Importance value over 1, having been indicated for up to seven body systems. The body systems that stood out the most were: the cardiovascular system, the immunity systems and infectious diseases. Most cited plant parts used for medicinal purposes were flowers, leaves and tubers.

Key words: Libya · El-Jabal El-Akhdar · Ethnobotany · Endemic species · Biological spectrum · Economic importance · Therapeutic uses · Relative Importance (RI) · Conservation

INTRODUCTION

Medicinal plants constitute the base of health care systems in many societies. The recovery of the knowledge and practices associated with these plant resources are part of an important strategy linked to the conservation of biodiversity, the discovery of new medicines and increasing of the quality of life of poor rural communities [1]. Ethnobotanical studies of medicinal plants have taken many paths, sometimes testing hypotheses of use and knowledge [2, 3] or sometimes describing the use of plants in given cultural contexts [4].

Libya occupies an area of about 1,759,540 km^2, of which more than 90% is desert, except the coastal strip and El-Jabal El-Akhdar region [5]. The total number of vascular plant species varied between 1900 and 2059 as indicated by World Conservation Monitoring Centre [6] and Sherif and Ben-othman [7], respectively. This can not be considered a very rich flora as compared to the large area of the country.

Studies available regarding the economic and medicinal importance of endemic species in El-Jabal El-Akhdar region are very rare. Medicinal plants are distributed all over the country. More than 100 species are extensively used by Bedouins in folk medicine as hot or cold drinks, or chewed raw, fresh or dry. Also these are used externally to cure dermal diseases, viral and bacterial infections, insect and animal bites, burns and sometimes for the treatment of hair problems. The flora of these medicinal plants is very well documented [8,9]. Moreover, many local plants in the region are used as ornaments. The most important ones are *Cistus parviflorus, Colchicum ritchii, Iris germanica* and *Ocimum basilicum* [10].

Endemism is fairly low in Libya, since only about 4% of the taxa are endemic (75 taxa). Endemism occurs in 4 main centers: (i) the El-Jabal El- Akhdar which has about 50% of the total endemic species, (ii) the coastal belt, (iii) the central part of Sahara and (iv) the southern part of Libya including Jabal Al Awaynat, Tibesti and Plateau of Ghat [11]. On the other hand, World Conservation Monitoring Centre [6] confirmed that 134 species of the total are endemic and 58 are threatened.

Nowadays, there is an imminent danger of genetic erosion of the endemic species because of heavy grazing, collection of medicinal and woody plants for local use and

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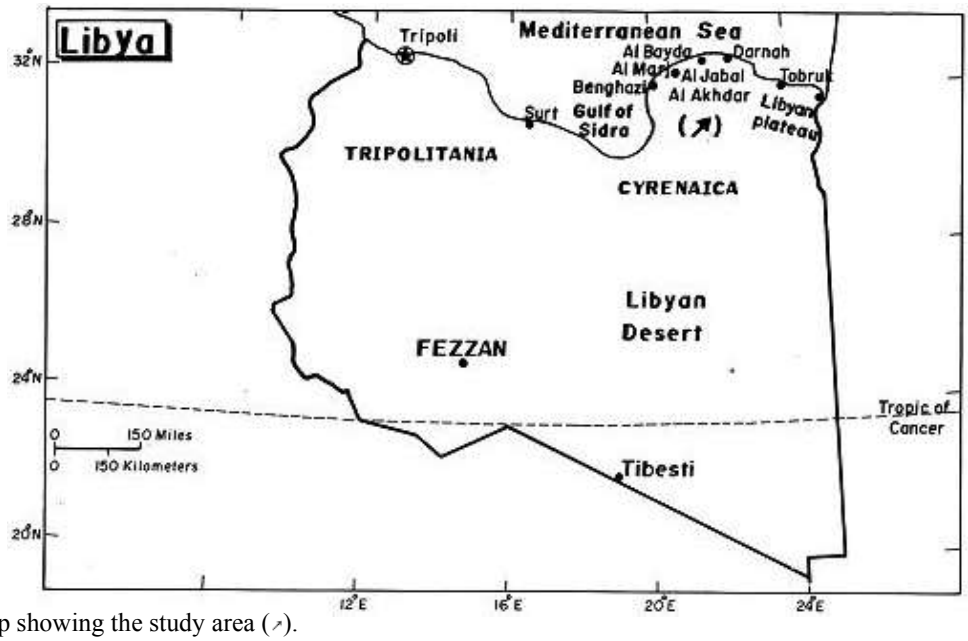

Fig. 1: A map showing the study area (↗).

trading, over cultivation, recurrent drought conditions and hazards which occur more frequently in El-Jabal El-Akhdar region.

The aim of the present study was to estimate the abundance and Relative Importance (RI) of endemic plant species that are used economically and therapeutically among the diverse flora of El-Jabal El-Akhdar ecosystem.

Study Area: Libya lies along the southern longitude coast of the Mediterranean, approximately between latitudes 18° and 33° North and 9° and 25° East. Most of the agricultural activities are limited to a long narrow strip along the Mediterranean coast, low mountains and scattered oases in the desert. The prevailing climatic conditions are typical of the Mediterranean region, characterized by variability and unpredictability. The rainfall is erratic in quantity, frequency and distribution [12].

El-Jabal El-Akhdar (Green Mountain) represents the study area of the present work (Figure 1). It is located immediately south of the coastal belt in the northeastern region of Libya. It extends on the coast belt to about 300 km and rises to about 881 m above sea level. The mountain is generally rocky and stony and intersected frequently by many wadis (rivers). The average rainfall ranges between 250-600 mm, the soils are terra-rossa or heavy clay [13, 14].

Agriculture production is depending mainly on the private sector. The private farms owned by individuals are producing the biggest part of the agriculture products. Some government production projects were established under irrigation in the desert, mainly for cereal and forage production like wheat, barley and oats [15].

The main forest type in Libya is the natural forest occurring in El- Jabal El- Akhdar. The total area of the forest in El-Jabal El-Akhdar was about 500,000 hectare of which 35% was converted to crop areas. Thus the actual area of these natural forests is about 320,000 ha [12].

Two major types of vegetation; maquis and steppe can be recognized in the study area. The maquis vegetation begins at the coast and extends across the upper terrace. A large number of the maquis species are found at all elevations, but in certain areas, in response to particular edaphic factors, certain elements of the flora achieve a local dominance. Examples for a number of substantial maquis species are: *Juniperus phoenicea, Pistacia lentiscus, Quercus coccifera* and *Ceratonia siliqua*. As rainfall totals diminish, a transition to a less aboreous, more open, steepe environment is made. *Asphodelus microcarpus, Sacropotirum spinosum* and *Artemisia herba-alba* are the most dominant species [16].

METHODS

Data and specimens of the endemic species in El-Jabal El-Akhdar region were collected during field trips in April-May 2006 and 2007. Field work consisted of two phases: 1) collecting and studying the floristic composition of the endemic species in the region and 2) interviews with local inhabitants, herbalists and

practitioners. Open-ended questionnaires [17] were applied separately for each informant to achieve the second point. The total numbers of interviewed informants were 66 men (more than 55 years old), 16 of them acquired only the bases of reading and writing (50 did not receive any education). Specific questions focused on the different ethnobotanical uses traditionally practiced in the area (e.g. food, medicine, construction, fixation of sand dunes, fuel wood, tanning, dying, handicrafts, fodder…etc.) were asked for the interviewees. Nevertheless, details for the different medicinal uses were also considered. Plants were collected when available and identified according to Ali and Jafri [18], Jafri and El-Gadi [19] and El-Gadi [20].

Data Analysis: The relative importance (RI) of the endemic species cited was calculated according to Bennett and Prance [21]. Relative importance was calculated according to the following formula, with "2", being the highest possible value, indicating the most versatile species. The most versatile species are those that have the greatest number of medicinal properties:

$$RI = NCS + NP$$

Where,

NCS (Number of Body Systems) = the number of body systems treated by a given species (NCSS) divided by the total number of body systems treated by the most versatile species (NSCSV). Then NCS = NCSS / NSCSV.

NP (The number of properties) is obtained by the relationship between the number of properties attributed to a species (NPS) divided by the total number of properties attributed to the most versatile species (NPSV). Then NP = NPS / NPSV.

RESULTS

A complete list of the surveyed endemic species with their relating taxonomic families, local names and life forms is given in Table 1. The arrangement of families is according to Engler's system. The data shows that 44 endemic species belonging to 28 families and 41 genera are recorded in the study area. Gymnosperms are represented by two species each related to one genus

Table 1: A complete list of the endemic species, their relating families, local names and life forms at El-Jabal El-Akhdar region (Libya, 2006-2007)

Family	Species	Local Name	Life Form
Ephederaceae	*Ephedera altissima* Desf.	Alandi	PHA
	var. *altissima* Pamp.		
Cupressaceae	*Cupressus sempervirens* L.	Sarow	PHA
	var. *horizontalis* (Mill.) Gord.		
Caryophyllaceae	*Silene cyrenaica* Maire&Weill.	Ommagrain	THE
Ranunculaceae	*Ranunculus cyclocarpus* Pamp.	Zeglil	THE
Capparaceae	*Capparis spinosa* L.	Cabbar	CHA
	var. *krugeriana* (Pamp.) Jafri		
Fabaceae	*Medicago cyrenaica* Maire&Weill.	Nafal	THE
Geraniaceae	*Erodium keithii* Guitt.&Le.	Regma	THE
Zygophyllaceae	*Fagonia arabica* L.	Tlaha	THE
	var. *membranacea* Ghafoor		
Polygalaceae	*Polygala ashersoniana* Chodat	-	CHA
Apiaceae	*Ferula marmarica* Aschers.	-	THE
Ericaceae	*Arbutus pavarii* Pamp.	Shmeri	PHA
Primulacea	*Cyclamen rohlfsianum* Aschers.	Rukkof	CRY
Plumbaginaceae	*Limonium cyrenaicum* (Rouy) Brullo	Zayta	THE
Convolvulaceae	*Convolvulus maireanus* Pamp.	Uilak	THE
Boraginaceae	*Cynoglossum clandestianum* Desf.	-	THE
	Onosma cyrenaicum Durand&Barratte	-	THE
Lamiaceae	*Ballota andreuzziana* Pamp.	Maila	CHA
	Micromeria guichardii (Quez.&Zaff.) Bru.&Fun.	-	THE
	Nepeta cyrenaica Quez.&Zaff.		
	Origanum cyrenaicum Beg.&Vacc.	-	CHA
	Teucrium barbeyanum Aschers.	-	CHA
	Teucrium zononii Pamp.	Jaada	THA
	Linaria laxiflora Desf.	Jaada	CHA

Table 1: Continued

Scrophulariacea	Subsp. *Calcarlongum* Qaiser	Ommolad	THE
	Linaria tarhunensis Pamp.		
	Orobanche cyrenaica Beck	-	THE
Orobanchaceae	*Plantago ceranaica* Durand&Barratte	Halook	THE
Plantaginaceae	*Valerianella petrovichii* Aschers.	Widna	THE
Valerianaceae	*Scabiosa libyca* Alavi	Jamir	THE
Dibsacaceae	*Anthemis cyrenaica* Coss.	Ain Tishima	THE
Astraceae	var. *cyrenaica*	-	THE
	Anthemis taubertii Durand&Barratte		
	Bellis sylvestris Cyr.	-	THE
	var. *cyrenaica* Beg.	-	CHA
	Carthamus divaricatus Beg.&Vacc.		
	Centaurea cyrenaica Beg.&Vacc.	-	THE
	Cynara cyrenaica Maire&Weill.	-	CHA
	Echinops cyrenaicus Durand&Barratte	Kharshofe	CHA
	Onopordum cyrenaicum Maire&Weill.	-	CHA
	Allium longanum Pamp.	Kharshofe Gamal	THE
Alliaceae	*Allium ruhmerianum* Aschers.	-	CRY
	Bellevalia cyrenaica Maire&Weill.	-	CRY
Liliaceae	*Crocus boulosii* Greuter	Bossaila	CRY
Iridaceae	*Romulea cyrenaica* Beg.	Gamhet	CRY
	Libyella cyrenaica (Durand&Barratte) Pamp.	-	CRY
Poaceae	*Arum cyrenaicum* Hruby.	-	THE
	Orchis cyrenaica Durand&Barratte		
Araceae		Renish	CRY
Orchidaceae		Orchid	CRY

(Phanerophytes = PHA Chamaephytes = CHA Cryptophytes = CRY Therophytes = THE)

Table 2: Biological spectrum of El-Jabal El-Akhdar region (Libya, 2006-2007)

Life Form	Number of Species	Percentage (%)
Phanerophytes	3	6.82
Chamaephytes	10	22.73
Hemicryptophytes	0	0.0
Cryptophytes	8	18.18
Therophytes	23	52.27
Total	44	100

in two separate families. On the other hand, Angiosperms harbor the remaining families (26) where dicotyledons are represented by 20 families, 32 genera and 34 species and monocotyledons by 6 families, 7 genera and 8 species. It is worth mentioning that, family Asteraceae attained the highest number of genera (7) and species (8), followed by family Lamiaceae (5 and 6 respectively). The remaining 26 families are represented by only 1 or 2 species.

With regard to the biological spectrum for the study area (Table 2), data showed that therophytes are represented by 23 species (52.27%), followed by chamaephytes (N=10, 22.73%) cryptophytes (N=8, 18.18%) and phanerophytes (N=3, 6.82%) while hemicryptophytes are not represented.

Data in Table 3 indicated that 3 endemic species were used for only medicinal purposes, 9 as fodder, 2 for honey production and 1 as ornament. On the other hand, one may notice that same species may have more than one purpose (e.g. *Arbutus pavarii* for medicine, honey production, food, industry and in construction; *Cynara cyrenaica* for medicinal, honey production and food; *Cupressus sempervirens* for medicine, industry and in construction; *Ephedera altissima* for medicine and in construction). It is interesting to note that 16 species out of 44 were not mentioned by the informants to have any economic value.

Specifically, the endemic species with the medicinal value are used to treat a considerable number of ailments

Table 3: The economic value of the endemic species at El-Jabal El-Akhdar region (Libya, 2006-2007)

Economic Parameter	Species
1- Medicinal uses	*Arbutus pavarii*, *Ephedera altissima, Cyclamen rohlfsianum*, *Teucrium zononii*, *Cynara cyrenaica*, *Plantago ceranaica*, *Allium longanum*, *Fagonia Arabica*, *Capparis spinosa*, *Cupressus sempervirens*, *Convolvulus maireanus*, *Orobanche cyrenaica*.
4- Fodder	*Medicago cyrenaica*, *Onopordum cyrenaicum*, *Plantago ceranaica*, *Erodium keithii*, *Convolvulus maireanus*,*Ranunculus cyclocarpus*, *Anthemis cyrenaica*, *Anthemis taubertii*, *Bellis sylvestris*, *Libyella cyrenaica*, *Linaria laxiflora, Linaria tarhunensis.*
2-Food	*Arbutus pavarii* (fruits), *Cynara cyrenaica* (heads), *Arum cyrenaicum* (corms).
3-Honey production	*Arbutus pavarii*, *Cynara cyrenaica*, *Medicago cyrenaica*, *Ballota andreuzziana, Nepeta cyrenaica.*
5-Ornaments	*Cyclamen rohlfsianum*, *Arum cyrenaicum*, *Orchis cyrenaica*, *Crocus boulosii*, *Romulea cyrenaica*, *Capparis spinosa*.
6-Construction	*Cupressus sempervirens*, *Arbutus pavarii*, *Ephedera altissima*.
7- Industry	*Arbutus pavarii* (tanning), *Crocus boulosii* (dyes), *Cupressus sempervirens* (oils).

Table 4: A list of the medicinal endemic plant species with its parts used, methods of administration and the treated diseases surveyed in El-Jabal El-Akhdar region (Libya, 2006-2007)

Species	Part (s) used	Administration	Treated Diseases
Allium longanum	BL-LV	Cold infusion, eaten fresh	Common cold, hypertension, fever
Arbutus pavarii	LV	Decoction	Gastritis, renal infections
Capparis spinosa	LV+FT+RT	Decoction with vinegar and honey	Spleenomegaly, vomiting, piles, stomach
Convolvulus maireanus	LV	Hot infusion, gargle	Stomach ulcers, gingivitis, toothache
Cupressus sempervirens	CN +LV	Decoction, smoking, inhaling	Asthma, piles, vaginal discharge,
Cyclamen rohlfsianum	TB	Decoction, fomentation	Diabetes, abscess
Cynara cyrenaica	RT+HD	Eaten fresh, decoction	Gallstone, anaemia, liver disorders, rheumatic pains
Ephedera altissima	SH	Smoking, inhaling	Asthma
Fagonia arabica	LV+FT	Decoction, powder	Jaundice
Orobanche cyrenaica	WH	Decoction, powder	Diuretic, wounds
Plantago ceranaica	LV	Hot infusion, fomentation	Abscess, wounds, colitis, varicose veins
Teucrium zononii	SH	Decoction	Diabetes, flatulence, hypertension

(WH= Whole plant, LV= Leaves, FR= Fruits, SH= Shoot, CN= Cones, HD= Head, BL= Bulb, TB= Tuber, RT= Root)

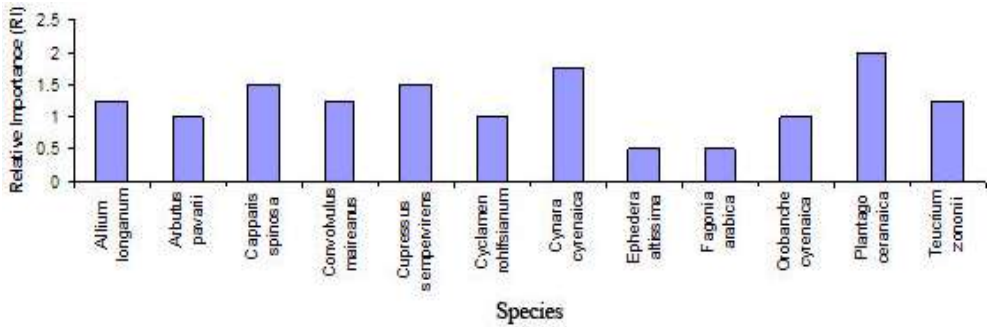

Fig. 2: Relative Importance (RI) of some medicinal endemic plant species in El-Jabal El-Akhdar region

(Table 4). Such ailments include those of the skin (e.g. *Cyclamen rohlfsianum, Plantago ceranaica* and *Orobanche cyrenaica*), toothache (e.g.*Convolvulus maireanus*) and to treat general and specific problems associated with the respiratory (e.g *Ephedera altissima* and *Cupressus sempervirens*), circulatory (e.g. *Teucrium zononii* and *Allium longanum*), digestive (e.g. *Arbutus pavarii*, *Capparis spinosa*, *Plantago ceranaica* and *Cynara cyrenaica*) and reproductive systems (e.g. *Cupressus sempervirens*). Some species are used to treat common ailments (e.g. cold, fever, flatulence, abscesses, anemia, vomiting) while others are only occasionally used to treat specific and unusual ailments such as those used for treating diabetes (e.g. *Cyclamen rohlfsianum* and *Teucrium zononii*), a large spleen (e.g. *Capparis spinosa*), gallstone and liver disorders (e.g. *Cynara cyrenaica* and *Fagonia arabica*) and kidney diseases (*Arbutus pavarii* and *Orobanche cyrenaica*). Generally, the method of administration and parts used differed with the species and disease.

The relative importance (RI) of the recorded endemic medicinal species in El-Jabal El-Akhdar region was presented in Figure 2. Among the species demonstrating the highest relative importance values (the most versatile species) in this study, are *Plantago ceranaica* and *Cynara cyrenaica* (2 and 1.75 respectively). On the other hand, *Ephedera altissima* and *Fagonia Arabica* attained the similar lowest values of relative importance (0.5).

DISCUSSION

About 50% of the total endemic plants (59 species) of Libyan flora are confined to El-Jabal El-Akhdar area which may be due to its unique physiographic and climatic conditions that isolate the region from the rest of the country. These conditions have provided an excellent ecological niche and contributed to the restriction of many endemic species [11]. Contrarily, the present survey showed that the region only harbors 44 endemic plant species. The difference between the two records (15 species) throws light on the possibilities of some ecological problems related to different land uses and human activities in the region. The uprooting of vegetation, fire, overgrazing, environmental pollution, collecting of plants for medicinal and non-medicinal purposes and agricultural expansion that are commonly prevailing in the region has resulted in the disappearance or rarity of some important species such as the fodder plant *Stipagrostis sp*., potentially medicinal species such as *Hypericum decaisneanum* and some *Teucrium sp*. The plant communities in the study area are threatened by over utilization and the depletion rate of the forest resources, which include the medicinal plants are very high [22].

All species recorded in the present study were ranked according to their life forms. The long dry period and cold winter in the region may explain why therophytes were dominant followed by Chamaephytes [23]. Similar results were obtained by El-Darier *et al*. [24] on diuretic plant species in Egypt.

In this study it is difficult to state which plants are most economically important to the inhabitants of the region. As Grenand [25] has noted, the term "useful species" does not have the same meaning for all cultures and probably not for all individuals within a society. In fact, the inhabitants of El-Jabal El-Akhdar region stated that not all the plants (endemic species) in the area are useful. In consistence with this, about one third (16 species) of the recorded species in the area were not mentioned by them to have any economic value. We are precisely unable to explain this point, but one may suggest that this may be ascribed to the lack of awareness of the inhabitants for the economic value of these species, or it may be due to inexperienced trials in ailment treatments [26] and the scarcity of the ethnobotanical studies in the region. More attention must be given to these species and therefore we strongly recommend that ecological, ethnobotanical, phytochemical and pharmacological studies be initiated in order to explore the validity and potentialities of this natural resource.

The number of times a plant was mentioned by informants may be considered as a guide to the extent of its use. Precisely, the need to calculate the relative importance (RI) of the different endemic species that having therapeutic values was essential. *Plantago ceranaica* and *Cynara cyrenaica* attained values of about 2 and 1.75, respectively where *Ephedera altissima* and *Fagonia arabica* attained values of about 0.5 for both. Probably, there is not any scientific information available concerning the two mentioned species with high RI values and most publications concern the genus of the two species that are widely used in other countries rather than Libya. The most widely used plants as reported by informants would seem to be *Arbutus pavarii* followed in decreasing order by *Cynara cyrenaica, Cupressus sempervirens* and *Ephedera altissima*. There are apparently no published studies focusing on the activities commonly attributed to the species cited in our survey. Curiously, these plants were not important in other ethnobotanical surveys undertaken in other regions, while other less-valued species in the current survey (such as *Ephedera altissima, Fagonia Arabica, Arbutus pavarii, Cyclamen rohlfsianum* and *Orobanche cyrenaica*) are highly valued in other communities

It is obvious that plant remedies in the region are usually administrated orally, most often as a decoction made with water and in some specific cases with olive oil or with vinegar and honey. From the ethnobotanical point of view, it was difficult to confirm completely the present use of many plants in the area, as on some occasions the uses of plants were described very vaguely and in many cases the treatment had been forgotten. Otherwise, treatments were often described in the past tense which may suggest that they be no longer used. Nevertheless, it seems that inhabitants maintain great faith in the curative properties of many plants which, are still used to treat minor ailments and for different other purposes of life.

As a final point, the sustainable management of El-Jabal El-Akhdar resources and the importance of its medicinal plants definitely propose advantages to the present generation and to meet the needs and aspirations of future generations. Conservation activities involving medicinal plant gardens maintained by herbalists, herbaria and various arboreta are necessary. Special programs must be started and utilized all the conventional methods of conservation (in situ and ex situ conservation, gene banks, biotechnology, etc.). Education of the rural dwellers, particularly the herbalists and the herb sellers in conservation awareness is important for an effective approach to the sustainable utilization of the natural resources in the region [27,28].

CONCLUSION

- Considering that the El-Jabal El-Akhdar has a high diversity of medicinal plants that are still poorly studied, more phytochemical and pharmacological studies are necessary in order to test popular indications and search for new pharmaceuticals.
- Additional studies are also necessary to identify possible links between a plant's chemical composition and its habitat and life strategy and to determine how human populations in El-Jabal El-Akhdar select and use these plants.
- Participation of public and private associations in management and utilization of medicinal plants in sustainable approach is indispensable to contest human pressures on these valuable natural resources.

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