Collection and Preservation of Rare and Endangered Plants (Case Study Endangered Plants in Libya)

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Abstract

The increase of endangered plants has led some research centers to give more attention in terms of plant preservation and investigation methods to avoid this risk in the future. Nowadays, endangered plants all over the world need to be protected for several reasons, for example, medical plant usage or for manufacturing reasons. Libya as one of the richest countries in plant genetic resources is seeking out to protect endangered plants such as Thapsia garganica var. Sylphium. This study has checked out the electronic database about Libya's important endangered plant areas such as Al-Jabal Al-Akhdar and has answered the main three questions; RQ1: What are the most important plant area in Libya?; RQ2: What are the main factors that affected endangered plants in Libya?; RQ3: Why plant conservation of endangered plants is important?. In addition, the result of this observational study has been presented in Table.A-1.1; Table.A-1.2.; Table.A-1.3.

Keywords: *Endangered plants, Endemic Species. Mediterranean Sea, Medicinal Plants, Libya, Plant Preservation, Rare Plant, IUCN.*

1.1. Introduction

Libya lies along the southern coast of the Mediterranean, in the region between latitude 18° as well as 33° North and 9° and 25° East. The total area is around 1,759,540 km 2, of which more than ninety percent is desert (Al-Sghair et al., 2019).

Figure. 1.1. The important plant area in Libyan.

Furthermore, the five plant areas of Libya are such as Jabal Al Akhdar, Sabkha Tawergha, Jabal Nafusa, Jabal Al Owainat, and Jabal Misak. The most plant area in Libya is Al-Jabal Al-Akhdar which is considered one of the largest vegetation areas and is located in Cyrenaica in northeastern Libya; which contains 80% of the Libyan plants; and is considered an exceptional center of endemism. Al-Jabal Al-Akhdar (Mahklouf and Etayeb 2018) the botanical areas also regulated climate with hot springs and open canals of Tawergha and the limestone formations in the Nafusa Mountains, which stretch five-hundred km from the Tunisian border strengthen to the Nagara region on the Mediterranean coast.

Libya consists of three main local botanical habitats, for instance, the coastal and the desert habitats with their crossing valleys from south to north as well as from west to east. A great number of plant species, which more than 1800 are flourishing in these habitats. These plant species form a vegetation type with variable features (Mahklouf and Etayeb 2018). The original vegetation of the coastal area is dominated by wormwood (*Artemisia campestris*) and white broom (*Retama raetam*) with some early spring flowering plants such as *Senecio gallicus*, *Hussonia pinnata*, *Eruca sativa*, *Chrysanthemum segetum*, *Malva sylvestris*, and *Erodium laciniatum*, in addition to the perennial herb *Echium angustifolium*. Furthermore, Aljabal Alakhdar area comprises the most wonderful plant diversity in Libya. This area is characterized by the red alluvial soil (terra rosa), relatively good rainfall (up to 600 mm/annually in certain locations), and closeness to the sea. The plant classes are *Arbutus pavarii, Juniperus phoenicea, Olea europaea* var. *oleaster*, *Pistacia lentiscus, Phlomis floccosa*, and *Cupressus sempervirens.* The western mountain is dominated as the population distribution in Libya based on 2001 estimation, people concentrate on two centers, the first, in the Jifara Plain where about sixty percent of all Libyans live, including Tripoli city the capital of Libya where more than one million people live, as well as the second center in northeastern Libya (Ben-Ghazi Plain).

1.2. The study purpose

This research study shed the light to determine several endangered plants in Libya and its geographic area; also has determined some factors that affected endangered plants all around Libya.

1.3. The study limitations

This study has observed the electronic database by screening the collected papers and summarize some information about the endemic plant, which presented in Table A-1.2. Also these studies have reviewed plant areas such as Cyrenaica, Jabal Al Akhdar, Sabkha Tawergha, Jabal Nafusa, Jabal Al Owainat, and Jabal Misak. Additionally, this study has evaluated several medicinal plants that has been endemic such as *Arbutus pavarii* Pamp, *Thymus capitatus* (L.), *Laurus nobili*s L. etc.as presented in Table A-1.1. Furthermore, this study has reviewed the collect papers from (electronic database, journal, books thesis, etc.) between from 2014 to 2019.

1.4. Research questions

1.4.1. RQ_1: What are the most important plant area in Libya?

Rational$_1$: There are five important plant area which included the coast belt, mountainous, and desert habitat types. Those are Jabal Alakhdar, Jabal Nafusah, Tawuorghawetland on the coast, the Messak area at the southwestern part, and the Alaweinat at the southeastern corner on the borders of Egypt and Sudan. (Valderràbano et al., 2018).

1.4.2. RQ$_2$: What are the main factors that effected endangered plants in Libya?

Rational$_2$: There are many factors in Libya depending on human civilization, climate change, overgrazing, traditional uses of plant species, representing the development to infrastructure, drop in rate of rainfall annually. In addition, the usage of firewood, which contributed of deterioration sharply of food and medical wild plant resources that led these species to endanger (Elmaghrabi et al., ra2017)**.**

1.4.3. RQ$_3$: Why plant conservation of endangered plants is important?

Rational$_3$: Because the plants have many characteristics such as genetic diversity in the endemic plants and medical uses (Mahklouf and Etayeb 2018).

1.5. IUCN Categories

IUCN classified as the International Union for Conservation of Nature (Sharrock et al., 2014); (Valderràbano et al., 2018) IUCN Red List of Threatened Species, also called IUCN Red List, one of the most well-known objective assessment systems for classifying the status of plants, animals, as well as other organisms threatened with extinction. IUCN unveiled this assessment system has been utilized in (1994). It contains explicit criteria and categories to classify the conservation status of individual species on the basis of their probability of extinction. Subsequently, a species is evaluated by the IUCN, it is placed into one of eight categories based on its current conservation status (Valderràbano et al., 2018).

IUCN members determine the risk of a species' extinction by utilizing criteria such as population size, subpopulations, the number of mature individuals, generation and the decline in population size etc. The Red List provides scientifically-based information about species' survival, promotes public education about biodiversity, influences governmental policies, and offers advice about conservation efforts (Fenu et al., 2018). The category assigned to each species is reassessed every 5 to 10 years by the IUCN Species Survival Commission Specialist Groups. This list is generally accepted as the most comprehensive information on the health and conservation of the world's species.

The IUCN considers an endangered species to be likely to become extinct. This is the second most serious conservation status for wild plant and animal species. Many international regulations prohibit killing, hunting, or selling species in this category. Additionally, large areas of land have been protected in order to conserve their population size. Conservations needs and approaches although a national system of protected area generally recognized as the underpinning of plant.

Conservation which is the protection afforded to threatened species by such areas alone is seldom sufficient and needs to be complemented by other actions in both *in-situ* and *ex-situ*. An example is the Egyptian Environmental Affairs Agency (EEAA) Saint Catherine Protectorate

Development project 'Botanical Conservation Measures and Ecological Monitoring Program. The protected area contains some five-hundred plant species, 30 of which are endemic to Egypt, and conservation activities have been ongoing there since the 1990s. Recent extensive studies on its threatened species have led to proposals to integrate the knowledge derived from ecological, demographic, and geographical approaches in formulating management strategies. An urgent need is to conserve the high-priority species *Rosa arabica and Salvia multicaulis* through both *in situ* and *ex situ* actions, including habitat restoration, fenced enclosures, species augmentation, recovery, and reintroduction, as well as a wide range of educational and awareness activities (Omar, 2017). The effectiveness of protected areas in contributing to biodiversity conservation depends largely on how well they are designed, managed, maintained, and protected, and on a comprehensive inventory of the species they contain so that necessary actions are taken to protect taxa of special concern (Heywood, 2017).

The research methods

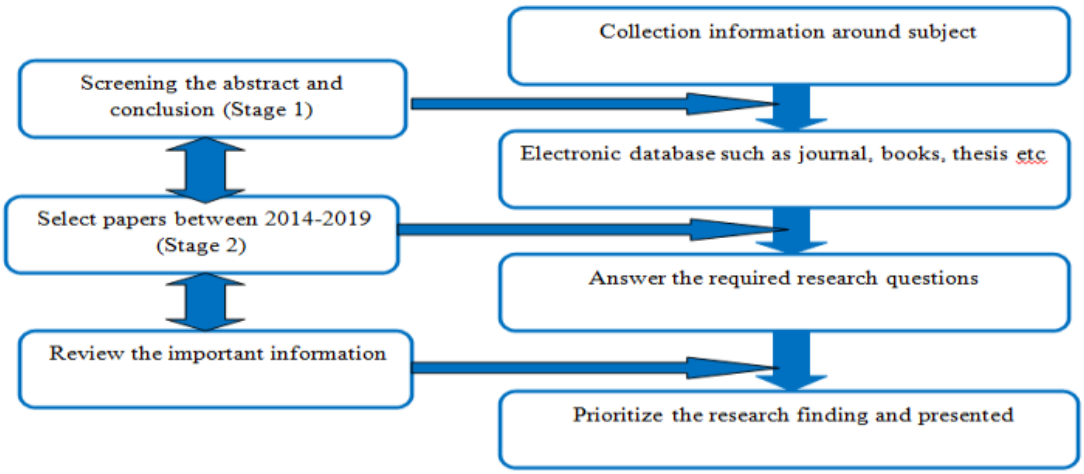

Figure. 1.1. The research methodology

Literature review

Generally, the important plant areas in Libya face many risks and threats that are affecting the plants preservation, for instance, genetic erosion of endemic species due to overgrazing, the collection of medicinal and woody plants that are used by locals, the spread of invasive alien species, as well as the development of tourism infrastructure (El-Maghrabi et al., 2017), indiscriminate construction, and forest fires have declined vegetation from 500,000 ha to 180,000 ha through 20 years. Rare plants may be rare, in part, because they are more susceptible to damage by predisposal insect seed predators than determinant of plant rarity. (APG-IV, 2016).

Endemic species form around 4% from the total species of Libyan flora. Thus, the area has been described as one of the important endemic centres in Libya. The Libyan flora species consists of

1,800 under the classification of 153 families. However, the majority of the Libyan flora has been distributed in Al- Jabal Al- Akhdar approximately 50%. (Mahklouf and Etayeb, 2018) and (APG-IV, 2016). Has reported that there are approximately 26 endemic plant species on the coastal belt of Cyrenaica. Two plant genera, *Pachyctenium maire* and *Libyella Pamp* are endemic to Al Jabal Al Akhdar, which contains one species; *Pachyctenium mirabile* and *Libyella Cyrenaica* as presented in Table.A-1.2.

The flora of Libya includes 1.907 taxa of specific or sub specific rank, or 2.154 if we include cultivated or naturalized species (Valderràbano et al., 2018). The number of endemic taxa is 130 corresponding to 6% of the total. An updated checklist covering 43 families, 138 genera and 411 species of the Libyan flora as treated in the Flora of Libya was recently published (Gawhari et al., 2018).

According to Valderràbano et al., (2018) there are no scientific plans for preparing a new national flora. Libya is sort out of the recurred digital database. Therefore, there is no national Red List for Libya and plants to prepare one the evaluation of Libyan taxa has been done by the international union for conservation of nature (IUCN) Red List (Fenu et al., 2018). Moreover, IUCN Red List based on (global or Mediterranean level) contains 158 plant taxa as total of flora including 7.3%. In addition, the threatened categories (CR, EN, and VU) reported as taxa value, which is 218.2% (Valderràbano et al., 2018).

In general, the climate change risk has been increased such as lack of rainfall annual, which is the most important environmental factor, consequently, the wild lands drier and seeds germination has decreased. (Elmaghrabi et al., 2017). Gebel Alakheder considered the richest area in vegetation with the highest number of species (about 50% of the total plant species of the Libyan flora are confined to this region). Recently, the diversity of the flora is mainly threatened by many factors such as illegal and non-sustainable wood and plants usage by local, civil war; heavy, overgrazing, over cultivation, recurrent drought conditions, and hazards uncontrolled urbanisation; traditional herbal usage as presented in Table.A-1.3 and armed conflict (Valderràbano et al., 2018).

EL-Mokasbi et al.,(2018) has announced that Libya is one of the most important rich medicine plants, which are used in conventional treatment (Dakeel et al., 2017). Specifically, Cyrenaica, which reported as, includes most of the overall total medicine and plants documented in Libya as presented in Table.A-1.3. (EL-Mokasbi et al., 2018). Furthermore, the most important plant in Cyrenaica, during remote time was the sylphium of antiquity, that cover a wide area. In fact, these valuable plant which yielded a gum-resin, the price of which was determined by an equal weight of silver was termed in shahat as well as emit to other country for the reason that it is power treating several illnesses. It is apparent that persistent overconsumption of sylphium for several centuries led to its scarcity and finally to its disappearance about the fifth century. (Valderràbano et al., 2018). Gebal Al Akhdar dominates the Cyrenaica region north- eastern Libya. It is a biogeographical island, with the Mediterranean Sea to the north and west, the marmarica plateau to the east and the Sahara desert to the south. It rises from sea level through three of escarpments and plains to 882 m. Between 100 and 140 taxa are endemic to Gabal Al Akhdar. Gabal Al Akhdar area is characterized by red alluvial soil (terra rossa), relative good rainfall up to 600 mm annually in certain location and closeness to the sea. The dominant species

are *Arbutus pavarii, Juniperus phoenicea, Olea europaea* var. *oleaster, pistacia lentiscus, Phlomis floccosa* and *Cupressus sempervirens.*

According to Agiel and Merical (2017) Eastern region of Libya has a highly diverse medicinal plants that remain to be poorly studied, more phytochemical pharmacological studies are necessary in order to test popular indications and to search for new pharmaceuticals. Additional studies are also necessary to identify possible links between the chemical composition of plants and its relation to habit and life strategy, and to determine how human populations in Eastern region select and use these plants. The region may be considered as one of the richest regions of medicinal and aromatic plants

Plants and collection methods

El-Mokasabi et al.,(2018) has collected several plant from Al-Gabel Akhder specifically, Wide Kofe region by using scheme Rauankier system to identify the classification of the collected plants. On the other hand, Mosallam *et al*., (2017) has used living forms of the recorded species were identified following the system of Raunkier (1934). This part of the Mediterranean basin, the total number of species (569 species) was higher than the normal spectrum of Raunkiaer's statistics, and was dominated by Therophytes followed by Chamaephytes and Phanerophytes. The medicinal plants in these typical valleys in Cyrenaica (89 species) were mostly annuals that reflect the climatic conditions of the area; these, with the Hemicryptophytes and Geophytes, form half of vegetation spectrum. As presented in Table A-1.2 the African Mediterranean sector that species with medicinal value are concentrated within half of the family taxa found. For example, Lamiaceae, Apiaceae and Asteraceae, with species, as the most dominant plant families. This is in contrast with many other areas where most medicinal plants are usually concentrated in the Rosaceae and Asteraceae (Moerman, 1979). Unfortunately, the top ranked plant species of medicinal found in our study were annuals or Chamaephytes which makes finding and collecting those species in the natural habitat very easy, and prone to over collection. The top three ranked plant families in our study that contained 24% of the medicinal plants are, however, among the six biggest families in Libya (Ali and Jafri, 1976).

Faunal Diversity in Libya

According to Mahklof and Etayeb, (2018) Libya is characterized by arid climatic situations, except the coastal strip and the northern hills toward the east and the west, while the overall area of Libya is desert and semi desert because of its location (Essghaier et al., 2015). This resulted in the presence of environments, for instance, temperature, humidity, and rainfall that reflected on the biological components of the plants and the animals that are able to coexist in various ways with those difficult environmental conditions (Mahklof and Etayeb, 2018).

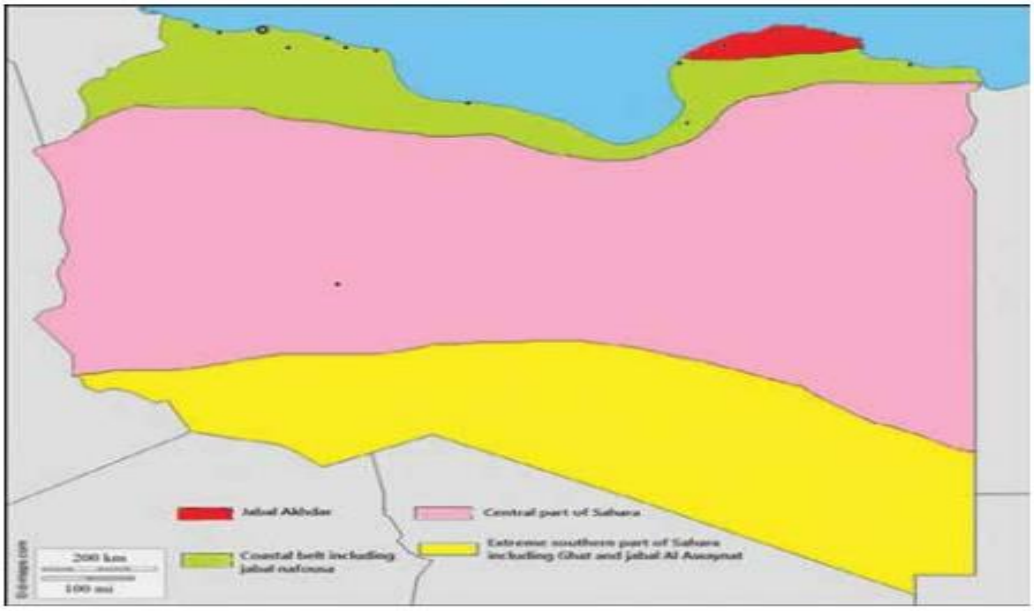

Figure.1.2. Centers of endemism in Libya.

There are a lot of ecosystems in Libya that range from the coastal environment with all its scattered salt marshes along the coastline, to green plains in the northeastern region and northwest highlands which include Nafusa Mountains, to desert and semi desert ecosystem showing its content of oases and valleys (Essghaier et al., 2015). The desert is ecologically sensitive and very important in terms of wildlife, for example, flora and fauna, which coexist in this habitat in spite of the harsh living conditions as much heat, especially during the summer months in addition to water scarcity and drought. However, these systems include a few diversity and abundance of species particularly those that have the capacity to live under these circumstances and some of them are endemic.

Conclusion

This study has explored the location of Libya and several endangered plants. Moreover, this study has reviewed some endemic plants and their several medicinal plant usages, for example; *Thymus capitatus*, *Pistacia lentiscus and Capparis spinosa* which are used to treat some diseases such as; common cold, cough, gastritis, diabetes and anticancer. In addition, the result of this study are presented in table.A-1.1 as well as table.A-1.2. This study also, amid to answer the three research questions. Finally, this study can be beneficial for next researchers to provide information for their similar research topic.

Future work

This study can be adapted to move forward to cover the topic of conservation methods to protect endangered plants in Libya.

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Appendix. A-1

Table.A-1.1. The medical uses of some endangered plant species in Libya

Scientific Name	Traditional name	The classification	Plant region	Endangered by	Author and years
Pistacia lentiscus L.	Battoum	Anacardiaceae	Endemic to Al-Jabal Al-Akhdar	Overgrazing and medical uses	Mokasabi etal., (2018)
Seriphidium herba-alba (Asso) Soják	Shih	Asteraceae	wadis Jardas Jerrari, Shahat	Overgrazing and medical uses	Mokasabi et al., (2018)
Cupressus sempervirens L. var. horizontalis (Mill.) Gord.	Srow	Cupressaceae	Wadi El-Kouf	medical uses	Mokasabi et al., (2018)
Juniperus phoenicea L.	Arar	Cupressaceae	Jarjar oma, Almosora	medical uses	Dakeel et al (2017)
Arbutus pavarii Pamp.	Shmary	shmary	Al-Marj-Al-Baida, El-Beida, Shahat	Climate change and medical uses and food industries	Kabiel et al., (2016) Mokasabi et al., (2018) Maghabi et al., (2017)
Ceratonia siliqua L	Kharroub	Fabaceae	Wadi El-Kouf, Jarjar oma, Almansora	medical uses	Mokasabi et al., (2018), Dakeel et al (2017)
Querecus coccifera L.	Ballout	Fagaceae	Al-Marj, Al-Baida motorway, El-Beida, Shahat, Susah and Wadi El-Kouf	medical uses	Mokasabi etal.,2018

Thymus capitatus (L.) Hoffmanns. & Link	Zahter	*Lamiaceae*	Wadis Jardas Jerrari.	medical uses	Mosallam et al., (2017) Troliet et al., 2016 Dakeel et al., (2017)
Laurus nobilis L.	Rand	Lauraceae	Al-Marj-Al-Baida, El-Beida, Shahat	medical uses	Mosallam et al., 2017 Troliet et al., 2016
Olea europaea L.	Zaitoun	Oleaceae	Al-Marj-Al-Baida, El-Beida, Shahat, Almansora	medical uses	Mosallam et al., 2017 Dakeel et al (2017)
Pinus halepensis Miller.	Senouber	Pinaceae	Al-Marj-Al-Baida, El-Beida, Shahat	medical uses	Mosallam et al., 2017
Ziziphus lotus (L.) Lam.	Sidr	Rhamnaceae	Wadis Jardas Jerrari and Susah	medical uses	Mosallam et al., 2017
Haplophyllum tuberculatum (Forsk)	(Forsk)	Rutaceae	Al-Jabal Al-Akhdar	medical uses	Elmaghabi et al., 2017
Allium longanum,	Gassol	monocotyledonea	Wadi Alkuf	medical uses and food	El-Mokasabi, (2014)
Allium ruhmerianum,	Nargis	monocotyledonea	Wadi Alkuf	Ornamental plant	El-Mokasabi, (2014)
Capparis spinosav	Kabbar		Wadi Alkuf	medical uses and food	El-Mokasabi, (2014)
Globularia alypum	Zerreiga	Globulariaceae	Wadi Alkuf, shahat	medical uses	El-Mokasabi, (2014), Dakeel et al (2017)
Helichrysum stoechas	Eshbet larnab	Astraceae	Wadi Alkuf	medical uses	El-Mokasabi, (2014)
Malva aegyptia	Khobbeizq	Malvaceae	Wadi Alkuf	medical uses	El-Mokasabi, (2014)
Pistacia atlantica Desf	Batum	Anacardiaceae.	Al-Jabal Al-Akhdar	medical uses	Agiel and Mericli,2017

Carum carvi L.	Krweia	Apiaceae		medical uses	Agiel and Mericli,2017
Retama raetam Forssk	Al- ratem	Fabaceae	Tarhona regions	medical uses	Agiel and Mericli,2017
Ruta graveolens L.	Fagal	Rutaceace	Al-Jabal Al-Akhdar jabal Naphosa	medical uses	Agiel and Mericli,2017
Solanum nigrum L.	Enab –Al-deib	Solanaceace	Al-Jabal Al-Akhdar	medical uses	Agiel and Mericli,2017

Scientific name	Family name	Genetic diversity limited some species(endemic) in Libya	Author and years
Pachyctenium mirabile	Umbelliferae	Unique genetic diversity in region Al-Jabal Al-Akhdar	Mahklouf and Etayeb, (2018)
Oudneya africana	Cruciferae	Unique genetic diversity in region Al-Jabal Al-Akhdar	Mahklouf and Etayeb, (2018)
Libyella Cyrenaica	Gramineae	Unique genetic diversity in region Al-Jabal Al-Akhdar	(Mahklouf and Etayeb, (2018)
Cyclamen rholfsianum	Primulaceae	in region Al-Jabal Al-Akhdar wadi Alkuf	Mahklouf and Etayeb, (2018)
Arum cyrenaicum	Araceae	Crete	Mahklouf and Etayeb (2018)
Teucrium cyrenaicum	Labiatae	in region Al-Jabal Al-Akhdar	Mahklouf and Etayeb (2018)
Linaria tarhunensis	Scrophulariaceae	in region Al-Jabal Al-Akhdar	Mahklouf and Etayeb (2018)
Tourneuxia varrifolia	Compositae	in region Al-Jabal Al-Akhdar	Mahklouf and Etayeb (2018)
Stachys rosea (Desf).Boiss		in region Al-Jabal Al-Akhdar	Mahklouf and Etayeb(2018)

Thapsia garganica var. sylphium	Apiaceae	in region Al-Jabal Al-Akhdar	Mahklouf and Etayeb(2018)
Cupressus sempervirens var. Horizontale	Cupressaceae	in region Al-Jabal Al-Akhdar and wady almahbole	Mahklouf and Etayeb (2018)
Satureja thymbra L	Lamiaceae	in region Al-Jabal Al-Akhdar	Agiel and Mericli,(2017)
Muscari stenanthum freyn		Just in region Al-Jabal Al-Akhdar	Mahklouf and Etayeb (2018)

Table.A.1-3: The traditional uses of some plants species (Medical and Endemic) in Libya

Scientific name	Local name	Traditional usage	Authors and years
Cyclamen rholfsianum	Rakaf	Diabetes, Anaemia, Abscess	El-Mokasabi, (2014)
Origanum cyrenaicum	Martwosha	Stomachic, Carminative,Expectorant	Agiel and Mericli,(2017)
Arum cyreanicum	Renish	Dermatitis, Psoriasis, Corn, Bone spur	El-Mokasabi, (2014)
Teucrium cyrenaicum	Gaada	Diabetes, Gastritis, Thyroiditis, Anemia, Common cold, Hypertension, Renal stones	El-Mokasabi, (2014)
Tourneuxia varrifolia	Gaada	Diabetes, Gastritis, Thyroiditis, Anemia, Common cold, Hypertension, Renal stones	El-Mokasabi, (2014)
Thapsia garganica	Derias	Arthritis, Herpes, Hair-fall, Hypertension, Rheumatic, Scabies.	El-Mokasabi, (2014)
Cupressus smpervirens	Srow	Asthma, Respiration strait, Piles, Nervous seizure, Gingivitis, Toothache, Varicose veins	El-Mokasabi et al., (2018)
Thymus capitatus	Zaater	Common cold, Cough, Flatulence, Dermatitis, Indigestion, Vermicide, Rheumatic, Inflenza, Gastritis, Antiseptic.	El-Mokasabi, (2014)
Laurus nobilis	Ghar- Rand	Rheumatic, Indigestion	El-Mokasabi, (2014)
Olea europaea	Zaitoun	Gingivitis, Dyspepsia, Eczema,Constipation, Earache	El-Mokasabi, (2014)
Pinus halepensis	Senouber	Liver diseases, Respiratory, diseases	El-Mokasabi, (2014)
Ziziphus lotus	Sidr-Nabq	Constipation, Hair parasites, Gastritis, Sciatica, Abscess, Piles, Hepatitis	El-Mokasabi, (2014)
Haplophyllum tuberculatum	Shagaret El-Reeh	Flatulence, Constipation, Lacticemia, Prostatis, Rheumatic, Vitiligo, Tranquilizing for nerves, Common cold.	El-Mokasabi et al., (2018)
Capparis spinosa	Kabbar	Anticancer, Diuretic, Wounds, Diabetes, Gastritis, Corn, Rheumatic	El-Mokasabi et al., (2018)
Globularia alypum	Zerreiga	Diuretic, Gastritis, Hypertension, Metritis, Ovary stimulant, Stroke, Vaginal diseases	El-Mokasabi et al., (2018)

Helichrysum stoechas	Eshbet Larnab	Renal stone, Urinary tract infection, Ureterolith, Jaundice, Renal colic, Gastritis	El-Mokasabi, (2014)
Malva aegyptia	Khobbeiza	Anemia, Gastroenteritis, Gingivitis, Renal stones, Hair-fall, Angina, Laryngitis, Abscess	El-Mokasabi et al., (2018)
Pistachia lentiscus	Batum	Collic, Gastritis, Skin cracks, Ulcer, Gingivitis, Psoriasis, Dermatitis, Rash, Crack hands and feet	El-Mokasabi, (2014)
Retama raetam	Ratam	Diabetes, Sinusitis	El-Mokasabi et al., (2018)
Ruta graveolens	Fagial	Earache, Colic, Virmocide, Flatulence, Headache, Dermatitis, Epilepsis, Validated women, Piles, Gastritis	El-Mokasabi et al., (2018) and Agiel and Mericli,(2017)
Solanum nigrum	Enab El-Deeb	Liver diseases, Diuretic, Constipation, Dermatitis. Arthritis,Rheumatic, Hypertension	El-Mokasabi et al., (2018)