

## ECOLOGICAL AND FLORISTIC STUDY ON THE MEDICINAL PLANTS IN AL-QASSIM REGION, SAUDI ARABIA

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### Abstract

Folk medicine is used in many countries. Arab countries, especially the Arabian Peninsula, are famous for using folk medicine. In local communities, traditional and folk medicine relies on plants that have medicinal properties. In Al-Qassim, Saudi Arabia 61 species of medicinal plants have been listed. The number of plant species recorded in Al-Qassim region is 24, 32, 45, 27 and 35 species in the central, northern, southern, eastern and western, respectively. Some listed plants are used to treat digestive diseases, blood diseases, bone and joint diseases, eye diseases, obstetrics & gynecology, oral & dental diseases, respiratory system diseases, skin diseases or urinary system diseases. Asteraceae is the most frequent plant families. Whole plant is the most common used part of medicinal plants. While, the largest number of recorded species is perennials. Biodiversity indicators were calculated, and many soil factors were analyzed (sand, silt, clay, pH, organic matter, nitrogen, phosphorus, potassium, chlorides, sodium, calcium, magnesium content and electrical conductivity). For processing and organizing data, multivariate statistical analyzes (TWINSPAN and DCA) were used.

**Key words:** Medicinal plants, Al-Qassim, Saudi Arabia

### Introduction

Medicinal plants can be used to treat a specific disease and their parts contain active substances that can be used in the pharmaceutical industry (Anon., 1976). Medicinal plants contain many active substances, such as carotenoids, glycosides, flavonoids, alkaloids and terpenoids. These materials are used directly to treat specific diseases or are extracted to make medicines (Malviya *et al.*, 2010). Throughout history, medicinal plants have been and still are the first and primary source for the discovery and development of medicines (Newman *et al.*, 2000).

In many countries of the world, medicinal plants are used to treat many diseases in traditional and folk medicine, which plays a very important role in treating many diseases besides modern medicine. More than 80% of medicines in the mid-nineteenth century were derived from medicinal plants (Gilani & Atta-ur-Rahman, 2005). More than 30% of the existing plants can be used for medicinal purposes (Siddiqui *et al.*, 2017). About 52,000 plant species can be used as medicinal plants (Anon., 2003). Medicines extracted from medicinal plants have many advantages, such as low cost, high efficacy, and no serious side effects (Odhav *et al.*, 2010).

Many medicinal plants are exposed to many dangers as a result of wrong practices such as unjust cutting of medicinal plants with the aim of using them in treating diseases as well as destroying the environments in which these plants are present. Despite the great importance of medicinal plants and the tendency of most countries of the world to benefit from these plants, there are not enough studies on these plants. Many medicinal plants are already extinct and others are threatened with extinction (Batanouny *et al.*, 1999). In this context, permanent encroachment on natural habitats and their transformation into agricultural lands has resulted in severe damage to many medicinal plants (Fakhry *et al.*, 2017).

In developing countries, folk medicine uses more than 75% of the total population, where they prefer treatment with medicinal plants safer than modern medicine (Anon., 2001 & Al-Arifi, 2013). Only folk medicine can be relied upon to treat many ailments. On the other side, folk medicine can also be used with modern medicine to treat other diseases. It should be noted that the use of folk medicine should be under the supervision of specialists in the treatment of diseases.

The Arab countries, especially the Arabian Peninsula, are considered the source of folk medicine (Hasan *et al.*, 2000). Arab countries are famous for using many plants in traditional and folk medicine. But recently many countries of the world use medicinal plants to treat many diseases. For example, from 1959 to 1980 in the United States of America, approximately twenty five percent of plant extracts are used in the pharmaceutical industry (Anon., 1993).

Saudi Arabia possesses many ingredients, which makes it the richest country in the Arabian Peninsula in plant biodiversity. Flora of Saudi Arabia contains 721 endangered species, 147 endemic species and 22 extinct species. The floristic composition in Saudi Arabia is a mixture of Mediterranean, Asia and Africa region (Collenette, 1999; Rahman *et al.*, 2004). More than 2500 plant species found in Saudi Arabia, many of which were used in the past to treat many diseases in folk medicine and many local communities inside Saudi Arabia still use these plants to treat many diseases (Abulafatih, 1987; Al-Essa *et al.*, 1998; Rahman *et al.*, 2004; Fakhry, 2016; Migahid, 1978). Many medicinal plants used in traditional and folk medicine in Saudi Arabia are endemic plants (Rahman *et al.*, 2004; Gushash, 2006). As well as, there are about 600 plant species (27% of all plants) that are used in the treatment of many diseases in traditional medicine in Saudi Arabia (Gushash, 2006).

Despite advances in health care and the presence of hospitals, many communities in Saudi Arabia still use folk

medicine to treat many diseases (Ahmed, 2015; Asmari *et al.*, 2017). Saudi citizens use medicinal plants to treat acute cases by 70% and to treat chronic diseases by up to 20% (Alanzi *et al.*, 2016). Previous studies conducted on medicinal plants in Saudi Arabia were partial and fragmented, and there are not enough detailed studies on medicinal plants in Saudi Arabia (Akbar & Al-Yahya 2011; AwadhAli *et al.*, 2017; Fakhry *et al.*, 2017; Nadi, 2017; Abdel-Kader *et al.*, 2018; Al Zandi *et al.*, 2019; Alshehri *et al.*, 2019; Fadlelmula *et al.*, 2019; Alqethami *et al.*, 2020; Al Nasr, 2020 a and b; Al-Wahaibi *et al.*, 2020). Many studies, in field and *In vitro*, can be done on medicinal plants. Many of them can also be cultivated on a large scale after conducting extensive studies on it.

This study aimed to conduct an ecological and floristic study on medicinal plants in Al-Qassim region, Saudi Arabia.

**Study area:** Al-Qassim Region is one of the thirteen administrative regions designated by the Saudi regions system. Buraidah is the headquarters of Al-Qassim. Its area is approximately 73,000 Km<sup>2</sup> (3.7% of the total area of Saudi Arabia). Al-Qassim is located in the middle of north Saudi Arabia, on the caravan road from Makkah to Mesopotamia. It is bordered on the north and northwest by the Hail region, on the east by the eastern region, on the south by the Riyadh region, on the west by the Medina and Hail region. The Qassim is between Latitude 24.416660308838 & 27.25 and longitude 41.5 & 44.75. The elevation above sea level is approximately 740 meters (Fig. 1). Al-Qassim is the central part of Saharo-Arabian region (Al-Nafie, 2008).

## Materials and Methods

In Al-Qassim, Saudi Arabia 5 stands (western, eastern, southern, northern and central) were chosen to assess the environmental status in the period from 1.1.2020 to 1.7.2020. In each stand forty quadrates have been selected, each quadrate with an area 10\*10 meter. The required field data were noted. As well as, collecting soil samples and then analyzing them.

The initial definition of plant species was done in the field, and the definition of plant samples was confirmed according to Täckholm (1974); Migahid (1978); Chaudhary & Akram (1987); Collentette (1999); Chaudhary (2001) & Al-Hassan (2006). Life forms of species were noted depending on Raunkiaer (1934) & Govaerts *et al.*, (2000).

In the 20 studied stands 15 soil factors were gauged; moisture content (%). pH, sodium (mg/L), potassium (mg/L), phosphorus (mg/L), bicarbonates (%), chlorides (mg/L), calcium (mg/L), magnesium (mg/L), nitrogen (%), electrical conductivity (EC; mS/cm) and total dissolved salts (ppm) in soil extract, on the other side, carbonates (%), organic carbon (%) and organic matter (%) were gauged, in dried soil. All soil factors were measured after Estefan *et al.*, (2013). Descriptive statistics (average, minimum and maximum) of all soil factors were extracted from Sigmaplot 12.5 program, Beirut, Lebanon: International Center for Agricultural

Research in the Dry Areas (ICARDA) (<https://hdl.handle.net/20.500.11766/7512>).

Biological diversity indicators (species richness, species diversity and species evenness), Two Way Indicator Species Analysis (TWINSPAN) and Detrended Correspondence Analysis (DCA) were extracted from PC-ORD program, Oregon, USA (McCune & Mefford, 1999) (<https://ci.nii.ac.jp/naid/10015646513/>).

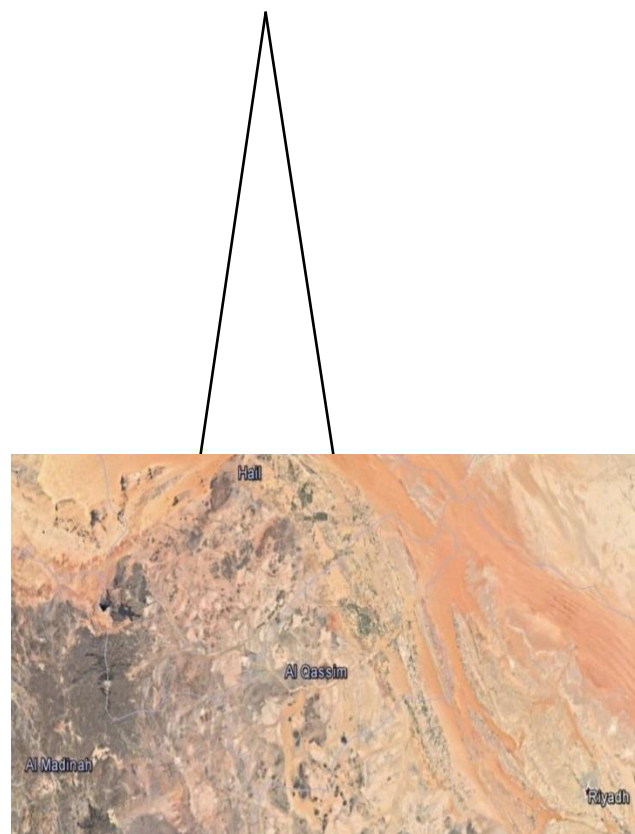
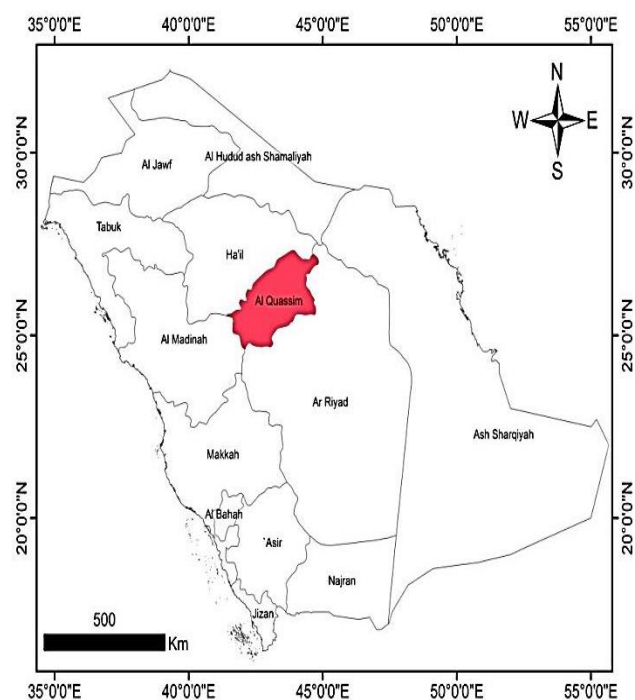


Fig 1. Map of Saudi Arabia display Al-Qassim Region. Source: Arc GIS and Google earth program.

Table 1. List of species and their plant families, life cycle, vegetation type, life cycle, medical usage and parts used in AQassim.

Species	Family	Life cycle	Vegetation type	Life form	Medical usage	Parts used
<i>Blepharis edulis</i> (Forssk.) Pers.	Acanthaceae	Herb	P.	Ch.	Asthma, Lungs, Throat, Cough, Toothache, Wounds and Vitiligo	Whole plant
<i>Adiantum capillus-veneris</i> L.	Adiantaceae	Herb	P.	He.	Cough	Leaves
<i>Aerva javanica</i> (Burm.f.) Juss. ex Schult.	Amaranthaceae	Herb	P.	Ch.	Cough and Tooth ache	Leaves and Stems
<i>Artemisia judaica</i> L.		Shrub	P.	Ch.	Anthelmintic and Carminative	Leaves and Flowers
<i>Artemisia monosperma</i> Delile		Shrub	P.	Ch.	Cold	Boiled leaves
<i>Artemisia sieberi</i> Bsser.		Shrub	P.	Ch.	Carminative, Colic, Liver failure and Anthelmintic	Whole plant
<i>Echinops spinosissimus</i> Turra		Herb	P.	He.	Sore throat and Splenic diseases	Whole plant
<i>Lactuca saligna</i> L.	Asteraceae	Herb	A.	Th.	Lungs	Whole plant
<i>Picris abyssinica</i> Sch.Bip		Herb	P.	Ch.	Dermatitis	Leaves
<i>Pulicaria undulata</i> (L.) C.A.Mey.		Shrub	P.	Ch.	Skin diseases	Leaves
<i>Rhanterium epapposum</i> Oliv.		Shrub	P.	Ch.	Respiratory system, Constipation and Laxative	Leaves
<i>Sonchus oleraceus</i> L.		Herb	A.	Th.	Anthelminticand Sores	Leaves and Flowers
<i>Amebia hispidissima</i> (Lehm.)DC.	Boraginaceae	Herb	A.	Th.	Throat and Eczema	Whole plant
<i>Anastatica hierochuntica</i> L.		Herb	A.	Th.	Facilitating birth and Purgative	Whole plant
<i>Eruca sativa</i> Mill.	Brassicaceae	Herb	A.	Th.	Ringworm	Seeds
<i>Farsetia aegyptia</i> Turra.		Herb	P.	Ch.	Rheumatism	Whole plant
<i>Lepidium aucheri</i> Boiss.		Herb	A.	Th.	Cough and Asthma	Whole plant
<i>Cassia italic</i> Mill.	Caesalpiniaceae	Shrub	P.	He.	Laxative and Urinary tract purifier	Whole plant
<i>Capparis decidua</i> (Forssk.) Edgew.	Capparaceae	Shrub	P.	Ph.	Cough, Constipation, Astringents, Skin rash, Dermatitis and Sores	Seeds
<i>Bassia muricata</i> (L.) Asch.		Herb	A.	Th.	Throat and Sores	Leaves and stems
<i>Salsola imbricata</i> Forssk.	Chenopodiaceae	Shrub	P.	Ph.	Anthelmintic	Whole plant
<i>Haloxylon salicornicum</i> (Moq.) Bunge		Shrub	P.	Ch.	Diabetic, Cold, Sores, Wounds and Dermatitis	Whole plant
<i>Traganum nudatum</i> Delile		Herb	P.	Ch.	Renal colic, Hepatitis, Stomatitis and Skin pain	Leaves
<i>Convolvulus arvensis</i> L.	Convolvulaceae	Herb	P.	Ge.	Purgative	Whole plant
<i>Cynomorium coccineum</i> L.	Cyomoriaceae	Parasite	P.	Pa.	Colic, Astringents and Constipation	Whole plant
<i>Chrozophora tinctoria</i> L.	Euphorbiaceae	Herb	A.	Th.	Emetic	Leaves
<i>Ricinus communis</i> L.		Shrub	P.	Ph.	Asthma and Skin	Extract of roots
<i>Acacia arabica</i> Lam.		Tree	P.	Ph.	Cough, Cold and Bleeding	Gum powder and Bark
<i>Acacia tortilis</i> (Forssk.) Hayne		Tree	P.	Ph.	Anthelmintic and Diarrhea	Leaves
<i>Alhagi camelorum</i> Fisch.	Fabaceae	Shrub	P.	He.	Lungs and Dermatitis	Whole plant
<i>Astragalus spinosus</i> Forssk.		Shrub	P.	Ch.	Purgative	Leaves
<i>Astragalus tribuloides</i> Delile.		Herb	A.	Th.	Throat pain, Irritation of the stomach and colon.	Seeds

Table 1. (Cont'd.).

Species	Family	Life cycle	Vegetation type	Life form	Medical usage	Parts used
<i>Teucrium polium</i> L.		Shrub	P.	Ch.	Lungs, Anthelmintic , Stomach and Intestinal troubles	Leaves
<i>Trigonella stellata</i> Forssk.		Shrub	A.	Th.	Gastric problems	Leaves and Stems
<i>Teucrium oliverianum</i> Ging.	Lamiaceae	Shrub	P.	Ch.	Diabetes	Whole plant
<i>Asphodelus fistulosus</i> L.	Liliaceae	Herb	A.	Th.	Swellings, Anthelmintic and Dermatitis	Flowers and Seeds
<i>Colchicum ritchei</i> R.Br.		Herb	P.	Ge.	Abdominal colic, Emetic and Purgative	Leaves
<i>Malva parviflora</i> L.	Malvaceae	Herb	A.	Th.	Cough, Laxative and promotes hair growth	Whole plant
<i>Ficus palmata</i> Forssk.	Moraceae	Tree	P.	Ph.	Constipation (Laxative), Throat, , Lungs, Bladder and Warts	Fruits and Extract
<i>Orobanchae aegyptiaca</i> Pers.	Orobanchaceae	Parasite	A.	Pa.	Throat and Sores	Whole plant
<i>Plantago amplexicaulis</i> Cav.		Herb	A.	Th.	Lungs, Renal diseases and urinary tract purifier	Whole plant
<i>Plantago boissieri</i> Hausskn. & Bomm.	Plantaginaceae	Herb	A.	Th.	Diarrhea	Leaves
<i>Plantago ciliata</i> Desf.		Herb	A.	Th.	Dysentery, Chronic constipation and Duodenum Ulcer.	Leaves
<i>Cymbopogon schoenanthus</i> (L.) Spreng.		Grass	P.	Ch.	Lungs	Roots
<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Grass	P.	Ge.	Wound bleeding, Vomiting, Dropsy and Astringents	Whole plant
<i>Panicum turgidum</i> Forssk.		Grass	P.	He.	Eye infection	Whole plant
<i>Calligonum comosum</i> L.		Shrub	P.	Ph.	Ulcers, Stomach diseases, Teeth and Laxative	Leaves
<i>Emex spinosa</i> (L.) Campd.	Polygonaceae	Herb	A.	Th.	Weak desire to eat (Appetizer), Purgative, Dyspepsia, Reliver colic and Stomach disorders	Whole plant
<i>Rumex vesicarius</i> L.		Herb	A.	Th.	Toothache, Purgative, Dysentery, Astringents, Promote appetite, Spleen, Dyspepsia, Vomiting and Liver Diseases.	Whole plant
<i>Portulaca oleracea</i> L.	Portulacaceae	Herb	A.	Th.	Lungs, inflammation, Dysentery and Skin diseases	Whole plant
<i>Reseda muricata</i> Presl.	Resedaceae	Herb	A.	Th.	Menstruation tonic	Fruits
<i>Ziziphus spina-christi</i> (L.) Desf.	Rhamnaceae	Tree	P.	Ph.	Lungs, Cold , Cough , Purgative, Liver complaints, Anthelmintic, Diarrhea, Astringents, Sores and Wounds	Whole plant
<i>Haplophyllum tuberculatum</i> (Forssk.) A. Juss.	Rutaceae	Herb	P.	He.	Cold	Leaves
<i>Tamarix aphylla</i> (L.) H. Karst.	Tamaricaceae	Tree	P.	Ch.	Throat, Wound infection, Stomach ache and Eczema	Buds
<i>Tamarix nilotica</i> (Ehrenb.) Bunge		Shrub	P.	Ph.	Leg varices, Diarrhea, Intestinal colic and Dermatitis	Leaves
<i>Forsskalea tenacissima</i> L.	Urticaceae	Herb	P.	He.	Ulcers	Whole plant
<i>Fagonia arabica</i> L.		Shrub	P.	Ch.	Throat and Wounds	Leaves
<i>Fagonia bruguieri</i> DC.		Shrub	P.	He.	Diarrhea, Asthma, Ophthalmia, Astringents, Dropsy, Dyspepsia, Dysentery, Stomachache, Stomatitis, Dermatitis, Swellings, Blisters, Vitiligo and Scabies	Whole plant
<i>Fagonia indica</i> Burm. f.	Zygophyllaceae	Herb	P.	Ch.	Gout	Whole plant
<i>Tribulus terrestris</i> L.		Herb	A.	Th.	Abdominal pain , Diarrhea and Dysentery	Whole plant
<i>Zygophyllum coccineum</i> L.		Shrub	P.	Ch.	Colic and Anthelmintic	Leaves

**Table 1. Number of species in each stands.**

Stand	Central	Northern	Southern	Eastern	Western
No. of species	24	32	45	27	35

**Table 2. Plant families, number and life cycle of species.**

Family	No. of species	%	Tree	Shrub	Parasite	Herb	Grass
Asteraceae	9	14.8	0	5	0	4	0
Fabaceae	7	11.5	2	4	0	1	0
Zygophyllaceae	5	8.2	0	3	0	2	0
Brassicaceae	4	6.6	0	0	0	4	0
Chenopodiaceae	4	6.6	0	2	0	2	0
Plantaginaceae	3	4.9	0	0	0	3	0
Poaceae	3	4.9	0	0	0	0	3
Polygonaceae	3	4.9	0	1	0	2	0
Euphorbiaceae	2	3.3	0	1	0	1	0
Liliaceae	2	3.3	0	0	0	2	0
Tamaricaceae	2	3.3	1	1	0	0	0
Acanthaceae	1	1.6	0	0	0	1	0
Adiantaceae	1	1.6	0	0	0	1	0
Amaranthaceae	1	1.6	0	0	0	1	0
Boraginaceae	1	1.6	0	0	0	1	0
Caesalpinaceae	1	1.6	0	1	0	0	0
Capparaceae	1	1.6	0	1	0	0	0
Convolvulaceae	1	1.6	0	0	0	1	0
Cymoriaceae	1	1.6	0	0	1	0	0
Laminaceae	1	1.6	0	1	0	0	0
Malvaceae	1	1.6	0	0	0	1	0
Moraceae	1	1.6	1	0	0	0	0
Orobanchaceae	1	1.6	0	0	1	0	0
Portulacaceae	1	1.6	0	0	0	1	0
Resedaceae	1	1.6	0	0	0	1	0
Rhamnaceae	1	1.6	1	0	0	0	0
Rutaceae	1	1.6	0	0	0	1	0
Urticaceae	1	1.6	0	0	0	1	0
<b>Total</b>	<b>61</b>	<b>100</b>	<b>5</b>	<b>20</b>	<b>2</b>	<b>31</b>	<b>3</b>

## Results

**Floristic composition:** A collection of 61 medicinal plant species, belonging to 28 plant families, were listed in Al-Qassim, Saudi Arabia. The number of plant species recorded in the central stand is 24, in the northern stand is 32 species, in the southern stand is 45 species, in the eastern stand is 27 species and in the western stand is 35 species (Tables 1 & 2).

The most repeated plant families are Asteraceae with nine species (five species are shrub and four species are herb), followed by Fabaceae with seven species (four species are shrub, two species are tree and only a single species is herb), Zygophyllaceae with five species (three species are shrub and two species are herb), Brassicaceae with four herb species, Chenopodiaceae with four species (two species shrub and two species herb), Plantaginaceae with three herb species, Poaceae with three grass species, Polygonaceae with three species (two species are herb and one species is shrub), Euphorbiaceae with two species (one species is shrub and one is herb), Liliaceae with two herb species, Tamaricaceae with two species (one species is tree and one species is shrub), Acanthaceae, Adiantaceae, Amaranthaceae, Boraginaceae, Convolvulaceae, Malvaceae,

Portulacaceae, Resedaceae, Rutaceae and Urticaceae with one herb species each, Caesalpinaceae, Capparaceae and Laminaceae with one shrub species each, Cymoriaceae and Orobanchaceae with one parasite species each, Moraceae and Rhamnaceae with one tree species each (Tables 1 & 3 & 4 and Figs 2 & 3).

Regarding listed species duration of life cycle, the largest number of species is perennials with 40 species (65.6%), while annuals have the percentage of 34.4% (21 species) (Tables 1 & 5 & Fig. 4).

With regard to life form, therophytes species were the most common with 20 species (32.8%), chamaephytes had 19 species (31.1%), phanerophytes had nine species (14%), hemicyptophytes had eight species (13.1%), geophytes had three species (4.9%) and parasites had two species (3.3%) (Tables 1 & 6 and Fig. 5).

For the part used in medicinal plants, the most used part was the whole plant with 28 species (45.9%), leaves with 18 species (29.5%), leaves and stems with three species (4.9%), seeds with three species (4.9%), fruits with two species (3.3%), leaves and flowers with two species (3.3%), roots with two species (3.3%), buds, flowers & seeds and gum powder & bark with one species each (Tables 1 & 7 & Fig. 6).

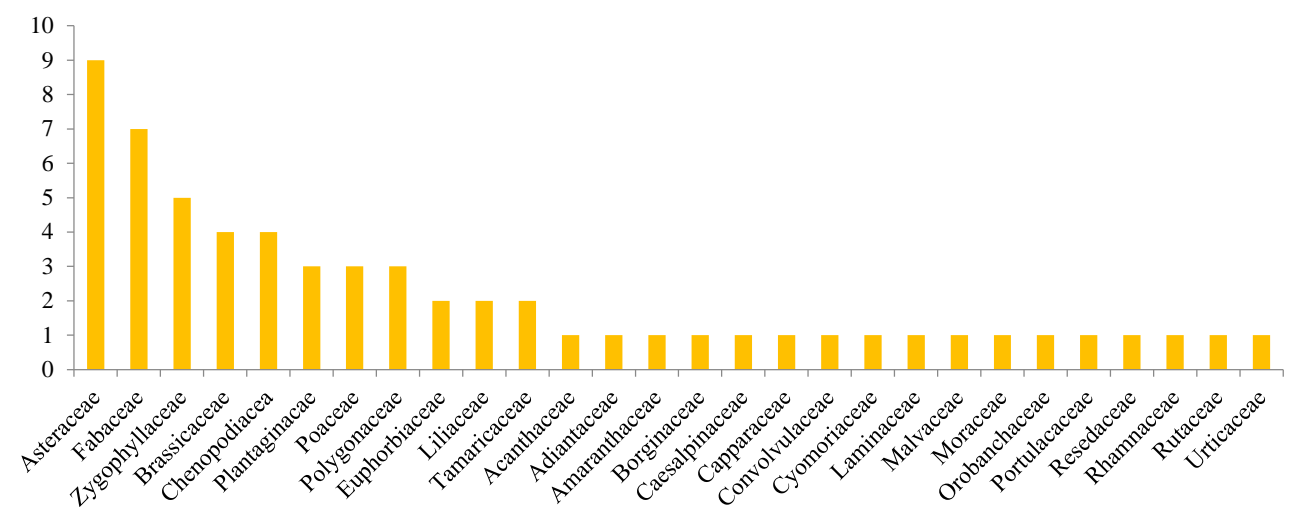


Fig. 2. Plant families of listed medicinal plant species.

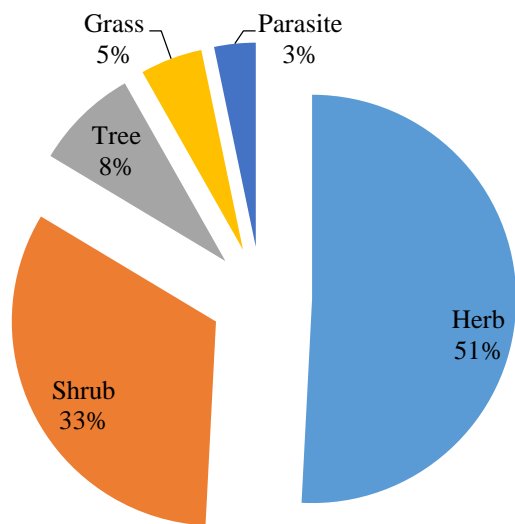


Fig. 3. Life cycle of listed plant.

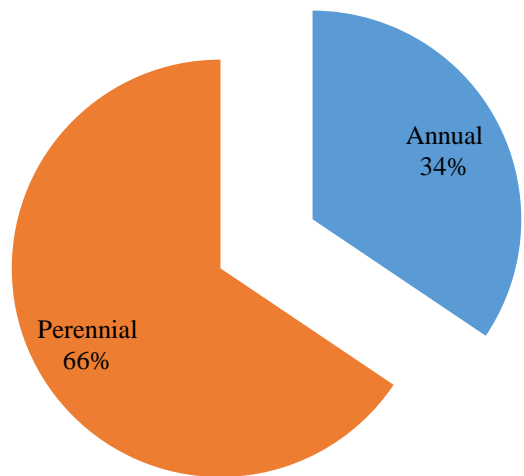


Fig. 4. Vegetation type of listed plant.

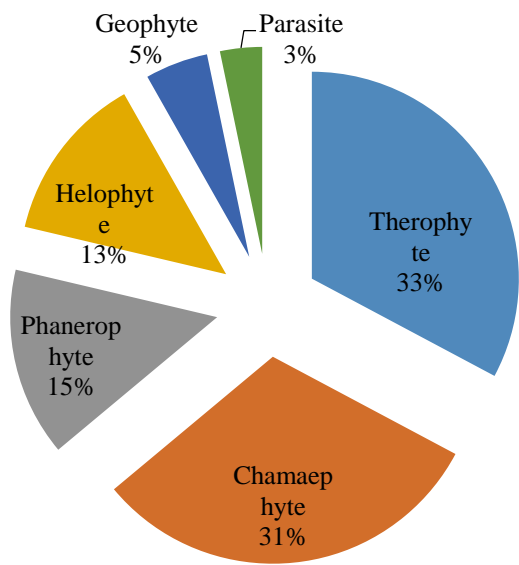


Fig. 5. Life forms of listed plant.

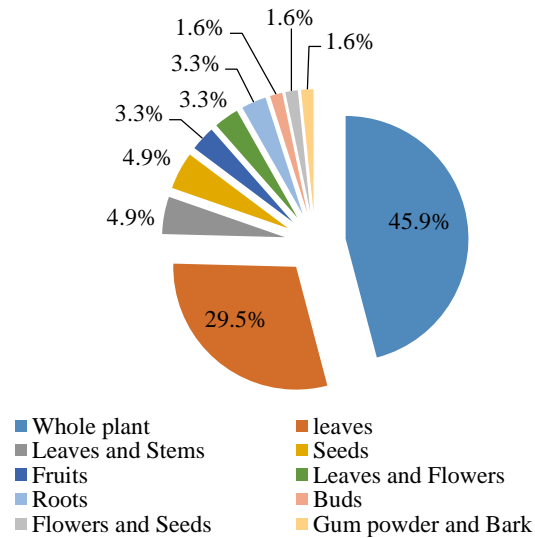


Fig. 6. Used parts of listed plant.

**Table 3. Number of species and percentage belonging to its life cycle.**

Life cycle	No. of species	%
Herb	31	50.8
Shrub	20	32.8
Tree	5	8.2
Grass	3	4.9
Parasite	2	3.3
<b>Total</b>	<b>61</b>	<b>100</b>

**Table 4. Number of species and percentage belonging to its vegetation type.**

Vegetation type	No. of species	%
Annual	21	34.4
Perennial	40	65.6
<b>Total</b>	<b>61</b>	<b>100</b>

**Table 5. Number of species and percentage belonging to its life form.**

Life form	No. of species	%
Therophyte	20	32.8
Chamaephyte	19	31.1
Phanerophyte	9	14.8
Helophyte	8	13.1
Geophyte	3	4.9
Parasite	2	3.3
<b>Total</b>	<b>61</b>	<b>100</b>

**Table 6. Number of species and percentage belonging to its parts used.**

Parts used	No. of species	%
Whole plant	28	45.9
leaves	18	29.5
Leaves and Stems	3	4.9
Seeds	3	4.9
Fruits	2	3.3
Leaves and Flowers	2	3.3
Roots	2	3.3
Buds	1	1.6
Flowers and Seeds	1	1.6
Gum powder and Bark	1	1.6
<b>Total</b>	<b>61</b>	<b>100.0</b>

The listed medicinal plants can be divided into: 79 species used to treat digestive system diseases (anthelmintic, laxative and constipation, colic, purgative, diarrhea, stomach diseases, dysentery, liver diseases, ulcers, dyspepsia, carminative, emetic, vomiting, dropsy, promote appetite, colon diseases, splenic diseases, weak desire to eat, diabetic, gastric problems, abdominal, spleen and swellings), 37 species used to treat skin diseases (dermatitis, sores, astringents, wounds, eczema, vitiligo, blisters, scabies, ringworm, warts and promotes hair growth), 36 species used to treat respiratory system diseases (lungs diseases, throat, cough, cold and asthma), seven species used to treat oral and dental diseases (tooth ache, stomatitis and swellings), four species used to treat urinary system diseases (urinary tract purifier, bladder and renal diseases). Two species used to treat eye diseases, bone & joint diseases (gout and rheumatism), and Obstetrics & gynecology (facilitating birth and menstruation tonic). Only a single species used to treat blood diseases (*Acacia arabica*) (Tables 1 & 8).

Indicators of biodiversity were calculated; shannon's index, simpson's index, species evenness and species richness. Average of shannon's and simpson's index is 0.864 and 0.5205, respectively. Average of species evenness and species richness is 0.836 and 2.7, respectively.

**Soil analyses:** Sand content ranged from 52% to 88%, silt content ranged from 3% to 11%, clay content ranged from 9% to 37%. Average of sand, silt and clay content were 73.2, 6.6 and 20.2, respectively. Average of pH was 7.6 and ranged from 7.3 to 7.8. Electrical conductivity ranged from 0.34 ds/m to 7 ds/m with an average of 2.6 ds/m. the range was of organic matter from 0.1% to 0.5% with an average of 0.3%. Nitrogen, phosphorus, potassium had an average of 16.4, 6.2 and 24.6 ppm, nitrogen ranged from 9 ppm to 30 ppm, phosphorus ranged from 4.9 ppm to 7.6 ppm and potassium ranged from 15 ppm to 35 ppm. Average of chlorides, sodium, calcium and magnesium were 7.8, 7.3, 10.7 and 9.2 Meq/L. chlorides ranged from 2.8 to 25.5 Meq/L. Sodium ranged from 2 to 22.5 Meq/L. Calcium ranged from 2 to 25 Meq/L. Magnesium ranged from 1.3 to 23 Meq/L (Table 9).

**Statistical analyses:** According to TWINSpan analysis five stands were classified into two chief groups at the first level of classification. The first group (negative group) includes four stands (northern, southern, eastern and western) and *Artemisia sieberi* is the most known indicator species. At the second level of classification, negative group is separated into two groups: the first one contains two stands (northern and eastern), the second one contains two stands (southern and western) and *Adiantum capillus-veneris* as indicator species. On the other hand, the second group (positive group) includes only central stand (Fig. 7).

DCA analysis showed that the five stands were divided into three groups: The first one is central stand with 14 indicator species (*Convolvulus arvensis*, *Sonchus oleraceus*, *Aerva javanica*, *Tamarix aphylla*, *Lepidium aucheri*, *Pulicaria undulate*, *Portulaca oleracea*, *Trigonella stellate*, *Tribulus terrestris*, *Bassia muricata*, *Ricinus communis*, *Salsola imbricate*, *Malva parviflora* and *Reseda muricata*) and positively correlated to phosphorus content, the second one is southern stand with 19 indicator species (*Rhanterium epapposum*, *Ficus palmate*, *Plantago amplexicaulis*, *Cymbopogon schoenanthus*, *Haplophyllum tuberculatum*, *Chrozophora tinctoria*, *Adiantum capillus-veneris*, *Artemisia judaica*, *Zygophyllum coccineum*, *Eruca sativa*, *Capparis decidua*, *Teucrium oliverianum*, *Panicum turgidum*, *Traganum nudatum*, *Fagonia indica*, *Rumex vesicarius*, *Alhagi camelorum*, *Forsskalea tenacissima* and *Cassia italica*) and positively correlated to clay, silt, nitrogen, total dissolved salts, chlorides, sodium, magnesium, calcium, potassium, organic matter content, the third one is northern and western stands with 18 indicator species (*Artemisia monosperma*, *Calligonum comosum*, *Fagonia bruguieri*, *Colchicum ritchii*, *Lactuca saligna*, *Plantago ciliate*, *Ziziphus spina-Christi*, *Farsetia aegyptia*, *Emex spinosa*, *Tamarix nilotica*, *Artemisia sieberi*, *Acacia tortilis*, *Cynomorium coccineum*, *Teucrium polium*, *Acacia arabica*, *Astragalus tribuloides*, *Fagonia arabica* and *Anastatica hierochuntica*) and positively correlated to pH (Figs. 8 & 9).

**Table 7. Number of species according to its medical usage and type of diseases.**

Type of disease	Medical usage	No. of species	%
Blood diseases	Bleeding	1	1.6
Bone and joint diseases	Gout	1	1.6
	Rheumatism	1	1.6
Digestive system diseases	Anthelmintic	9	14.8
	Laxative and Constipation	8	13.1
	Colic	7	11.5
	Purgative	7	11.5
	Diarrhea	6	9.8
	Stomach diseases	6	9.8
	Dysentery	5	8.2
	Liver Diseases	4	6.6
	Ulcers	3	4.9
	Dyspepsia	3	4.9
	Carminative	2	3.3
	Emetic	2	3.3
	Vomiting	2	3.3
	Dropsy	4	6.6
	Promote appetite	2	3.3
	Colon diseases	1	1.6
	Splenic diseases	1	1.6
	Weak desire to eat	1	1.6
	Diabetic	2	3.3
	Gastric problems	1	1.6
	Abdominal	1	1.6
	Spleen	1	1.6
	Swellings	1	1.6
Eye diseases	Ophthalmia	1	1.6
	Eye diseases	1	1.6
Obstetrics and gynecology	Facilitating birth	1	1.6
	Menstruation tonic	1	1.6
Oral and dental diseases	Tooth ache	4	6.6
	Stomatitis	2	3.3
	Swelings	1	1.6
Respiratory system diseases	Lungs diseases	9	14.8
	Throat	9	14.8
	Cough	8	13.1
	Cold	5	8.2
	Asthma	4	6.6
	Respiratory system diseases	1	1.6
Skin diseases	Dermatitis	7	11.5
	Sores	6	9.8
	Astringents	6	9.8
	Skin diseases	5	8.2
	Wounds	4	6.6
	Eczema	2	3.3
	Vitiligo	2	3.3
	Blisters	1	1.6
	Scabies	1	1.6
	Ringworm	1	1.6
	Warts	1	1.6
	Promotes hair growth	1	1.6
Urinary system diseases	Urinary tract purifier	2	3.3
	Bladder	1	1.6
	Renal diseases	1	1.6



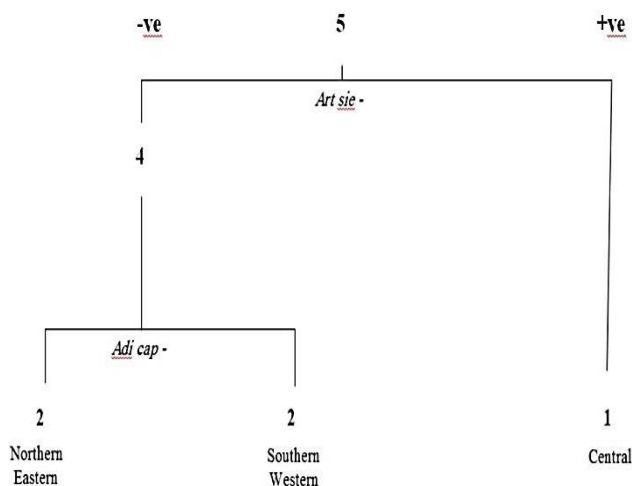
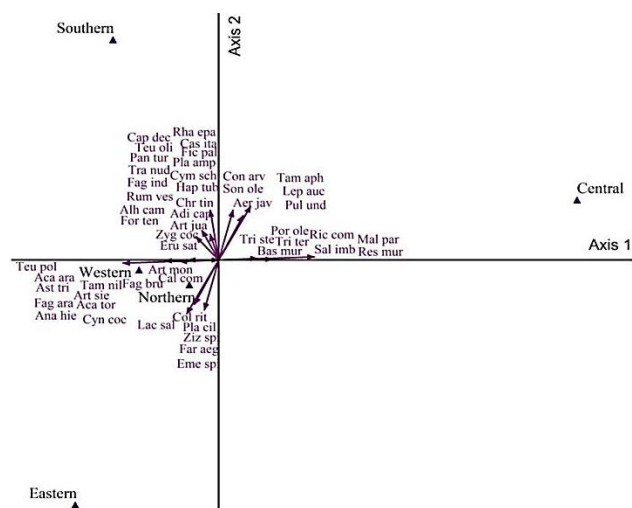


Fig. 7. TWINSpan analysis 5 stands in Al-Qassim. Art sie= *Artemisia sieberi*, Adi cap = *Adiantum capillus-veneris*.



Con arv=*Convolvulus arvensis*, Son ole=*Sonchus oleraceus*, Aer jav=*Aerva javanica*, Tam aph=*Tamarix aphylla*, Lep auc=*Lepidium aucheri*, Pul und=*Pulicaria undulate*, Por ole=*Portulaca oleracea*, Tri ste=*Trigonella stellate*, Tri ter=*Tribulus terrestris*, Bas mur=*Bassia muricata*, Ric com=*Ricinus communis*, Sal imb=*Salsola imbricate*, Mal par=*Malva parviflora*, Res mur=*Reseda muricata*, Rha epa=*Rhanterium epapposum*, Fic pal=*Ficus palmate*, Pla amp=*Plantago amplexicaulis*, Cym sch=*Cymbopogon schoenanthus*, Hap tub=*Haplophyllum tuberculatum*, Chr tin=*Chrozophora tinctoria*, Adi cap=*Adiantum capillus-veneris*, Art jud=*Artemisia judaica*, Zyg coc=*Zygophyllum coccineum*, Eru sat=*Eruca sativa*, Cap dec=*Capparis decidua*, Teu oli=*Teucrium oliverianum*, Pan tur=*Panicum turgidum*, Tra nud=*Traganum nudatum*, Fag ind=*Fagonia indica*, Rum ves=*Rumex vesicarius*, Alh cam=*Alhagi camelorum*, For ten=*Forsskalea tenacissima*, Cas ita=*Cassia italic*, Art mon=*Artemisia monosperma*, Cal com=*Calligonum comosum*, Fag bru=*Fagonia bruguieri*, Col rit=*Colchicum ritchii*, Lac sal=*Lactuca saligna*, Pla cil=*Plantago ciliate*, Ziz spi=*Ziziphos spina-Christi*, Far aeg=*Farsetia aegyptia*, Eme spi=*Emex spinosa*, Tam nil=*Tamarix nilotica*, Art sie=*Artemisia sieberi*, Aca tor=*Acacia tortilis*, Cyn coc=*Cynomorium coccineum*, Teu pol=*Teucrium polium*, Aca ara=*Acacia arabica*, Ast tri=*Astragalus tribuloides*, Fag ara=*Fagonia arabica* and Ana hie=*Anastatica hierochuntica*

Fig. 8. DCA analysis presented the grouping of studied stands depending on the indicator species.

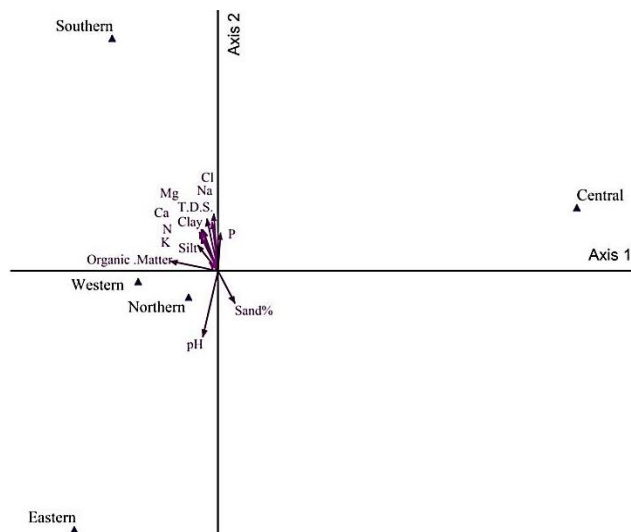


Fig. 9. DCA analysis display stands classification according to tested soil factors.

Table 8. Soil factors with an average, minimum and maximum.

Soil factors	Average (Minimum-Maximum)
Sand (%)	73.2 (52-88)
Silt (%)	6.6 (3-11)
Clay (%)	20.2 (9-37)
pH	7.6 (7.3-7.8)
Electrical conductivity (ds/m)	2.6 (0.34-7)
Organic matter (%)	0.3 (0.1-0.5)
Nitrogen (ppm)	16.4 (9-30)
Phosphorus (ppm)	6.2 (4.9-7.6)
Potassium (ppm)	24.6 (15-35)
Chlorides (Meq/L)	7.8 (2.8-25.5)
Sodium (Meq/L)	7.3 (2-22.5)
Calcium (Meq/L)	10.7 (2-25)
Magnesium (Meq/L)	9.2 (1.3-23)

## Discussion

In Al-Qassim, there are 61 species of medicinal plants that can be used to treat many ailments in folk medicine have been listed. Recorded medicinal plants can be used to treat digestive system diseases, respiratory system diseases, skin diseases, oral and dental diseases, urinary system diseases, eye diseases, bone & joint diseases, Obstetrics & gynecology or blood diseases.

Several previous studies the medicinal plants in the Al-Qassim, as (Emad & Gamal, 2013), who shed light on antimicrobial activity of nine medicinal, plants (*Blepharis ciliaris*, *Tamarix aphylla*, *Echinops spinosissimus*, *Francoeuria crispa*, *Haloxylon salicornicum*, *Rhazya stricta*, *Dactyloctenium aegyptium*, *Trichodesma africanum* and *Zygophyllum simplex*) in Al-Rass area, Al-Qassim. (Youssef, 2013), who identified 83 species of medicinal plants that are used for medical and non-medical purposes in the Al-Qassim. (Aldoweriej *et al.*, 2016), assessment the antimicrobial activity of numerous plants in Al-Qassim. (Al-Harbi *et al.*, 2016 a), who studied several medicinal plants (*Cyperus conglomeratus*, *Tribulus longipetalus*,

*Rhazya stricta*, *Plantago coronopus*, *Astragalus spinosus*, *Lepidium sativum*, *Lasiurus scindicus*, *Heliotropium bacciferum* and *Haloxylon salicornicum*) and their anti-diarrheal effect in Al-Qassim. (Al-Harbi et al., 2016 b), who studied the possibility of using some native medicinal plants (21 species) in Al-Qassim to treat wounds healing. (Abdallah, 2017), who studied antimicrobial activity of *Cistanche violacea* that collected from Al-Qassim. (Hikal et al., 2017) studied the anticancer activity of (*Anacardium occidentale*) and (*Prunus dulcis*) kernels. (Al-Harbi et al., 2019) they studied anticancer Potentiality of *Convolvulus Spicatus* and *Astragalus Vogelii*. (Abdel-Mageed et al., 2019) they evaluated the ant diabetic potentiality of *Truffles* and *Balanites aegyptiaca*. (Al Nasr et al., 2019), who studied antitoxoplasmal activity of some medicinal plants in Al-Qassim. (Mohammed et al., 2019), who studied volatile oil content and antimicrobial activity of *Rhanterium epapposum* that found in Al-Qassim. (Al Nasr, 2020 a) assessment Anti-Leishmanial of nine medicinal plants (*Sonchus oleraceus*, *Trichodesma Africana*, *Teucrium oliverianum*, *Citrillus colocynthis*, *Aerv javanica*, *Echinops spinosissimus*, *Pergularia tomentosa*, *Blepharis ciliaris* and *Cleome amblyocarpa*) in Al-Qassim. (Al Nasr, 2020 b), who assessment Anti-Leishmanial activities of *Rhazya stricta* and *Calotropis procera* that growing in Al-Qassim, (Habeballa et al., 2020) studied antiviral activity of *Illicium verum* and *Zingiber officinale*. (Alqahtani et al., 2020) on some *Thymus* species.

In the same context, many studies have been done on medicinal plants in other regions of Saudi Arabia; Medicinal plants in Al-Baha region, (Ahmed et al., 2016; Ali et al., 2017; Samaha et al., 2017; Mothana et al., 2018; Almalki et al., 2019; Alshehri et al., 2019; Al Zandi et al., 2019; Fadlilmula et al., 2019), in Riyadh (Al Kahtani, 2016; Elhindi et al., 2016; Elsayed et al., 2016; Alfarraj, 2018; Nasr et al., 2018; Al-Wahaibi et al., 2020), in Jazan (Areeshi & Ahmed 2016; El-Shabasy 2016; Tounekti et al., 2019), in Rafha (Elnaggar et al., 2016), Northern area of Saudi Arabia (Elsharkawy & Algozar 2016), in Jeddah (Mosleh et al., 2016; Al-Kattan & Khayyat 2017; Farhan et al., 2017; Alqethami et al., 2020; Al-Azab et al., 2020), in Tabuk (Khan et al., 2016; Al-Harbi, 2017 a & b), in Alabwa (Aly et al., 2017), in Taif (Arbab et al., 2016; Attia et al., 2017; Algandaby & Salama 2018; Mostafa et al., 2018), in Madina (Daradka, 2016; Brima 2017; Brima, 2018), in Hail (Suliman et al., 2017), in the Eastern area (Khalil et al., 2017), in the Western area (Khan et al., 2017), in South region (Ganash & Qanash 2018), in Makkah (Alqethami, 2017; Mashat et al., 2018), Asir region (Suleiman, 2019), in Al-Hassa (Al-Humaidi 2016), in Al-Qunfudah province (Alothyqi et al., 2016), in Al-Gouf Governorate (Gashgari et al., 2016), in Shaqra area (Al-Ghanayem et al., 2017), in desert of Gulf (Almalki, 2017), in Widi Nissah, Huraimla, Howta Banu Tamim and Salbouk (Alotaibi et al., 2017), in Arar (Elsharkawy et al., 2017; Osman & Abdein, 2019; Abdein & Osman, 2020; Rayan et al., 2020), Jeddah, Hail, Al-Qassim and in Southwestern region (Fawzy et al., 2017).

## Conclusions

Throughout the ages Saudi Arabia was one of the most famous countries that used folk medicine, which relies mainly on the use of medicinal plants to treat many diseases. In Al-Qassim, 61 species of medicinal plants have been recorded that can be used to treat many diseases in the past. Medicinal plants can be used to extract the active substances from them that are used in the pharmaceutical industry. The study recommended conducting specialized studies on each plant for use in the modern pharmaceutical industry, and many studies on medicinal plants should be done in other regions of Saudi Arabia.

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