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## ORIGINAL ARTICLE

### Initial Assessment of Medicinal Plants Across the Libyan Mediterranean Coast

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#### ABSTRACT

The medicinal plants of the Libyan Mediterranean Coast represent an opportunity to reduce rural poverty in the arid and semi-arid ecosystems due to their water use efficiency, low costs of collection and cultivation, high economic returns per unit area, and the creation of new jobs within the value-added activities of processing and marketing. However, major medicinal plants in the region are in danger of extinction due to global climate change, overgrazing, uprooting, and wood cutting. Mitigating this depletion of biodiversity along the Libyan Coast requires: 1) *ex-situ* conservation of important plant genetic resources in the national genebank; 2) establishment of field genebanks in the two major agro-ecological zones; and 3) conservation of selected specimen in the national herbarium. During the spring and summer of 2009 and 2010 collection missions were conducted along the Libyan Mediterranean coast. The field visits occurred, and surveyed a total of 79 sites across the western and eastern coastal areas of Libya. The collection mission recorded a total of 151 species belonging to 47 families, the most dominant of which were Chenopodiaceae (20 %) followed by Fabaceae (13 %). 78 species with medicinal benefits were encountered, the most prevalent of which were the Lamiaceae (12 %) and Fabaceae (10 %) families. Major medicinal plants were classified according to their life form and various uses. Given the ecological, social, and economic benefits of medicinal plants in Libya, this sector must be developed through the following research strategy. First, a thorough inventory and mapping of all potential medicinal plants in Libya and their status should be established and regularly maintained. Second, decision-makers should develop clear policies for the protection/conservation, production, transportation, and marketing of medicinal plants. In particular, a national program based upon scientific standards should collect seeds and conserve key medicinal plants in the national genebank. Furthermore, improve public awareness of the importance of medicinal plants, and build on traditional knowledge and cultural heritage.

**Key words:** Libya, medicinal plants, multi-purposes species, biodiversity, genebank, herbarium, rangelands

#### Introduction

Worldwide, between 50,000 and 80,000 flowering plants are used in traditional medicine [15]. Growing global demand for herbal, medicinal, and aromatic plants has created a new niche market for these products valued at \$60 billion US per year, with an average annual growth rate of about 7 % [13]. In recent years, such medicinal plants have

also been recognized as a significant source of livelihood opportunities for the rural poor, especially women, the landless poor, and marginalized farmers, and also constitute an important source of revenue for governments. In fact, due to the over-exploitation of some wild species, a number of institutes recommend that wild species be brought under cultivation [28,29]. Furthermore, medicinal plants often provide a buffer in times of low

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employment, crop failure, and other periods of economic stress [8]. Finally, they represent a promising opportunity for reducing rural poverty and achieving economic development in dry ecosystems because of their higher water use efficiency, relatively higher economic return per unit area compared to traditional crops, and the potential to add value through processing and marketing [20,12].

Libya lies along the southern coast of the Mediterranean in North Africa and has a total area of about 1,759,540 km<sup>2</sup>, of which more than 90 % is desert. The climate is typical Mediterranean, with erratic rainfall. Agriculture and arid and semi-arid rangelands are limited to a narrow strip along the Mediterranean coast. Nevertheless, Libya has a number of advantages in medicinal plants production, including low production costs, favorable climatic conditions, large areas of wild medicinal species, and proximity to European markets. Unfortunately, its medicinal plants have been degraded because of over-exploitation due to deforestation, cultivation, and overgrazing; the absence of adequate policies and legislation; and habitat degradation and loss attributable to climatic change and its associated intensification of drought [310,18], all of which will inevitably result in the impoverishment of a large number of people.

It is now recognized that many wild harvested medicinal plants face extinction or severe genetic loss, but detailed information on the extent of this degradation is either unavailable or poorly documented due to the limited amount of formal research undertaken on medicinal plants in Libya. Thus, much research is needed to ensure the safeguarding of highly threatened species, either within their natural habitats or in artificial settings, and to thereby protect these resources for future generations (Given, 1994). The overall objectives of this study were: 1) to assess the status of multipurposes species, particularly medicinal plants, across the Libyan Mediterranean Coast; and 2) to present recommendations for the conservation, management, and sustainable utilization of medicinal plants in Libya.

## Materials and methods

### *Details about the sites:*

The surveyed areas experience arid, temperate winters with an average annual rainfall of 220 mm that varies from 150 mm to 300 mm. 79 sites were surveyed in the western and eastern coastal areas of Libya, covering a wide range of geographical areas and ecosystems (Figure 1). This heterogeneity consisted of seven morphological zones (namely, forest, valleys, rangelands, *sabkhas* [saline depressions], sand dunes, roads sides, and sea sides),

each with unique flora and vegetation (Table 1). The respective zones provide environmental niches for hundreds of wild medicinal species used by indigenous communities for food and medicine.

Of the collected species, more than 70 were gathered from rangelands, mainly because of the huge area occupied by rangelands in Libya (Figure 2). In terms of species richness, valleys (*wadis*) were more diversified per unit area than any other geomorphologic zones. These ecosystems generally have higher fertility levels and better than average water availability.

### *Data collection:*

Seed collection and vegetation survey of medicinal plants were conducted across seven morphological zones mentioned above. In addition to the site description, detailed ethno-botanical data and herbarium material were gathered to confirm uses and species identification. The following information was recorded during the collection missions:

### *Sample seed collection:*

For each matured species, a small sample of seed was harvested. The collection date, collector's name, location, site number, coordinates (longitude, latitude), altitude, rainfall, habitat, aspect, slope, and soil data were recorded.

### *Plant characteristics:*

Identification and nomenclature of plant species, including botanical name, local name, common name, and family name, were performed according to Keith [17], IPNI [14], and USDA-ARS[27]. Abundance of each species was determined quantitatively based on presence percentage according to the following scale: dominant (greater than 25 %); associated (less than 10 %); and rare (less than 5 %). Growth form (erect, semi-erect, or prostrate) and life form (trees, phanerophyte, chamaephyte, annual shrubs, perennial forbs, perennial grasses, biennial forbs, therophyte, or climbers) were assigned following Ali and Jari [1] and Sankary[26]. In addition, a close-up photograph was taken.

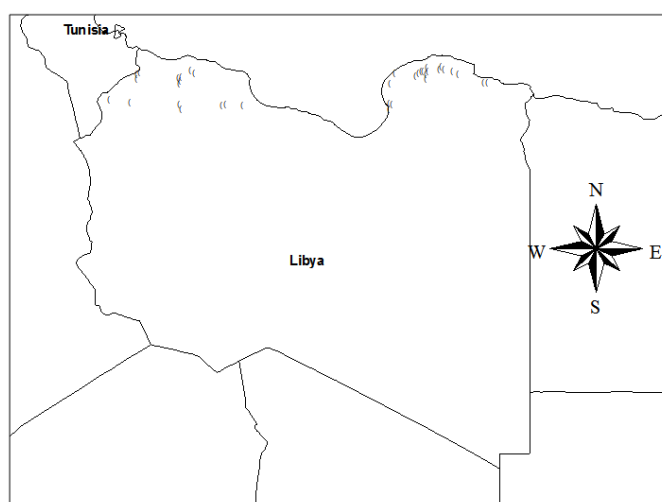
*Herbarium sample collection:* Specimens of medicinal plants collected in this study were deposited at the National Genebank in Tripoli, Libya. Percent vegetation and stone covers were measured at each site using visual estimation [21,23].

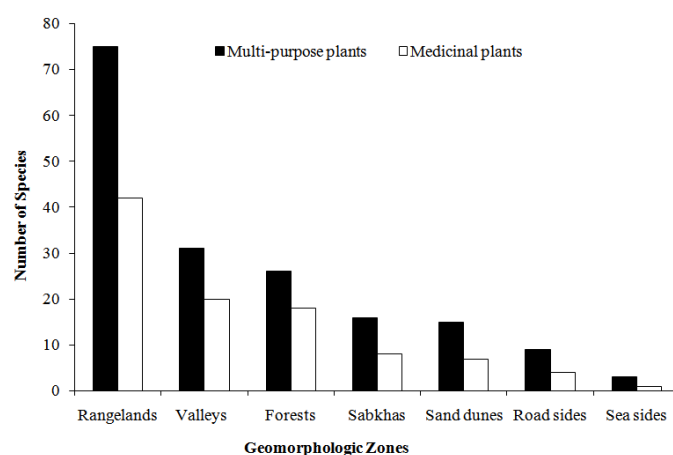
### *Economic uses:*

The majority of the encountered wild species have a wide array of uses, including human food, feed for livestock and wildlife, fuel, medicine, and

**Table 1:** Characteristics of the surveyed sites in the Mediterranean coast of Libya

| Geographic type  | Site              | East           | Nourth         | Altitude ( m) | Aspect | Slope (%) | Percent Cover |            |
|------------------|-------------------|----------------|----------------|---------------|--------|-----------|---------------|------------|
|                  |                   |                |                |               |        |           | Stones        | Vegetation |
| Forest           |                   |                |                |               |        |           |               |            |
| Degraded         | Al Koof           | 21° 18' 47.02" | 32° 34' 52.90" | 302           | S      | 5         | 10            | 30         |
|                  | Jardas            | 21° 46' 53.00" | 32° 31' 21.97" | 691           | W      | 8         | 60            | 10         |
| Protected        | Herdanem          | 20° 40' 46.84" | 32° 35' 00.84" | 32            | N      | 5         | 25            | 40         |
|                  | Al-Zarda          | 22° 05' 55.51" | 32° 47' 33.71" | 386           | E      | 5         | 20            | 75         |
|                  | Belghra           | 21° 40' 37.45" | 32° 42' 18.79" | 527           | W      | 5         | 25            | 40         |
|                  | Al-Arkoob Abyad   | 22° 09' 34.01" | 32° 50' 03.06" | 488           | S      | 7         | 20            | 65         |
| Artificial       | Slenta            | 21° 22' 28.96" | 32° 36' 03.20" | 825           | N      | 5         | 5             | 60         |
| Valleys          |                   |                |                |               |        |           |               |            |
| Jabal Al- Akhdar | Wadi Al-Koof      | 21° 34' 26.15" | 32° 42' 43.12" | 392           | F      | 0         |               |            |
|                  | 30                |                |                |               |        |           |               |            |
|                  | Slook             | 20° 33' 02.45" | 31° 33' 02.66" | 70            | E      | 5         | 2             | 10         |
|                  | Sadd Al Qatara    | 20° 23' 59.24" | 32° 01' 47.46" | 209           | S/E    | 30        | 50            | 40         |
|                  | Darnah            | 22° 36' 38.34" | 32° 42' 14.40" | 101           | F      | 0         | 5             | 75         |
| Jabal Al- Gharbi | Hera              | 13° 01' 42.03" | 32° 25' 58.51" | 141           | F      | 0         |               |            |
|                  | 30                |                |                |               |        |           |               |            |
|                  | Al-Ramel          | 13° 35' 31.81" | 32° 46' 54.08" | 122           | F      | 0         | 0             | 10         |
| Rangelands       |                   |                |                |               |        |           |               |            |
| Protected        | Abu Ghelann       | 13° 01' 42.93" | 32° 15' 40.55" | 258           | W      | 8         | 20            | 60         |
|                  | Ein Toubé         | 13° 02' 09.04" | 32° 10' 38.08" | 606           | E      | 3         | 10            | 70         |
|                  | Reserve Shaafeen  | 13° 49' 58.01" | 32° 36' 38.23" | 383           | W      | 6         | 15            | 40         |
|                  | Reserve Al Toyoor | 11° 32' 47.11" | 32° 54' 38.99" | 17            | F      | 0         | 0             | 20         |
|                  | Montazah Tala     | 10° 59' 16.58" | 31° 52' 05.09" | 491           | N      | 28        | 15            | 45         |
| Unprotected      | The foot of Jabal | 13° 02' 47.77" | 32° 20' 17.09" | 204           | F      | 0         | 20            | 40         |
|                  | Al Gharbi         |                |                |               |        |           |               |            |
|                  | South Mezda       | 13° 04' 01.96" | 31° 19' 29.82" | 437           | F      | 0         | 3             | 7          |
|                  | Mizdah            | 13° 03' 00.46" | 31° 24' 06.65" | 443           | F      | 0         | 50            | 2          |
|                  | Sadadeh           | 14° 56' 15.47" | 31° 35' 07.48" | 19            | F      | 0         | 55            | 3          |
|                  | Om Rezam          | 22° 56' 23.03" | 32° 33' 47.70" | 133           | Ft     | 0         | 35            | 5          |
|                  | Mrassasa          | 23° 46' 14.66" | 32° 05' 50.82" | 91            | F      | 0         | 5             | 10         |
| Depressions      | West Jardas       | 21° 46' 39.47" | 32° 26' 30.80" | 594           | F      | 0         | 15            | 15         |
|                  | Al-Herabeh        | 11° 30' 31.90" | 31° 42' 22.93" | 640           | F      | 0         | 5             | 18         |
| Sabkha           |                   |                |                |               |        |           |               |            |
|                  | Hiesha Jadida     | 15° 13' 21.88" | 31° 30' 12.47" | 45            | F      | 0         | 2             | 45         |
|                  | Al Jbebehneh      | 11° 32' 47.11" | 32° 54' 38.99" | 17            | F      | 0         | 0             | 20         |
|                  | Al-Qaminis        | 19° 57' 16.08" | 31° 42' 27.09" | 12            | F      | 0         | 3             | 45         |
| Sand dunes       |                   |                |                |               |        |           |               |            |
|                  | West slook        | 20° 21' 02.99" | 31° 38' 20.80" | 72            | F      | 0         | 0             | 10         |
|                  | Nafad             | 14° 44' 00.74" | 31° 31' 49.84" | 90            | F      | 0         | 0             | 5          |
|                  | Maghzar Sabbet    | 11° 49' 22.19" | 32° 46' 00.70" | 35            | F      | 0         | 0             | 8          |
| Road sides       |                   |                |                |               |        |           |               |            |
|                  | Qarnada           | 21° 54' 24.62" | 32° 43' 47.35" | 645           | F      | 0         | 10            | 20         |
|                  | Al Athron         | 22° 05' 44.30" | 32° 52' 19.75" | 19            | F      | 0         | 45            | 40         |
| Sea sides        |                   |                |                |               |        |           |               |            |
|                  | Sail Amer         | 21° 51' 43.99" | 32° 54' 33.19" | 3             | F      | 0         | 10            | 10         |
|                  | Tubroq            | 23° 57' 57.46" | 32° 04' 37.27" | 1             | F      | 0         | 0             | 5          |

**Fig. 1:** A map showing the study area. Black dots represent visited sites along the Libyan Mediterranean coast



**Fig. 2:** Number of species per geographical zones recorded during the collection missions of the Mediterranean coast of Libya in the spring and summer of 2009 and 2010

environmental uses (such as erosion control and sand dune fixation)[6,30].

#### *Medicinal use and part of medicinal plant used:*

Indigenous people actively engage in traditional healthcare practices, and local experts were interviewed to record their unique knowledge about the medicinal values of different plant species. Information on the medicinal value of plants was counterchecked against the available literature[1,2,516,7,25].

### **Results and discussion**

The assessment undertaken during the spring and summer of 2009 and 2010 recorded 151 plant species (132 perennials, 2 biennials, and 17 annuals) belonging to 117 genera and 47 families (Table 2). Among these species, 19 are endemic, 25 are rare (19 perennials and six annuals), 15 are noteworthy species, and 10 species are under threat. 90 species (or 59.6 %) are woody plants (mainly shrubs), with 55 phanerophytes, 11 chamaephytes, and 24 trees. 88 species (58.3 %) possess at least one aspect that has a potential or actual economic use, most commonly in grazing or medicine.

31 plant communities were identified across the seven geomorphological zones where rangeland sites have the highest number with 13 different assemblages of plant species (Table 3). From an ecological and vegetation viewpoint, then, the Libyan Mediterranean Coast has a rich biodiversity, and accounts for the majority of the species found in the Libyan Mediterranean region, the richest phyto-geographical region in Libya.

The most dominant families were Chenopodiaceae (20 %), followed by Fabaceae (13 %) and Poaceae (10 %) (Table 4).

The eastern region is characterized by a more

favorable climate condition, and thus more species were found (76 species) there in comparison to the rest of the country (Table 5).

#### *Growth forms and plant parts used*

Plant species were split into nine groups based on morphology (life form) and life span. The life form of the analyzed taxa exhibited a wide range of variation. Life form, which was divided into nine classes, took into account the growth of higher plants resulting from tissue initiation at the apices. Among which chamaephyte, a perennial plant that sets its dormant vegetative buds just at or above the surface of the ground; geophyte, a perennial plant that propagates by underground bulbs or tubers or corms; phanerophyte, the surviving buds or shoot apices are borne on shoots which projected into the air. Therophyte plants completed their life cycle from seed to seed and died. More than 50 species (36 %) were classified as Phanerophytes or shrubs, followed by trees and perennial forbs (Table 6).

The biodiversity delineated above is fundamental to the livelihoods of local communities, especially those residing in mountainous, arid, and semi-arid regions. This biodiversity encompasses a wealth of medicinal and other useful plants that enhance the healthcare of humans and livestock in rural areas [24]. If well-managed, these species represent good opportunities to increase and diversify the incomes of many people, as the demand for these species is increasing at both the national and international levels. The economic uses of the major collected species were recorded after consultation with local communities, experts, and several other sources (Table 7).

For the primary needs of health care, more than 80% of the world population depends on traditional medicine [22]. Our results confirm the report of WHO [29] indicating that medicinal plants are used

**Table 2:** List of multi-purpose plants and their uses collected during the collection missions of the Mediterranean coast of Libya in the spring and summer of 2009 and 2010

| Scientific name                                      | Author                 | Common name                  | Uses                                     |
|------------------------------------------------------|------------------------|------------------------------|------------------------------------------|
| <i>Acacia cyclops</i>                                | A. Cunn. ex G. Don     | Coastal wattle               | AF, FP, IP (tannin production)           |
| <i>Acacia farnesiana</i>                             | (L.) Willd.            | Sweet acacia                 | AF, MP, HF, OP, FP                       |
| <i>Acacia Karroo</i>                                 | Hayne                  | Sweet thorn                  | AF, FP, IP, SF                           |
| <i>Acacia ligulata</i>                               | A.Cunn. ex Benth.      | Umbrella bush                | AF, FP                                   |
| <i>Acacia neriifolia</i>                             | A.Cunn. ex Benth.      | Oleander wattle              | AF, FP, SHP                              |
| <i>Acacia nilotica</i>                               | (L.) Delile            | Babul acacia                 | AF, MP, HP, IP (tannin, gum, wood)       |
| <i>Acacia oswaldii</i>                               | F. Muell.              | Umbrella acacia              | AF, FP                                   |
| <i>Acacia salign</i>                                 | (Labill.) H. L. Wendl. | Milkweed                     | AF, MP, HF, EC, FP, BP                   |
| <i>Acacia sclerosperma</i>                           | F. Muell.              | Silver bark wattle           | AF, FP, WB, EC                           |
| <i>Acacia tortilis</i>                               | (Forssk.) Hayne        | Umbrella thorn Acacia        | AF, FP, EC                               |
| <i>Acacia victoriae</i>                              | Benth.                 | Bramble wattle               | AF, IP, EC, WB                           |
| <i>Aeluropus lagopoides</i>                          | (L.) Thwaites          | Mamoncillo                   | AF, IS                                   |
| <i>Alcea rosea</i>                                   | L.                     | Hollyhock                    | HF, MP, OP                               |
| <i>Amaranthus hybridus</i>                           | L. Engl                | Smooth pigweed               | AF, MP                                   |
| <i>Anabasis articulata</i>                           | (Forssk.) Moq.         | Jointed anabasis             | MP, IP (soap)                            |
| <i>Anvillea garcini</i>                              | (Burm.f.) DC.          | Guayache                     | AF, MP                                   |
| <i>Arbutus pavarii</i>                               | Pamp.                  | Guitarfish                   | AF, HF, MP, FP, BP                       |
| <i>Argania spinosa</i>                               | (L.) Skeels.           | Argan                        | MP, IP (argan oil)                       |
| <i>Argyrobium uniflorum</i>                          | (Decne.) Jaub. & Spach |                              | ISF, SF                                  |
| <i>Arnebia tetragyna</i>                             | Forssk.                |                              | AF, MP                                   |
| <i>Artemisia campestris</i>                          | L.                     | Wormwood                     | SF                                       |
| <i>Artemisia herba-alba</i>                          | Asso                   | Wormwood                     | AF, MP, FP, AP                           |
| <i>Arthrocnemum glaucum</i>                          | (Del.) Ungern-Sternb.  | Glasswort                    | IS                                       |
| <i>Arthrocnemum perenne</i>                          | (Mill.) Moss.          | Chickenclaws                 | IS                                       |
| <i>Asparagus aphyllus</i>                            | L.                     | Prickly asparagus            | MP                                       |
| <i>Asparagus stipularis</i>                          | Forssk.                | Thorny asparagus             | HF                                       |
| <i>Atriplex halimus</i>                              | L.                     | Saltbush                     | AF, HF, SF, HP, EC                       |
| <i>Atriplex leucoclada</i>                           | Boiss.                 | Saltbush                     | AF                                       |
| <i>Atriplex nummularia</i>                           | Lindl.                 | Old man saltbush             | AF, OP, EC, HP                           |
| <i>Atriplex semibaccata</i>                          | R.Br.                  | Australian saltbush          | AF                                       |
| <i>Balanites aegyptiaca</i>                          | (L.) Del.              | Egyptian balsam              | MP                                       |
| <i>Bassia indica</i>                                 | (Wight) A.J.Scott.     | Indian bassia                | AF, SF                                   |
| <i>Bassia muricata</i>                               | (L.) Asch.             | Five-spine-bassia            | AF, SF                                   |
| <i>Bassia scoparia</i>                               | (L.) A.J. Scott.       | Fireweed. kochia             | AF                                       |
| <i>Blackiella inflata</i>                            | (F. Muell.) Aell.)     | Little saltbush              | AF, SF, IS                               |
| <i>Caesalpinia gilliesii</i>                         | (Hook.) D. Dietr.      | Yellow bird of paradise      | OP, ISF                                  |
| <i>Calligonum arich</i>                              | Le Houér.              | Arta                         | AF, MP, SF                               |
| <i>Calligonum comosum</i>                            | L'Hér.                 | Abal                         | AF, MP, SF                               |
| <i>Capparis spinosa</i>                              | L.                     | Common caper                 | AF, MP, HF, EC, BP                       |
| <i>Carthamus lanatus</i>                             | L.                     | Saffron thistle              | MP                                       |
| <i>Ceratonia siliqua</i>                             | L.                     | Carob                        | AF, MP, FP, IP, SHP                      |
| <i>Chenopodium murale</i>                            | L.                     | Australian-spinach           | MP                                       |
| <i>Cistus salvifolius</i>                            | L.                     | Snow fountain                | OP, IP (essential oil)                   |
| <i>Citrullus colocynthis</i>                         | (L.) Schrader          | Bitter cucumber              | MP                                       |
| <i>Cleome arabica</i>                                | L.                     | Tamachek                     | AF, MP                                   |
| <i>Cupressus sempervirens</i> var. <i>dupreziana</i> | (A. Camus) Silba       | Tarout                       | AFFP, AP, IP (wood)                      |
| <i>Cyperus rotundus</i>                              | L.                     | Nut grass                    | MP                                       |
| <i>Dactylis glomerata</i> subsp. <i>hispanica</i>    | (Roth) Nyman           | Barnyard grass               | AF                                       |
| <i>Datura innoxia</i>                                | Mill.                  | Jimson weed                  | MP                                       |
| <i>Deverra tortuosa</i>                              | (Desf.) DC.            | Loder's gazelle              | MP, HF (soup powder), IP (essential oil) |
| <i>Dodonaea viscosa</i>                              | (L.) Jacq.             | Hopbush                      | OP, HP                                   |
| <i>Ecballium elaterium</i>                           | (L.) A. Rich.          | Squirting cucumber           | MP                                       |
| <i>Enchylaena tomentosa</i>                          | R.Br.                  | Ruby salt bush               | AF, MP                                   |
| <i>Ephedra alata</i>                                 | Decne.                 | White shrubby                | AF, MP                                   |
| <i>Eryngium campestre</i>                            | L.                     | Sea holly                    | AF, MP                                   |
| <i>Euphorbia dendroides</i>                          | L.                     | Tree spurge                  | OP                                       |
| <i>Fagonia microphylla</i>                           | Pomel                  |                              | MP                                       |
| <i>Festuca arundinacea</i>                           | Schreb.                | Tall fescue                  | AF                                       |
| <i>Globularia alypum</i>                             | L.                     | Cebollada                    | MP                                       |
| <i>Halocnemum strobilaceum</i>                       | (Pall.) M. Bieb.       | Yan jie mu                   | MP                                       |
| <i>Haloxylon articulatum</i>                         | (Moq.) Bunge           | R'meth                       | FP                                       |
| <i>Haloxylon salicornicum</i>                        | (Moq.) Bge.            | Saxaul                       | FP                                       |
| <i>Hammada schmittiana</i>                           | (Pomel) Botsch.        | Wormwood subdesertic steppes | AF, SF                                   |
| <i>Hammada scoparia</i>                              | (Pomel) Iljin          |                              | FP                                       |
| <i>Haplophyllum tuberculatum</i>                     | (Forsk.) Juss.         | Oarn el-gazal                | MP, IR, FP                               |
| <i>Helianthemum lippii</i>                           | (L.) Dum.Cours.        | Sun-rose plants              | AF                                       |

**Table 2:** Continue

|                                                 |                                  |                        |                                                        |
|-------------------------------------------------|----------------------------------|------------------------|--------------------------------------------------------|
| <i>Hyparrhenia hirta</i>                        | (L.) Stapf                       | Coolatai grass         | AF, EC                                                 |
| <i>Imperata cylindrica</i>                      | (L.) Raeuschel                   | Cogongrass             | AF, MP                                                 |
| <i>Juniperus phoenicea</i>                      | L.                               | Phoenician juniper     | AP, IP (cosmetic uses, essential oil), AFFP            |
| <i>Kickxia aegyptiaca</i>                       | (L.) Nábelek                     |                        | AF                                                     |
| <i>Launaea nudicaulis</i>                       | (L.) Hooker fil.                 | Bold-Leaf launaeae     | MP                                                     |
| <i>Lavandula multifida</i>                      | L.                               | Fernleaf lavender      | MP, AP, BP                                             |
| <i>Lawsonia inermis</i>                         | L.                               | Henna                  | MP, IP (henna)                                         |
| <i>Limoniastrum guyonianum</i>                  | Dur. ex Boiss.                   | Limoniastrum           | AF, IS                                                 |
| <i>Limonium lobatum</i>                         | (L. f.) Chaz.                    | Grow Sea lavender      | IS                                                     |
| <i>Limonium pruinosum</i>                       | L.                               | Frosty sea lavender    | IS                                                     |
| <i>Limonium tubiflorum</i>                      | (Del.) O. Kuntze                 |                        | IS                                                     |
| <i>Lonicera etrusca</i>                         | Santi                            | Honeysuckle            | BP, AP, OP                                             |
| <i>Lycium shawii</i>                            | Roem. & Schult.                  | Awsaj                  | MP, SS                                                 |
| <i>Lygeum spartum</i>                           | Loefl. ex L.                     | Lygeum                 | AF                                                     |
| <i>Macrochloa tenacissima</i>                   | (Loefl. ex L.) Kunth             | Esparto grass          | SF, EC, IP (paper)                                     |
| <i>Maireana brevifolia</i>                      | (R.Br.) Paul G.Wilson            | Blue bush              | AF                                                     |
| <i>Marrubium alysson</i>                        | L.                               | White horehound        | MP                                                     |
| <i>Marrubium vulgare</i>                        | L.                               | Horehound              | FAA, BP, OP, MP                                        |
| <i>Matricaria aurea</i>                         | (Loefl.) Sch. Bip.               | Golden chamomile       | MP, AP, IP (cosmetic product, essential oil chamomile) |
| <i>Mesembryanthemum nodiflorum</i>              | L.                               | Senderleaf ice plant   | MP                                                     |
| <i>Moricandia arvensis</i>                      | (L.) DC.                         | Violet cabbage         | MP, HF, OP                                             |
| <i>Myrtus communis</i>                          | L.                               | Common myrtle          | MP, OP, AP, FP                                         |
| <i>Neurada procumbens</i>                       | L.                               | Camel's thorn          | MP, HF (Bedouin)                                       |
| <i>Nicotina glauca</i>                          | R. Graham                        | Tree tobacco           | MP                                                     |
| <i>Nitraria retusa</i>                          | (Forsk.) Asch.                   | Salt tree              | MP, AF                                                 |
| <i>Noaea mucronata</i>                          | (Forsk.) Asch. & Schweinf        |                        | AF, FP, EC                                             |
| <i>Ocimum basilicum</i>                         | L.                               | Sweet basil            | AP, MP, OP, AF, HF (mild flavor in vegetable)          |
| <i>Olea europea</i> var. <i>oleaster</i>        | (Hoffm. & Link) D. C.            | Wild olive             | GS, IP, MP                                             |
| <i>Panicum turgidum</i>                         | Forssk.                          | Harmal shrub           | AF, MP, EC, HF, SF                                     |
| <i>Parkinsonia aculeata</i>                     | L.                               | Jerusalem thorn        | AF, MP, OP, FP, BP                                     |
| <i>Peganum harmala</i>                          | L.                               | Harmal shrub           | MP                                                     |
| <i>Pennisetum ciliare</i>                       | (L.) Link                        | Buffelgrass            | AF                                                     |
| <i>Pennisetum setaceum</i>                      | (Forssk.) Chiov.                 | Fountaingrass          | AF                                                     |
| <i>Pergularia tomentosa</i>                     | L.                               | Baram-milk             | MP                                                     |
| <i>Periploca laevigata</i>                      | Ait.                             | Periploca of the woods | AF, MP, OP                                             |
| <i>Phagnalon rupestre</i>                       | (L.) DC.                         | Rock phagnalon         | MP                                                     |
| <i>Phalaris truncata</i>                        | Guss. ex Bertol.                 | Canary grass           | AF                                                     |
| <i>Phillyrea angustifolia</i>                   | L.                               | False olive            | OP, AP                                                 |
| <i>Phlomis floccosa</i>                         | D. Don                           |                        | MP                                                     |
| <i>Piptatherum miliaceum</i>                    | (L.) Coss.                       | Smilgrass              | AF                                                     |
| <i>Pistacia atlantica</i>                       | Desf.                            | Mount atlas pistache   | AF, FAA, MP, FP, IP (gum)                              |
| <i>Pistacia lentiscus</i>                       | L.                               | Mastic tree            | AF, MP, FP, IP (gum/resin)                             |
| <i>Pituranthos tortuosus</i>                    | (DC.) Benth. ex Asch. & Schweinf |                        | MP                                                     |
| <i>Plantago lanceolata</i>                      | L.                               | Narrow-leaf plantain   | AF, MP                                                 |
| <i>Polygonum equisetiforme</i>                  | Sm.                              | Horse-tail khotweed    | AF, MP                                                 |
| <i>Prosopis juliflora</i>                       | (Sw.) DC.                        | Algaroba               | AF, FP                                                 |
| <i>Reaumuria vermiculata</i>                    | L.                               | Molleih, hong sha shu  | MP (for human and animal)                              |
| <i>Retama raetam</i>                            | (Forsk.) Webb et Benth.          | White broom            | AF, SF, MP, FP                                         |
| <i>Rhamnus lycioides</i> subsp. <i>oleoides</i> | (L.) Jahand. & Maire             | Arçot                  | OP, AF                                                 |
| <i>Rhanterium suaveolens</i>                    | Desf.                            | A'rfej                 | SF                                                     |
| <i>Ricinus communis</i>                         | L.                               | The castor oil plant   | MP, IP (castrol oil), AF                               |
| <i>Rumex pictus</i>                             | Forssk.                          | Dock. hebrew           | MP, HF                                                 |
| <i>Ruta chalepensis</i>                         | L.                               | Aleppo rue             | AF, MP                                                 |
| <i>Salicornia fruticosa</i>                     | (L.) A. J. Scott                 | Glasswort              | IS                                                     |
| <i>Salsola delileana</i>                        | Botsch.                          |                        | AF                                                     |
| <i>Salsola kali</i>                             | L.                               | Prickly saltwort       | AF                                                     |
| <i>Salsola longifolia</i>                       | Forssk.                          |                        | AF                                                     |
| <i>Salsola tetragona</i>                        | Del.                             |                        | AF, FP                                                 |
| <i>Salsola tetrandra</i>                        | Del.                             |                        | AF, FP, IS                                             |
| <i>Salvia fruticosa</i>                         | Mill.                            | Greek sage             | AP, MP, IP (essential oil), HF                         |
| <i>Sarcopoterium spinosum</i>                   | (L.) Spach                       | Thorny burnet          | MP, HP, FP                                             |
| <i>Satureja thymbra</i>                         | L.                               | Pink savory            | MP, AP, BP                                             |
| <i>Scirpus littoralis</i>                       | Schrad.                          | Three-square bulrush   | AF, IS                                                 |
| <i>Scrophularia canina</i>                      | L.                               | French figwort         | MP                                                     |
| <i>Searsia tripartita</i>                       | (Ucria) Moffett.                 | Sumac                  | AF, IP (tanning), HF, FP                               |
| <i>Simmondsia chinensis</i>                     | (Link) Scheneider                | Jojoba                 | MP, FP                                                 |
| <i>Spartium junceum</i>                         | L.                               | Spanish broom          | AF, MP, AP, BP, OP                                     |
| <i>Stipa legascae</i>                           | Roem. & Schult.                  | Feather grass          | AF, SF                                                 |

**Table 2:** Continue

|                             |                        |                         |                                      |
|-----------------------------|------------------------|-------------------------|--------------------------------------|
| <i>Stipagrostis plumosa</i> | (Linn.) Munro          | Desert grass            | AF                                   |
| <i>Stipagrostis pungens</i> | (Desf.) De Winter      | Three-awn grass         | SF, IP (tent, basket, carpet, shoes) |
| <i>Suaeda</i> sp.           |                        |                         | IS                                   |
| <i>Suaeda vera</i>          | Forssk. ex JF Gmel.    | Sweida                  | IS                                   |
| <i>Suaeda pruinosa</i>      | Lange.                 | Risultati della ricerca | IS                                   |
| <i>Suaeda vermiculata</i>   | Forssk.                | Sea-blight              | IS                                   |
| <i>Tamarix boveana</i>      | Bunge                  | Tamarix alacanti        | SF, HP, AF                           |
| <i>Tamarix</i> sp.          |                        | Tamarix                 | SF, HP, AF                           |
| <i>Tetraena alba</i>        | (L. f.) Beier & Thulin | Syrian bean caper       | MP, IP (medicinal soap), IS          |
| <i>Teucrium polium</i>      | L.                     | Felty germander         | AF, MP, EC, AP, BP                   |
| <i>Thymelea hirsuta</i>     | (L.) Endl.             | Hairy thymelaea         | SF, MP, IP (fiber)                   |
| <i>Thymus capitatus</i>     | (L.) Hoffmanns. & Link | Conehead-thyme          | AF, MP, HF, BP, EC                   |
| <i>Traganum nudatum</i>     | Del.                   |                         | FP, IS                               |
| <i>Trifolium repens</i>     | L.                     | White clover            | AF, ISF                              |
| <i>Typha domingensis</i>    | Pers.                  | Narrow-leaved Cumbungi  | OP, MP, HF, IP                       |
| <i>Viburnum tinus</i>       | L.                     | Laurustinus viburnum    | HP                                   |
| <i>Ziziphus lotus</i>       | (L.) Desf.             | Lotus jujube            | AF, MP, BP, HF (acid drink)          |

Abbreviations:

|                      |                       |                              |                                 |
|----------------------|-----------------------|------------------------------|---------------------------------|
| AF = Animal Feed     | OP = Ornamental Plant | SHP = Shade Plant            | SF = Sand Fixation              |
| HF = Human Food      | BP = Bee Plant        | IR = Insect Repellent        | WB = Wind Break                 |
| MP = Medicinal Plant | EC = Erosion Control  | AFFP = Afforestation         | FAA = Food Additives            |
| FP = Fuel Plant      | IP = Industry Plant   | ISF = Improve Soil Fertility | IS = Indicator of Soil Salinity |
| AP = Aromatic Plant  | HP = Hedge Plant      | SS = Soil Stabilization      | GS = Graft Stock                |

**Table 3:** List of plant communities per geomorphological zones

| Geomorphological zones | Plant communities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Forest                 | <i>Juniperus phoenicea</i> and <i>Pistacia lentiscus</i><br><i>Juniperus phoenicea</i><br><i>Searsia tripartita</i> and <i>Periploca laevigata</i><br><i>Arbutus pavarii</i><br><i>Ceratonia siliqua</i> and <i>Pistacia lentiscus</i><br><i>Arbutus pavarii</i> and <i>Juniperus phoenicea</i><br><i>Sarcopoterium spinosum</i> and <i>Pinus halepensis</i>                                                                                                                                                                                                                                             |
| Valleys (wadis)        | <i>Juniperus phoenicea</i> and <i>Pistacia lentiscus</i><br><i>Atriplex nummularia</i> and <i>Suaeda vera</i><br><i>Ziziphus lotus</i><br><i>Capparis spinosa</i> and <i>Nicotina glauca</i><br><i>Acacia farnesiana</i> and <i>Acacia victoriae</i><br><i>Retama raetam</i> and <i>Imperata cylindrica</i>                                                                                                                                                                                                                                                                                              |
| Rangelands             | <i>Atriplex nummularia</i> and <i>Periploca laevigata</i><br><i>Acacia victoriae</i><br><i>Macrochloa tenacissima</i> and <i>Pistacia lentiscus</i><br><i>Aeluropus lagopoides</i> and <i>Pituranthos tortuosus</i><br><i>Atriplex halimus</i><br><i>Retama raetam</i><br><i>Haloxylon salicornicum</i><br><i>Haloxylon articulatum</i> and <i>Lavandula multifida</i><br><i>Artemisia herba-alba</i> and <i>Ziziphus lotus</i><br><i>Ziziphus lotus</i> and <i>Lycium shawii</i><br><i>Thymelea hirsuta</i> and <i>Atriplex halimus</i><br><i>Haloxylon salicornicum</i><br><i>Stipagrostis pungens</i> |
| Sabkha                 | <i>Retama raetam</i><br><i>Aeluropus lagopoides</i> and <i>Pituranthos tortuosus</i><br><i>Thymelea hirsuta</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Sand dunes             | <i>Retama raetam</i> and <i>Ziziphus lotus</i><br><i>Retama raetam</i> and <i>Panicum turgidum</i><br><i>Artemisia campestre</i> and <i>Stipagrostis pungens</i>                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Road sides             | <i>Acacia Karroo</i><br><i>Atriplex halimus</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Sea sides              | <i>Pistacia lentiscus</i> and <i>Euphorbia dendroides</i><br><i>Chenopodium murale</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

throughout the world as home remedies, over the counter drug products and raw materials for pharmaceutical industries. For instance, trees such as pods and roots of *Acacia tortilis* are used to treat skin infections, allergic dermatomes, and as a vermifuge; *Parkinsonia aculeata* is used as an antipyretic and to treat diabetics; pods of *Ceratonia*

*siliqua* are used as a laxative and have demulcent qualities. Leaves and flowering tops of *Coridothymus capitatus* are used as a bronchoantispasmodic and to treat asthma. Other herbs, such as *Datura inoxia*, are used as antispasmodics, narcotics, and hypnotics. Seeds of *Citrullus colocynthis* induce abortion, and are used as

**Table 4:** Number of species of the most dominant families sound during the collection missions of Mediterranean coast of Libya during the spring and summer of 2009 and 2010

| Family         | Species | %  |
|----------------|---------|----|
| Chenopodiaceae | 31      | 20 |
| Fabaceae       | 19      | 13 |
| Poaceae        | 15      | 10 |
| Lamiaceae      | 9       | 6  |
| Asteraceae     | 8       | 5  |
| Zygophyllaceae | 4       | 3  |
| Plumbaginaceae | 4       | 3  |

**Table 5:** Number of collection sites and species per geographic area.

| Geographic area | Sites | Species | Medicinal species |
|-----------------|-------|---------|-------------------|
| Eastern area    | 48    | 76      | 44                |
| Western area    | 30    | 65      | 33                |
| Middle area     | 1     | 10      | 1                 |
| Total           | 79    | 151     | 78                |

**Table 6:** Number of species in each life form for all species collected during the collection missions of Mediterranean coast of Libya during the spring and summer of 2009 and 2010

| Life form                 | Number of species | %   |
|---------------------------|-------------------|-----|
| Trees                     | 24                | 16  |
| Phanerophyte (shrubs)     | 55                | 36  |
| Chamaephyte (semi-shrubs) | 11                | 7   |
| Annual shrubs             | 4                 | 3   |
| Perennial forbs           | 24                | 16  |
| Perennial grasses         | 17                | 11  |
| Biennial forbs            | 2                 | 1   |
| Therophyte (annual forbs) | 11                | 8   |
| Climbers                  | 3                 | 2   |
| Total                     | 151               | 100 |

**Table 7.** Economic uses of the major collected species in Libya.

| Species                     | Animal feed | Human food | Medicinal | Fuel | Bee forage | Aromatic | Ornamental | Erosion control | Dune fixation | Hedge | Shade | Afforestation | Soil improver | Food additive | Industrial uses |
|-----------------------------|-------------|------------|-----------|------|------------|----------|------------|-----------------|---------------|-------|-------|---------------|---------------|---------------|-----------------|
| <i>Acacia cyclops</i>       | ✓           |            | ✓         | ✓    |            |          |            | ✓               | ✓             |       |       |               | ✓             |               |                 |
| <i>Acacia farnesiana</i>    | ✓           |            |           | ✓    | ✓          |          | ✓          | ✓               | ✓             |       |       |               | ✓             | ✓             | ✓               |
| <i>Acacia victoriae</i>     | ✓           |            | ✓         | ✓    |            |          |            | ✓               |               |       |       |               | ✓             | ✓             | ✓               |
| <i>Balanites aegyptiaca</i> | ✓           | ✓          | ✓         | ✓    |            |          |            | ✓               | ✓             |       |       |               |               |               |                 |
| <i>Capparis spinosa</i>     | ✓           |            | ✓         |      | ✓          |          |            |                 |               |       |       |               |               | ✓             | ✓               |
| <i>Ceratoniasiliqua</i>     | ✓           | ✓          | ✓         | ✓    |            |          | ✓          |                 |               |       | ✓     |               |               | ✓             | ✓               |
| <i>Parkinsonia aculeata</i> | ✓           | ✓          | ✓         | ✓    | ✓          |          | ✓          | ✓               |               |       |       |               |               |               |                 |
| <i>Prosopis juliflora</i>   | ✓           |            | ✓         | ✓    | ✓          |          |            | ✓               | ✓             |       | ✓     | ✓             |               |               | ✓               |
| <i>Searsia tripartita</i>   | ✓           | ✓          | ✓         | ✓    |            | ✓        |            |                 |               |       |       |               |               | ✓             | ✓               |
| <i>Spartium junceum</i>     |             |            | ✓         |      | ✓          |          | ✓          | ✓               |               |       |       | ✓             |               | ✓             | ✓               |
| <i>Ziziphus lotus</i>       | ✓           |            | ✓         | ✓    | ✓          |          |            | ✓               |               | ✓     |       |               |               | ✓             |                 |

**Table 8:** List of medicinal plants collected from Mediterranean coast of Libya during the spring and summer of 2009 and 2010

| Scientific name              | Author                 | Family         | Life-form      |
|------------------------------|------------------------|----------------|----------------|
| <i>Acacia farnesiana</i>     | (L.) Willd.            | Fabaceae       | Tree           |
| <i>Acacia nilotica</i>       | (L.) Delile            | Fabaceae       | Tree           |
| <i>Acacia salign</i>         | (Labill.) H. L. Wendl. | Fabaceae       | Tree           |
| <i>Acacia tortilis</i>       | (Forssk.) Hayne        | Fabaceae       | Tree           |
| <i>Alcea rosea</i>           | L.                     | Malvaceae      | Biennial forb  |
| <i>Amaranthus hybridus</i>   | L. Engl                | Amaranthaceae  | Therophyte     |
| <i>Anabasis articulata</i>   | (Forssk.) Moq.         | Chenopodiaceae | Phanerophyte   |
| <i>Anvillea garcini</i>      | (Burm.f.) DC.          | Asteraceae     | Perennial forb |
| <i>Arbutus pavarrii</i>      | Pamp.                  | Ericaceae      | Tree           |
| <i>Argania spinosa</i>       | (L.) Skeels.           | Sapotaceae     | Tree           |
| <i>Arnebia tetraginta</i>    | Forssk.                | Boraginaceae   | Perennial forb |
| <i>Artemisia herba-alba</i>  | Asso                   | Asteraceae     | Phanerophyte   |
| <i>Asparagus aphyllus</i>    | L.                     | Asparagaceae   | Climber        |
| <i>Asparagus stipularis</i>  | Forssk.                | Asparagaceae   | Phanerophyte   |
| <i>Balanites aegyptiaca</i>  | (L.) Del.              | Balanitaceae   | Tree           |
| <i>Calligonum arich</i>      | Le Houér.              | Polygonaceae   | Phanerophyte   |
| <i>Calligonum comosum</i>    | L'Hér.                 | Polygonaceae   | Phanerophyte   |
| <i>Capparis spinosa</i>      | L.                     | Capparaceae    | Phanerophyte   |
| <i>Carthamus lanatus</i>     | L.                     | Asteraceae     | Perennial forb |
| <i>Ceratoniasiliqua</i>      | L.                     | Fabaceae       | Tree           |
| <i>Chenopodium murale</i>    | L.                     | Chenopodiaceae | Therophyte     |
| <i>Citrullus colocynthis</i> | (L.) Schrader          | Cucurbitaceae  | Perennial forb |
| <i>Cleome arabica</i>        | L.                     | Capparaceae    | Perennial forb |
| <i>Cyperus rotundus</i>      | L.                     | Cyperaceae     | Perennial forb |
| <i>Datura innoxia</i>        | Mill.                  | Solanaceae     | Therophyte     |
| <i>Deverra tortuosa</i>      | (Desf.) DC.            | Apiaceae       | Phanerophyte   |

**Table 8:** Continue

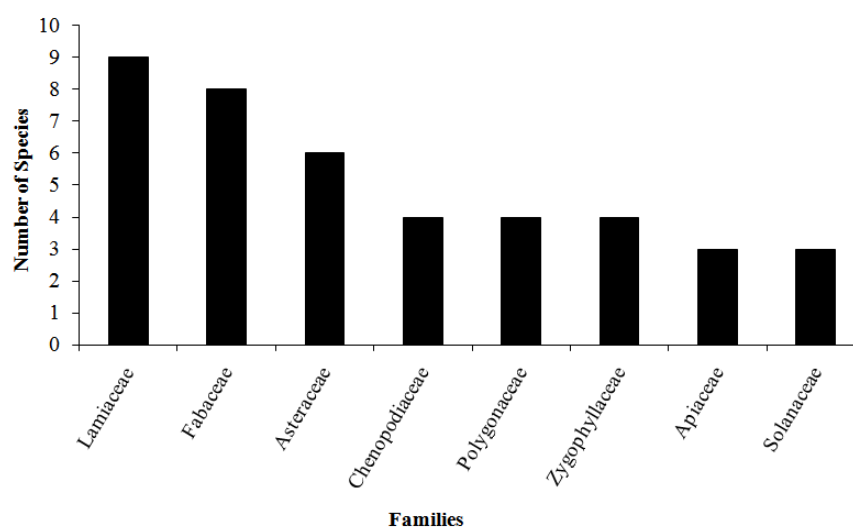
|                                          |                                   |                  |                 |
|------------------------------------------|-----------------------------------|------------------|-----------------|
| <i>Ecballium elaterium</i>               | (L.) A. Rich.                     | Cucurbitaceae    | Perennial forb  |
| <i>Enchylaena tomentosa</i>              | R.Br.                             | Chenopodiaceae   | Phanerophyte    |
| <i>Ephedra alata</i>                     | Decne.                            | Ephedraceae      | Phanerophyte    |
| <i>Eryngium campestre</i>                | L.                                | Apiaceae         | Perennial forb  |
| <i>Fagonia microphylla</i>               | Pomel                             | Zygophyllaceae   | Chamaephyte     |
| <i>Globularia alypum</i>                 | L.                                | Globulariaceae   | Perennial forb  |
| <i>Halocnemum strobilaceum</i>           | (Pall.) M. Bieb.                  | Chenopodiaceae   | Phanerophyte    |
| <i>Haplophyllum tuberculatum</i>         | (Forsk.) Juss.                    | Rutaceae         | Perennial forb  |
| <i>Launaea nudicaulis</i>                | (L.) Hooker fil.                  | Asteraceae       | Perennial forb  |
| <i>Lavandula multifida</i>               | L.                                | Lamiaceae        | Phanerophyte    |
| <i>Lawsonia inermis</i>                  | L.                                | Lythraceae       | Tree            |
| <i>Lycium shawii</i>                     | Roem. & Schult.                   | Solanaceae       | Phanerophyte    |
| <i>Marrubium alysson</i>                 | L.                                | Lamiaceae        | Perennial forb  |
| <i>Marrubium vulgare</i>                 | L.                                | Lamiaceae        | Perennial forb  |
| <i>Matricaria aurea</i>                  | (Loefl.) Sch. Bip.                | Asteraceae       | Therophyte      |
| <i>Mesembryanthemum nodiflorum</i>       | L.                                | Aizoaceae        | Therophyte      |
| <i>Moricandia arvensis</i>               | (L.) DC.                          | Brassicaceae     | Chamaephyte     |
| <i>Myrtus communis</i>                   | L.                                | Myrtaceae        | Tree            |
| <i>Neurada procumbens</i>                | L.                                | Neuradaceae      | Therophyte      |
| <i>Nicotina glauca</i>                   | R. Graham                         | Solanaceae       | Phanerophyte    |
| <i>Nitraria retusa</i>                   | (Forsk.) Asch.                    | Zygophyllaceae   | Phanerophyte    |
| <i>Ocimum basilicum</i>                  | L.                                | Lamiaceae        | Therophyte      |
| <i>Olea europea</i> var. <i>oleaster</i> | (Hoffm. & Link) D. C              | Oleaceae         | Phanerophyte    |
| <i>Panicum turgidum</i>                  | Forssk.                           | Poaceae          | Perennial grass |
| <i>Parkinsonia aculeata</i>              | L.                                | Fabaceae         | Tree            |
| <i>Peganum harmala</i>                   | L.                                | Zygophyllaceae   | Perennial forb  |
| <i>Pergularia tomentosa</i>              | L.                                | Asclepiadaceae   | Climber         |
| <i>Periploca laevigata</i>               | Ait.                              | Asclepiadaceae   | Phanerophyte    |
| <i>Phagnalon rupestre</i>                | (L.) DC.                          | Asteraceae       | Chamaephyte     |
| <i>Phlomis floccosa</i>                  | D. Don                            | Lamiaceae        | Perennial forb  |
| <i>Pistacia atlantica</i>                | Desf.                             | Anacardiaceae    | Tree            |
| <i>Pistacia lentiscus</i>                | L.                                | Anacardiaceae    | Tree            |
| <i>Pituranthos tortuosus</i>             | (DC.) Benth. ex Asch. & Schweinf. | Apiaceae         | Chamaephyte     |
| <i>Plantago lanceolata</i>               | L.                                | Plantaginaceae   | Perennial forb  |
| <i>Polygonum equisetiforme</i>           | Sm.                               | Polygonaceae     | Perennial forb  |
| <i>Reaumuria vermiculata</i>             | L.                                | Tamaricaceae     | Chamaephyte     |
| <i>Retama raetam</i>                     | (Forsk.) Webb et Benth.           | Fabaceae         | Phanerophyte    |
| <i>Ricinus communis</i>                  | L.                                | Euphorbiaceae    | Annual shrub    |
| <i>Rumex pictus</i>                      | Forssk.                           | Polygonaceae     | Therophyte      |
| <i>Ruta chalepensis</i>                  | L.                                | Rutaceae         | Perennial forb  |
| <i>Salvia fruticosa</i>                  | Mill.                             | Lamiaceae        | Perennial forb  |
| <i>Sarcopoterium spinosum</i>            | (L.) Spach                        | Rosaceae         | Phanerophyte    |
| <i>Satureja thymbra</i>                  | L.                                | Lamiaceae        | Chamaephyte     |
| <i>Scrophularia canina</i>               | L.                                | Scrophulariaceae | Chamaephyte     |
| <i>Simmondsia chinensis</i>              | (Link) Scheneider                 | Simmondsiaceae   | Phanerophyte    |
| <i>Spartium junceum</i>                  | L.                                | Fabaceae         | Phanerophyte    |
| <i>Tetraena alba</i>                     | (L. f.) Beier & Thulin            | Zygophyllaceae   | Phanerophyte    |
| <i>Teucrium polium</i>                   | L.                                | Lamiaceae        | Chamaephyte     |
| <i>Thymelea hirsuta</i>                  | (L.) Endl.                        | Thymelaeaceae    | Phanerophyte    |
| <i>Thymus capitatus</i>                  | (L.) Hoffmanns. & Link            | Lamiaceae        | Phanerophyte    |
| <i>Typha domingensis</i>                 | Pers.                             | Typhaceae        | Perennial grass |
| <i>Ziziphus lotus</i>                    | (L.) Desf.                        | Rhamanaceae      | Phanerophyte    |

a laxative and a vermifuge. Leaves and flowers of *Marrubium alysson* are used for colds, coughs, and asthma. Seventy-eight species with medicinal benefits were found across the Libyan Mediterranean Coast (Table 8). As was previously reported, such medicinal plants have important commercial value as they represent a key source of income for many rural households. Yet, despite their significance, this sector remains marginal and traditional, characterized by a limited number of cultivated species. In light of the encroachment of desertification as well as limited water resources, developing the cultivation of medicinal plants rather than water-demanding crops will contribute to the better management of limited natural resources. Indeed, indigenous medicinal plants are better adapted to the local environment,

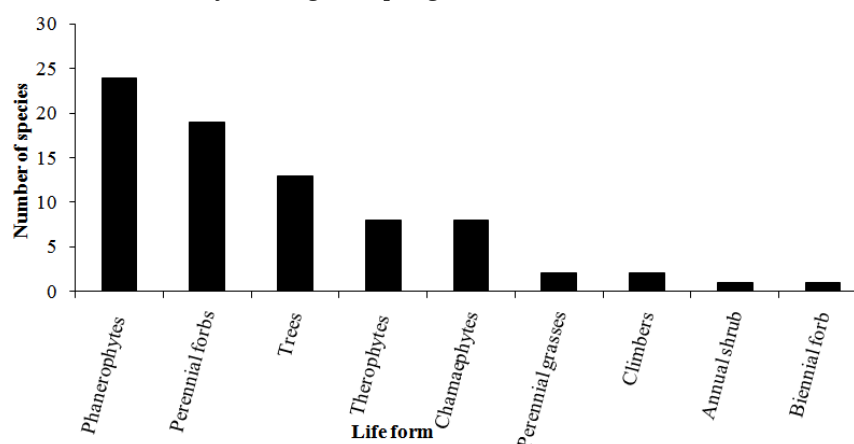
even under stressful conditions.

Among the medicinal plants, the Lamiaceae, Fabaceae, and Asteraceae families were the most prevalent, accounting for 12, 10, and 8 %, respectively, of the total (Figure 3). With regard to the biological spectrum for the visited sites, data indicated that Phanerophytes (shrubs) and perennial forbs were the most dominant life-form type, representing more than 55 % of all species encountered during the collection missions (Figure 4).

Major medicinal plants were organized into three classes depending on their families, life form, used parts, and types of uses (Boukef, 1986; El-Darier and El-Mogaspi, 2009). The medicinal uses of different plant species are given in Table 9.



**Fig. 3:** Number of species encountered for the main families found during the collection missions of Mediterranean coast of Libya during the spring and summer of 2009 and 2010



**Fig. 4:** Number of species sorted based on life-form during the collection missions in 2009 and 2010 in the Mediterranean coast of Libya

**Table 9:** Plant part used and medicinal uses of the major medicinal plants recorded during the collection missions in Libya

| Species                            | Part used                       | Medicinal use                                            |
|------------------------------------|---------------------------------|----------------------------------------------------------|
| <i>Acacia tortilis</i>             | Pods and roots                  | Treat skin infections, allergic dermatomes               |
| <i>Parkinsonia aculeata</i>        | Aerial parts                    | Antipyretic and to treat diabetics                       |
| <i>Ceratonia siliqua</i>           | Pods                            | Laxative and have demulcent qualities                    |
| <i>Argania spinosa</i>             | Oil of seeds                    | lowers blood pressure                                    |
| <i>Periploca laevigata</i>         | The root powder                 | Treat dyspepsia, constipation and hepalsplenomegales     |
| <i>Thymus capitatus</i>            | Leaves and flowering tops       | Bronchoantispasmodic and to treat asthma                 |
| <i>Searsia tripartita</i>          | Seeds                           | Stomach disease                                          |
| <i>Ruta chalepensis</i>            | Aerial parts                    | Anti-inflammatory, antipyretic, analgesic                |
| <i>Deverra tortuosa</i>            | Leaves, roots and stem extracts | Potential nutritional and antifungal uses                |
| <i>Halocnemum strobilaceum</i>     | Oil of seeds                    | Applied on head for hair loss                            |
| <i>Sarcopoterium spinosum</i>      | Roots                           | Treat stomachaches, toothache, gingivitis, oligouria     |
| <i>Tetraena alba</i>               | Plant extracts                  | Therapeutic use; Wounds healing, dental caries, diabetes |
| <i>Lavandula multifida</i>         | Oil from flower                 | Antiseptic and aromatherapy                              |
| <i>Datura inoxia</i>               | All parts of plants             | Antispasmodic, narcotic and hypnotic                     |
| <i>Citrullus colocynthis</i>       | incite abortion                 | Laxative and vermifuge                                   |
| <i>Marrubium alysson</i>           | Leaves and flowers              | Used against colds, coughs and asthma                    |
| <i>Carthamus lanatus</i>           | Aerial parts                    | Anti-inflammatory and analgesic effect                   |
| <i>Cleome arabica</i>              | Leaves                          | Arthritis, rheumatism                                    |
| <i>Mesembryanthemum nodiflorum</i> | Seeds                           | Antipoetic                                               |
| <i>Typha domingensis</i>           | Rootstocks                      | Used as a diuretic for increasing urination              |
| <i>Rumex pictus</i>                | Roots, stem, fruits, leaves     | Sedative, spasmogenic                                    |

# Conclusion and Recommendations

This initial assessment of the status of medicinal plants has confirmed the vast richness of the plant biodiversity of Libya, which furnishes an incredible array of traditional uses with high economic potential. From an ecological point of view, medicinal plants are well adapted to dry conditions, consume less water than most crops, and offer considerably higher returns. If effectively developed, the industry could substantially improve the livelihoods of a large number of the rural poor. The diagnostic assessment of the current medicinal plants sector in Libya revealed several deficiencies, however, and to promote this sector the following recommendations are offered for the consideration of those parties involved, either directly or indirectly, in the production and commercialization of medicinal plants in Libya:

Establish a national strategy for the promotion of medicinal plants in Libya.

Support the conservation, management, and sustainable utilization of medicinal plants in Libya through conservation, cultivation, and propagation.

Promote *in situ* conservation of precious genetic resources that are threatened by human encroachment and climate change.

Compile a national database on indigenous medicinal plants in order to assess their use, status, and means of cultivation.

Promote the domestication and cultivation of new medicinal plants to help reduce the over-exploitation of plant biodiversity in natural habitats.

Establish extension programs on the importance and conservation of medicinal plants for rural people.

Develop a clear policy for the protection, production, transportation, and marketing of raw medicinal plant materials that is sensitive to the needs of the rural poor, who depend upon such natural resources for income.

Improve public awareness of the importance of medicinal plants, and build on traditional knowledge and cultural heritage.

Establish or strengthen market linkages for small farmers by working with small and medium sized-enterprises, traders, and other market intermediaries involved in medicinal plants.

Conduct value-chain analyses of medicinal plants so as to understand constraints along the chain and thereby identify opportunities for value-added benefits to small growers as well as the capacity-building needs; investment gaps; and policy, institutional, and marketing issues that must be addressed.

# Acknowledgments

The authors greatly appreciate the support of the Libyan government in funding this research, along with the invaluable assistance and cooperation provided by the Agricultural Research Center, the Libyan genebank in Tripoli, and many colleagues and

friends.

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