

Review

Ethnobotanical Diversity of Trees and Shrubs of Iran: A Comprehensive Review

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Abstract: Iran, possessing unique topographic and diverse climatic conditions, is the home of 8167 vascular plant species. Iran has a historical tradition in using plants for medicinal purposes. Approximately 2075 species over the whole are popularly characterized as medicinal or aromatic. Medicinal trees and shrubs compose a significant percentage of Iranian medicinal flora. Nonetheless, there are no integrated databases on their applications and most of the publications and documents have been scattered to date. Therefore, the present investigation aims to integrate the published literature considering its ethnobotanical aspects that would serve as promising precursors for developing potent medicines of plant origin. In the study, we compile information about ethnobotany of trees and shrubs of Iran. Our survey found 174 taxa belonging to 109 genera and 56 families. The majority of species were classified in Rosaceae, Fabaceae, Rutaceae, Salicaceae, and Lamiaceae families. Rosaceae was the most dominant, representing 21.8% of the total plant species recorded, among them, the genus with the highest number of species was *Prunus* (16 species). *Berberis vulgaris*, *Citrus limon*, and *Betula pendula* have the highest number of medicinal uses (24 number of uses) in Iran. Leaves (22.7%) represented the most dominant usage of the plant parts, while the most commonly used preparation method was infusion (33.5%). Most of the plant species have been consumed for digestive system treatment (21%), followed by immune system treatment (20%). The present review highlights that different trees and shrubs taxa have great traditional applications in various healing throughout the Iranian territory. The represented data can potentially be a precious reference containing useful information for directing further phytochemical, biological, and pharmacological investigations. Several endemic species of trees and shrubs, particularly *Ribes khorasanicum*, are frequently used in Iranian traditional medicine. Because of overharvesting, these species are calling a wake-up alarm for conservation.

Keywords: ethnobotany; Iranian medicinal plants; trees and shrubs; literature survey



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1. Introduction

Plants play diverse important roles in human life, supplying basic needs such as food, clothing, medicine, and housing [1]. During the last few decades there has been an increasing interest in the study of medicinal plants and their traditional uses all around

the world [2]. In the last few decades, due to the side effects of synthetic drugs, the interest in medicinal plants has increased [3,4]. Currently, various medicinal plants have gained special importance in biotechnology and nanotechnology industries due to their antioxidant properties and active biochemical metabolites [5–7]. The term “ethnobotany” was initially introduced by American botanist “John Harshberger” in 1896. The definition of ethnobotany can be summed up in four words, i.e., people, plants, interactions, and uses. Ethnobotany studies the relationship between humans and plants in all its complexity and is generally based on a detailed observation and study of the use a society makes of plants, including all the beliefs and cultural practices associated with this application [8,9]. Plants used in traditional medicine define the field of ethnomedicine, which is a subfield of ethnobotany [10].

The importance of the study of local knowledge has been recognised in defining strategies for the conservation and utilization of biological resources [9]. Collection information regarding how people deal with their natural surroundings is not only important for the recording of local cultural traditions and the richness of this heritage but also gives us some of the information necessary to protect our natural habitat in the long term and forms the best source of hope for safe future medicines [11]. The importance of traditional medicine has also been recognized by the World Health Organization (WHO) and guidelines and standards for botanical medicines have been created. According to the WHO, about 80% of the population in developing countries depend on traditional medicinal plants for primary health care, income generation and livelihood improvement [1].

Iran, by having varied climate, geographical diversity and 8167 species of vascular plants (2597 (sub)endemic vascular plant species), is considered one of the ten important centres of speciation in the world [12,13]. Approximately 2075 of the 8167 species are popularly characterized as medicinal or aromatic [1]. Iran has an admirable past regarding traditional medicines, especially involving plants. The history of indigenous medicines dates back to the time of Babylonian Assyrian civilization [14]. Some scholars such as Avicenna (980–1037 AD) and Al-Biruni (973–1048 AD), of the ninth century, published classical books on ethnomedicine which have been used as textbooks for several centuries.

Approximately 99 families, 329 genera, and 956 species of trees and shrubs have been reported in Iran. The most important families of trees and shrubs in Iran are Rosaceae, Papilionaceae, Tamaricaceae. Other important families are Pinaceae, Mimosaceae, Myrtaceae, Caprifoliaceae, Oleaceae, and Caesalpinaceae [15].

Recently, several activities to collect ethnobotanical data have been published in Iran [16–23]. However, there are no distinct references on the ethnobotanical applications of trees and shrubs in Iran and most of the publications and documents are scattered. Therefore, this review aims to integrate the findings concerning the different applications of trees and shrubs taxa of Iran in order to support sufficient baseline data for the next scientific works with ethnobotanical interests.

2. Results

The present review reported 174 medicinally important tree and shrub species distributed into 109 genera and 56 families for the treatment of various human ailments in Iran. The scientific name, along with plant families, local name, uses, plant part used, mode of preparation, and references are listed in Table 1.

Table 1 indicated that the plant families contributing the highest number of medicinal species was Rosaceae and Fabaceae each with 38 and 12 species, respectively; these are the most used families in Iran, followed by Rutaceae (10 species) and Salicaceae (7 species) (Figure 1). The genus *Prunus* participates with the highest number of species (16 species) (Figure 2).

Table 1. Ethnomedicinal uses of trees and shrubs in Iran (Iranian endemics are marked by asterisk).

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Acanthaceae	<i>Avicennia marina</i> (Forssk.) Vierh.	root, bark, leaves, fruit	poultice	astringent, aphrodisiac, blister and Hansen's disease (leprosy)	[15]
Amaranthaceae	<i>Aerva javanica</i> (Burm.f.) Juss. ex Schult.	whole plant, leaves, seed	decoction, poultice	diuretic, calmative, treatment of wounds, emetic, cathartic, headaches, antirheumatics	[15]
Anacardiaceae	<i>Pistacia atlantica</i> Desf.	leaves, bark, fruit, gum	liniment, juice	anti-acid stomach, digestive problems blood purification, bone and joint pains, toothache, and wound skin	[15,24,25]
Anacardiaceae	<i>Pistacia khinjuk</i> Stocks	fruit, gum	juice, liniment	gynecological infection, bone and joint pains, digestive discords, diuretic, asthma, stomach stranger and fragrant mouth	[26,27]
Anacardiaceae	<i>Pistacia vera</i> L.	fruit	infusion	lower blood cholesterol, weight loss, antioxidant and antianemia	[11,15]
Anacardiaceae	<i>Rhus coriaria</i> L.	fruit	infusion	astringent, wound healing, prevent bleeding, antidiarrhea, antidiabetic, antimicrobe and virus, antioxidant, antiphlogistic and anticancer	[15,25]
Apocynaceae	<i>Calotropis procera</i> (Aiton) W.T.Aiton	whole plant	decoction, powder, poultice	diaphoretic, anthelmintic, elephantiasis, leukoma, wounds, malignant glands, hemorrhoids, alterative, flatulence, constipation, dyspepsia, antirheumatic, epilepsy, blister, leucorrhoea, emmenagogue, Ausmus, colds antidote, asthma, rheumatism, skin disease, antiinflammation, remove bur from skin and wound healing	[14,15]
Apocynaceae	<i>Nerium oleander</i> L.	leaves, bark	decoction	treatment of skin diseases, skin problem, anti pest, rheumatism, and anti-leg tumult	[14,28]
Apocynaceae	<i>Periploca graeca</i> L.	bark, root, seed	juice, tincture	strengthen the heart, dyspnea	[15]
Apocynaceae	<i>Rhazya stricta</i> Decne.	root, leaves, bark, seed, latex	infusion, juice	skin seeds, blister, sore throat, antifebrile, throat pain, antifebrile, excretion syphilis, antirheumatism and joint pains	[14,15]
Aquifoliaceae	<i>Ilex spinigera</i> (Loes.)Loes.	leaves	infusion	diuretic, antipyretic, sedative, antirheumatics, jaundice and intestinal cleansing	[15]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Araliaceae	<i>Hedera helix</i> L.	bark, root, leaves, flower	powder, tincture	antispasmodic respiratory tract, expectorant, depurative, choleric, pertussis, chronic bronchitis, pneumonia, laryngitis, antigout, antirheumatics, gallstones, menstrual insufficiency, leukorrhea, antihypertensive, neurological analgesic, vascular retractor, decongestant, treatment of nasal polyps and corns and calluses, wounds, scald, anticancer, relieving toothache, emetic and spasmolytic	[14,15,29]
Arecaceae	<i>Nannorrhops ritchieana</i> (Griff.) Aitch.	leaves	poultice	anti-diarrhea, dysentery, hyperlipidemia, ulcer	[14,30]
Arecaceae	<i>Phoenix dactylifera</i> L.	fruit, flower, and seed	decoction	expectorant, purgative	[14,16,27,30]
Asparagaceae	<i>Ruscus hyrcanus</i> Woronow	aerial parts, root	infusion, decoction	vasoconstrictor, diuretic, stomachic, antihemorrhagic, hemorrhoids and varicose veins	[15]
Asteraceae	<i>Hertia intermedia</i> (Boiss.) Kuntze	leaves	poultice, poultice	colds, antifebrile, cephalalgia and boils	[15]
Berberidaceae	<i>Berberis integerrima</i> Bunge	fruit	juice	edible as wild fruit, antidiabetic, antihypertensive, blood purifier and liver, creating jaundice, antipyretic, antigout, and abdominal ache, antifebrile and stomach ulcers	[11,31–36]
Berberidaceae	<i>Berberis vulgaris</i> L.	bark, leaves	decoction	alterative, aperitif, stomachic, choleric, vein retractor, diuretic, laxative, anticancer, antirheumatics, jaundice, antigout, kidney and gallbladder stones, liver and kidney colic, constipation, anti-amoeba, anti-Alzheimer, anti-inflammatory joints, antimicrobial, antipruritic, antipyretic, antispasmodic, anticancer, vitamin C deficiency compensation, spasmolytic, astringent, choleric, diaphoretic, diuretic, expectorant, antifungal, liver booster, lowering blood pressure and immune system stimulant	[9,15,25,35,37]
Betulaceae	<i>Alnus glutinosa</i> subsp. <i>barbata</i> (C.A.Mey.) Yalt.	leaves, bark	decoction, poultice, juice	astringent, antipyretic, throat inflammation, antirheumatics	[15,30]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Betulaceae	<i>Betula pendula</i> Roth	bark, fruit, leaves, bark	infusion, liniment, decoction	kidney stones and bladder bag, rheumatism, antiseptic, eczema, anthelmintic, antipyretic, blood purifier, dyspnea, albuminuria, jaundice, diuretic, depurative, black bile, rheumatism, anthelmintic, antifebrile, wound healing, dyspnea, antigout, rheumatism, azotemia, jaundice, antineuralgic, lower blood cholesterol, atherosclerosis and antihypertensive	[15,30]
Betulaceae	<i>Carpinus betulus</i> L.	leaves, bark	decoction	astringent, pharyngitis, alterative and antipyretic	[15,30]
Betulaceae	<i>Corylus avellana</i> L.	leaves, bark, root skin, fruit	decoction	vasoconstrictor, antihemorrhagic, blood purifier, attendant, varicose veins, menstrual regulation, diaphoretic, grippe, pneumonia, antidiarrhea, cicatrice, antipyretic and varicose veins	[15,30]
Cannabaceae	<i>Celtis caucasica</i> Willd.	fruit	infusion	astringent, antidiarrhea, dysentery and epilepsy	[30]
Capparaceae	<i>Cadaba farinosa</i> Forssk.	leaves, root	decoction, infusion, poultice	anthelmintic, anti-venom, pulmonary disease, dysentery, antifebrile, antirheumatics, antispasmodic, emmenagogue, cathartic, treatment of wounds	[15]
Capparaceae	<i>Capparis cartilaginea</i> Decne.	leaves, root cortex	poultice	antigout, diuretic, cathartic, alterative, expectorant, anthelmintic, emmenagogue, antirheumatics, paralysis, the treatment of enlarged spleen and tuberculosis	[15]
Capparaceae	<i>Capparis decidua</i> (Forssk.) Edgew.	bark, fruit, leaves, young branch	infusion	blister, boils, anti-venom, odontalgia, laxative, anthelmintic, diaphoretic, alterative, Ausmus, cough removal, swelling treatment, antirheumatism	[15]
Caprifoliaceae	<i>Lonicera nummulariifolia</i> Jaub. & Spach	bark, leaves, flower	infusion	osteoporosis, anti-fever, antidiarrheal and sedative and cough	[12,24,38]
Cornaceae	<i>Cornus mas</i> L.	fruit	juice	antihemorrhagic, antidiarrhea, antipyretic	[15]
Cornaceae	<i>Cornus sanguinea</i> L.	fruit, bark	juice	antipyretic	[15]
Cupressaceae	<i>Cupressus sempervirens</i> L.	cones, leaves	juice, liniment	astringent, vasoconstrictor, spasmolytic, antirheumatics, diuretic, anticancer, deodorant, varicose veins, menopause, pertussis, enuresis, violent sound, hemorrhoids	[15,30]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Cupressaceae	<i>Juniperus communis</i> L.	fruit	decoction	tonic, diuretic, antiseptic, gout, rheumatic, stimulates menstruation	[39,40]
Cupressaceae	<i>Juniperus polycarpos</i> K.Koch	female cones, gum	infusion	menstruation disorders, women's cysts, toothache	[38]
Cupressaceae	<i>Juniperus sabina</i> L.	leaves	infusion, liniment	emmenagogue, parasiticide, cleansing, anticancer, aborticide, antiviral, diuretic, uterus ailments, excitant, wart removal	[15]
Cupressaceae	<i>Platyclusus orientalis</i> (L.) Franco	leaves	infusion	emmenagogue, expectorant, diaphoretic, emollient, diuretic, antirheumatics, wart removal hemorrhoids	[15,30]
Ebenaceae	<i>Diospyros lotus</i> L.	wood, fruit, leaves	decoction, infusion	blood purifier, lenitive and antipyretic	[15]
Elaeagnaceae	<i>Elaeagnus angustifolia</i> L.	seed, flower, fruit, leaves	juice, liniment	antidiarrhea, antifebrile, astringent, excitant, antiphlogistic, antioxidant, anticancer	[15,24,41]
Elaeagnaceae	<i>Hippophae rhamnoides</i> L.	fruit, seed, bark, leaves	decoction	analeptic, antiinfection, anorexia, anemia, antiscorbutic, anthelmintic, laxative	[15]
Ephedraceae	<i>Ephedra ciliata</i> Fisch. & C.A.Mey.	root, stem	decoction	antibacterial, antifever	[24]
Ephedraceae	<i>Ephedra major</i> subsp. <i>procera</i> (C.A.Mey.) Bornm.	flower twigs	decoction, infusion	treatment of joints pain	[33]
Ephedraceae	<i>Ephedra pachyclada</i> Boiss.	stem, gum	decoction, infusion	hay fever, asthma, influenza, rheumatic fever	[24,26]
Ericaceae	<i>Vaccinium arctostaphylos</i> L.	fruit	infusion	antihypertensive, antidiabetic	[15]
Euphorbiaceae	<i>Ricinus communis</i> L.	seed, fruit, leaves	infusion	detergent	[25,38]
Fabaceae	<i>Alhagi pseudalhagi</i> (M. Bieb.) Desv. ex Wangerin	manna	infusion	laxative	[30]
Fabaceae	<i>Anagyris foetida</i> L.	leaves, root, stem, seed	infusion, poultice	cathartic, vermifuge, emetic, emmenagogue	[30]
Fabaceae	<i>Astragalus gummifer</i> Labill.	root, stem	maceration	antitussive, antidiarrhea, anticancer, calmative, immunostimulant, sedative, scald	[15]
Fabaceae	<i>Cercis siliquastrum</i> L.	leaves, bark	infusion	astringent	[15,30]
Fabaceae	<i>Colutea buhsei</i> (Boiss.) Shap.	fruit, leaves	infusion	toothache	[17]
Fabaceae	<i>Dalbergia sissoo</i> Roxb. ex DC.	bark, wood, root, leaves	juice, infusion	aborticide, expectorant, vermifuge, aperitif, dysentery	[15,30]
Fabaceae	<i>Genista tinctoria</i> L.	flower, leaves, seed	powder, decoction	cathartic, diaphoretic, diuretic, emetic, vasoconstrictor, antirheumatism, and gout	[15]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Fabaceae	<i>Indigofera oblongifolia</i> Forssk.	whole plant, root	infusion, decoction	syphilis, antiphlogistic, laxative, antirheumatics, antiseptic	[15]
Fabaceae	<i>Parkinsonia aculeata</i> L.	flower, seed	infusion	antipyretic	[15,30]
Fabaceae	<i>Prosopis cineraria</i> (L.) Druce	bark, flower, fruit	infusion, decoction	anti-abortion, antirheumatism, astringent, and expectorant	[15]
Fabaceae	<i>Sophora mollis</i> (Royle) Graham ex Baker	root, seed	decoction	cholera, purgative and laxative	[30]
Fabaceae	<i>Vachellia nilotica</i> (L.) P.J.H.Hurter & Mabb.	gum, leaves	infusion	astringent, anthelmintic, cough, bronchitis, antidiarrhea, dysentery, liver tonic and antiedema	[30]
Fagaceae	<i>Quercus brantii</i> Lindl.	fruit, gall	decoction	stomach ulcer, diarrhea, gastric ulcer, stringent, sore throat, antidiabetes	[16,38]
Fagaceae	<i>Quercus infectoria</i> G.Olivier	gall, leaves, fruit, bark, wood	poultice, decoction	epistaxis, antihemorrhagic, mouth sores, hemorrhoids, astringent, diabetes, antibacterial and antiviral	[25,42]
Fagaceae	<i>Quercus infectoria</i> subsp. <i>veneris</i> (A.Kern.) Meikle	gall	poultice, decoction	antibacterial, antiphlogistic, antiseptic, anticancer, antiviral, astringent, carcinogen, nauseant, expectorant, homeostasis, immune system stimulant, vermifuge, kidney and bladder stones, anodyne, acronarcotic, hypoglycemic, sedative, and alterative	[15]
Fagaceae	<i>Quercus robur</i> L.	bark, gall	decoction, ointment, powder	astringent, deodorant, decongestant, homeostasis, antiseptic, hemorrhoids, tooth decay, treatment of throat ulcers, tonsillitis, scald, dysentery	[15]
Grossulariaceae	* <i>Ribes khorasanicum</i> Saghafi & Assadi	fruit	infusion, decoction	antihypertensive, diabetes, depurative	[25,43,44]
Grossulariaceae	<i>Ribes rubrum</i> L.	fruit, leaves	juice, powder, infusion	appetizer, digestive, kidney stone, bladder stone, antirheumatic and gout, burn complications	[30]
Grossulariaceae	<i>Ribes uva-crispa</i> L.	fruit	juice	laxative, urinary tract infection, liver disorder	[30]
Hypericaceae	<i>Hypericum androsaemum</i> L.	fruit	juice, liniment	astringent, antacid, diuretic, antiphlogistic, anthelmintic, antipyretic, cicatrice, bronchitis, Ausmus, antidiarrhea, white and female genital secretions, treatment of wounds, nervous system problems, cystitis, antihemorrhagic, migraine, sciatica, emmenagogue, antiperiodic, enuresis, antidepressant, antiviral and anti-HIV	[15]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Juglandaceae	<i>Juglans regia</i> L.	leaves, fruits, wood	infusion, decoction	fortifying, scrofula, eczema, tonsillitis anthelmintic, elimination of women's discharge, tuberculosis, antidiabetic, antiseptic, astringent, dysentery, metrorrhagia, wart removal, ringworm and homeostasis	[25,30,32]
Lamiaceae	<i>Rydingia persica</i> (Burm.f.) Scheen & V.A.Albert	flower, leaves	infusion	treatment of blister	[15]
Lamiaceae	<i>Stachys inflata</i> Benth.	flower, leaves	decoction	antifebrile, tonic	[39]
Lamiaceae	<i>Vitex agnus-castus</i> L.	leaves, root	decoction, powder	hormonal stimulator, increase milk secretion, antispasmodic, stomach pain, eye disorders	[15]
Lamiaceae	<i>Vitex trifolia</i> L.	leaves, root, fruit	poultice, decoction	rheumatoid arthritis, blister, bronchitis, fever, anthelmintic, hair tonic, memory enhancer, mouthwash, anti-inflammatory, emmenagogue, expectorant, indigestion	[15]
Lamiaceae	<i>Volkameria inermis</i> L.	leaves, root	poultice, decoction, leaf juice, root juice	anti-tumor, scabies, gonorrhea, vaginal discharge, rheumatoid arthritis, antipyretic	[15]
Lamiaceae	<i>Zataria multiflora</i> Boiss.	flower, leaves	infusion, liniment	jaundice, throat pain, emmenagogue, antiseptic, antibacterial, spasmolytic, odontalgia, carminative, tonsillitis, nerve pain, stomachic	[15]
Loranthaceae	<i>Loranthus europaeus</i> Jacq.	leaves, fruit	infusion	epilepsy, hair tonic	[15]
Lythraceae	<i>Lawsonia inermis</i> L.	leaves, bark, flower, seed	poultice, decoction, liniment	anti-fungal, eczema, anticholinergics, hair tonic, body heat, eye wound, skin disease, foot pain, hypertension, hypertension	[14,15,25,30]
Lythraceae	<i>Punica granatum</i> L.	flower, leaves, young stem skin, root, fruit skin	infusion, decoction, juice	astringent, antidiarrhea, stop bleeding, vaginal discharge, stomachic, anemia, migraine, antihemorrhagic	[9,15,25,30]
Malvaceae	<i>Grewia asiatica</i> L.	fruit, bark, root, skin	infusion	astringent, cooling effect, digestive problems, rheumatoid arthritis, fever, vaginal and urinary tract infection	[15]
Malvaceae	<i>Grewia tenax</i> (Forssk.) Fiori	leaves, fruit	infusion	kidney pain, antitussive	[15]
Malvaceae	<i>Grewia villosa</i> Willd.	bark, root	maceration, juice	gonorrhea, antidiarrhea, syphilis, abdominal pain and smallpox	[15]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Malvaceae	<i>Sida spinosa</i> L.	leaves, root	infusion, decoction	sedative, soling effect, gonorrhea urinary disorders, tonic, diaphoretic	[15]
Malvaceae	<i>Tilia dasystyla</i> subsp. <i>caucasica</i> (V.Engl.) Pigott	flower, bark	infusion, decoction	antirheumatic, antispasmodic, hyperhidrosis, antianxiety, antipyretic, hypertension, skin rash	[15]
Menispermaceae	<i>Cocculus pendulus</i> (J.R.Forst. & G.Forst.) Diels	leaves, root, bark	decoction	arthritis, rheumatism, sedative, pertussis, eye diseases, digestive diseases, malaria and fever	[14]
Moraceae	<i>Ficus carica</i> L.	fruit, bark, leaves, root	juice, liniment, decoction, poultice	wart removal, antidiarrhea, antihemorrhagic, laxative, hemorrhoids, pneumonia, pleurisy, kidney problems, colds, bronchitis, pneumonia, constipation, gingivitis, edema, scald black bile, rheumatoid arthritis, abortion, laxative, gonorrhea cooling effect, skin disorders, heart tonic, asthma, heart tonic, asthma	[25,30,41]
Moraceae	<i>Morus alba</i> L.	root cortex, leaves, fruit	juice	diuretic, antipyretic, laxative	[30,33]
Moraceae	<i>Morus nigra</i> L.	root cortex, leaves	decoction, juice	anthelmintic, anthelmintic, antidiabetic, astringent, laxative, throat pain, stomatitis and aborticide	[25,30]
Myrtaceae	<i>Eucalyptus</i> spp.	leaves, fruit	infusion	sinusitis, antidiabetic, cold, headache	[45]
Myrtaceae	<i>Myrtus communis</i> L.	leaves, fruit, seed	infusion, liniment	edible as wild fruit, psoriasis, sinusitis, stomach ulcer, antifungal, cold, hair tonic, antiinflammatory antiseptic, antiseptic, bronchitis, tuberculosis, hemorrhoids, epilepsy, rheumatoid arthritis, vaginal discharge, eczema, carminative, hair tonic, respiratory diseases	[15,25,46–48]
Nyctaginaceae	<i>Boerhavia elegans</i> Choisy	flower, thin branch	infusion	body pain, fatigue and general weakness, dysmenorrhea, urinary tract infection, intestinal infections, inflammation, blood purifier, abdominal pains, anemia, malaria	[14]
Oleaceae	<i>Fraxinus angustifolia</i> Vahl	leaves, seed	decoction	coughs, foot pain	[12]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Oleaceae	<i>Fraxinus excelsior</i> L.	leaves, fruit, seed, bark	juice, infusion	Diuretic, gout, antirheumatic, blood purifier, purgative, antipyretic, bladder stone, antianemia, hemorrhoids sedative, Viagra, stammering, hemorrhoids	[15,25]
Oleaceae	<i>Olea europaea</i> L.	fruits, leaves, seed	liniment	fever, laxative, urinary infection, antihyperglycemic, laxative, dermatitis, antioxidant, antispasmodic, antiarrhythmic, antibacterial, antipyretic, astringent, diuretic, cholesterol lowering action, gout	[15,26,35,38]
Platanaceae	<i>Platanus orientalis</i> L.	bark, fruit, leaves	decoction	hoarseness, antidiarrhea, dysentery, snake bite	[30]
Polygonaceae	<i>Calligonum polygonoides</i> L.	root, flower	decoction	treatment of throat ulcers	[15]
Rhamnaceae	<i>Frangula alnus</i> Mill.	bark, branch	decoction	laxative, choleric, cicatrice, constipation, hemorrhoids, obesity, scabies, ringworm, anticancer, antiherpetic, galactagogue	[15,30]
Rhamnaceae	<i>Paliurus spina-christi</i> Mill.	fruit	infusion	diuretic, anti-blood urea, antihypertensive kidney stone, cholesterol lowering action, hypertension	[15,24]
Rhamnaceae	<i>Rhamnus cathartica</i> L.	fruit	infusion	purgative, diuretic, antihypertensive, laxative, hypertension	[15]
Rhamnaceae	<i>Ziziphus jujuba</i> Mill.	fruit	infusion	antifebrile, constipation, creating jaundice, antitussive, anti-microbial, antiphlogistic, spasmolytic, anti-tumour, astringent, expectorant, acronarcotic, antihypertensive, antidiabetic, calmative	[15,16,25,34,35,49]
Rhamnaceae	<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn.	fruit, leaves	infusion, liniment	hypertension, anti-fever, blood purifier	[24,34,35,38]
Rhamnaceae	<i>Ziziphus spina-christi</i> (L.) Desf.	leaves, fruit, seed	decoction, juice	analgesic, antipyretic, anticancer, astringent, laxative, purgative, stomach tonic, antitussive, hair tonic, eczema, tonic, antifungal, anti-itching	[14,34,35,38]
Rhizophoraceae	<i>Rhizophora mucronata</i> Poir.	bark	decoction	astringent, antidiabetic	[15]
Rosaceae	<i>Cotoneaster luristanicus</i> G.Klotz	resin	internal	laxative for baby	[24]
Rosaceae	<i>Cotoneaster nummularioides</i> Pojark.	fruit	infusion	laxative, purgative, expectorant, stomachic, reduce body heat, cough removal and antipyretic	[15,27,41]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Rosaceae	<i>Cotoneaster nummularius</i> Fisch. & C.A.Mey.	manna	infusion	jaundice, cough, constipation, emetic, diuretic	[16,25]
Rosaceae	<i>Cotoneaster persicus</i> Pojark.	fruits, seed	infusion	bladder problems	[26]
Rosaceae	<i>Crataegus azarolus</i> var. <i>aronia</i> L.	fruit	juice, infusion	hypnotic	[46]
Rosaceae	<i>Crataegus germanica</i> (L.) Kuntze	leaves, fruit	juice, decoction	astringent, antidiarrhea	[15,24,30]
Rosaceae	<i>Crataegus microphylla</i> K.Koch	flower, leaves, bark, fruit	infusion	antispasmodic, cordial, antihypertensive, nervous system problems, obesity, antifebrile, calmative, antioxidant, antihypertensive, kidney stones, spasmolytic, acronarcotic	[30]
Rosaceae	<i>Crataegus monogyna</i> Jacq.	fruit, leaves	juice, infusion	antianxiety	[34,35,46]
Rosaceae	<i>Crataegus pontica</i> K.Koch	fruit, leaves	juice, infusion	edible as wild fruit, heart tonic, antihypertensive and headache	[24,34,35]
Rosaceae	<i>Cydonia oblonga</i> Mill.	fruit, seed, leaves, bark	decoction, juice, maceration	antidiarrhea, tonic stomachic, cough removal, violent sound, astringent, cordial, flatulence, emollient, diuretic, emmenagogue,	[2,15,25,26]
Rosaceae	<i>Malus orientalis</i> Uglitzk. ex Juz.	root skin, leaves, fruit	infusion, decoction, poultice, juice	alterative, astringent, antifebrile, kidney problems, laxative, ant catarrh, antidiarrhea, diuretic, lenitive, acronarcotic, rheumatism, atherosclerosis, eczema, hemorrhoids, colds, violent sound, cough removal, anticatarrh, nervous system problems, lower blood cholesterol	[15,30]
Rosaceae	<i>Prunus amygdalus</i> Batsch	flower, fruit skin, leaves, seed grain	liniment, poultice, decoction, infusion	cathartic, anthelmintic, pertussis, liver problems, pharyngitis, mouth and throat inflammations, lenitive, antibilious, antifebrile, kidney stones, vaginal discharge, pleurisy, nervous system problems, grippe, liver and kidney colic, elimination of rheumatism	[12,15,30, 38,41]
Rosaceae	<i>Prunus arabica</i> (Olivier) Meikle	fruit	infusion	child ear pain, body pain and analgesic, bronchitis, anti-calculus, and digestive discords	[24,46]
Rosaceae	<i>Prunus armeniaca</i> L.	fruit, seed grain	liniment	astringent, antidiarrhea, depurative, anemia, treatment of ear pain, emollient	[30]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Rosaceae	<i>Prunus avium</i> (L.) L.	stem, flower tail, fruit, seed grain	liniment, decoction	kidney and bladder stones, prostate disease, stomach problems	[25]
Rosaceae	<i>Prunus brachypetala</i> (Boiss.) Walp.	seed	infusion	diarrhea	[38]
Rosaceae	<i>Prunus cerasus</i> L.	seed grain, flower tail, fruits	decoction, fruit, juice	fever, liver disease, urination, depurative, nervine, obesity, atherosclerosis, rheumatism, antigout, kidney stones, constipation, migraine, rheumatism, wart removal, regulation of blood, strengthening the nerves	[15,30,41]
Rosaceae	<i>Prunus domestica</i> L.	fruit, seed	infusion	constipation	[30]
Rosaceae	* <i>Prunus eburnea</i> (Spach) Aitch.	fruit	infusion	Alopecia, laxative, hyperlipidemia, antihypertensive	[33]
Rosaceae	* <i>Prunus haussknechtii</i> C.K.Schneid.	gum, wood	infusion, decoction	Toothache, laxative, hyperlipidemia, antihypertensive	[38]
Rosaceae	<i>Prunus laurocerasus</i> L.	leaves	infusion	antispasmodic, dyspnea, emesis, pruritus, antineuralgic and sciatica	[30]
Rosaceae	<i>Prunus lycioides</i> (Spach) C.K.Schneid.	fruit, seed	powder, infusion	hyperlipidemia, hypoglycemia, good hair condition	[12,24,32]
Rosaceae	<i>Prunus mahaleb</i> L.	fruit, wood, seed	poultice	edible as wild fruit, diaphoretic, kidney problems, laxative, anti-calculus, culinary and spice and wild fruit stomachic	[30,38]
Rosaceae	<i>Prunus microcarpa</i> C.A.Mey.	fruit, root	decoction	carminative, cure for pains of digestive system, sedative	[24,25,46]
Rosaceae	<i>Prunus persica</i> (L.) Batsch	flower, leaves, fruit	poultice, infusion, decoction	cathartic, diuretic, lenitive, antifebrile, anthelmintic, pertussis, kidney problems, kidney stones, tenesmus, scald	[15,30]
Rosaceae	<i>Prunus scoparia</i> (Spach) C.K.Schneid.	leaves, fruit, stem, bark, gum	infusion	snake bites, eczema	[26,34,35,38]
Rosaceae	<i>Prunus spinosa</i> L.	bark, leaves, flower, fruit	infusion, decoction, juice	astringent, antifebrile, diuretic, laxative, depurative, antidiabetic, cough removal, kidney stones, kidney problems, vaginal discharge, dysentery, throat pain, gingivitis, gum disorder	[30]
Rosaceae	<i>Pyrus communis</i> L.	young leaves, bark, fruit	infusion, poultice	astringent, lenitive, kidney and bladder stones, anemia	[15,30]
Rosaceae	<i>Pyrus salicifolia</i> Pall.	fruit	infusion	nerve tonic	[1]
Rosaceae	<i>Pyrus syriaca</i> Boiss.	seed	infusion	migraine	[15,38]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Rosaceae	<i>Rosa beggeriana</i> Schrenk ex Fisch. & C.A.Mey.	fruit, flower	infusion	antihypertensive, diuretic, kidney stones kidney, inflammation, treatment	[25,26]
Rosaceae	<i>Rosa canina</i> L.	leaves, fruit flower	infusion, decoction, juice	edible as wild fruit, astringent, lenitive, antiscorbutic, diuretic, alterative, scald	[24,30,50]
Rosaceae	<i>Rosa × damascena</i> Mill.	flower	infusion, juice	laxative, constipation, anti-blood urea, blood and liver cleanser, constipation, sedative	[2,15,25,30, 38]
Rosaceae	<i>Rosa foetida</i> Herrm.	flower	infusion	emmenagogue	[25]
Rosaceae	<i>Rosa gallica</i> L.	flower	poultice, juice, infusion	astringent, vaginal discharge, throat pain	[30,51]
Rosaceae	<i>Rubus caesius</i> L.	leaves, root, fruit	infusion	edible as wild fruit, astringent, skin conditions, antiseptic, hemorrhoids, dysentery, leucorrhea, antigout, anemia, pharyngitis, gingivitis, treatment of toothache	[15]
Rosaceae	<i>Sorbus aucuparia</i> L.	fruit	infusion, juice	cathartic, cough removal, bronchitis, diuretic, emmenagogue, antiscorvy, astringent, kidney stones, dysentery, rheumatism	[15,30]
Rosaceae	<i>Torminalis glaberrima</i> (Gand.) Sennikov & Kurtto	fruit	infusion	astringent, diarrhea, dysentery	[15]
Rutaceae	<i>Citrus × aurantiifolia</i> (Christm.) Swingle	fruit, leaves, root cortex, seed grain	infusion, decoction, poultice	antimalaria, anthelmintic, neuralgia, antiseptic, antiscorbutic, astringent, diuretic liver tonic, rheumatoid arthritis, hair tonic	[2,15,25]
Rutaceae	<i>Citrus × aurantium</i> L.	flower	infusion	antidepressants, antianxiety, heart tonic, digestive, hypertension	[2,25,46,47]
Rutaceae	<i>Citrus × limon</i> (L.) Osbeck	fruit	juice	antibacterial, antiseptic, immunostimulant, mood enhancer, antipyretic, heart tonic, diuretic, antirheumatic, gout, analgesic, antacid, atherosclerosis, antiscorbutic, blood purifier, carminative, antimalarial, asthma, cold, sinusitis, warts, antimigraine, antiinflammatory	[15,52,53]
Rutaceae	<i>Citrus maxima</i> (Burm.) Merr.	fruit, bark fruit	juice	sea sickness, motion sickness, cold, vomiting, abdominal pain, rheumatoid arthritis skin disorder	[15]
Rutaceae	<i>Citrus medica</i> L.	bark	liniment	sea sickness, respiratory diseases, expectorant, antibiotics	[15]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Rutaceae	<i>Citrus paradisi</i> Macfad.	fruit, leaves	juice	antioxidant, anticancer, antimicrobial, heart tonic, cholesterol lowering action, tonic, laxative, epilepsy, rheumatoid arthritis, bronchitis	[15]
Rutaceae	<i>Citrus reticulata</i> Blanco	bark, flower, fruit, leaves	liniment	abdominal pain, spleen enlargement, menorrhagia, headache, abdominal pain, tonic, carminative, laxative, nausea and vomiting, diaphoretic, astringent, analgesic, asthma, cholesterol lowering action, antiseptic, antiseptic, carminative	[15,54]
Rutaceae	<i>Citrus sinensis</i> (L.) Osbeck	fruit	poultice	antiscorbutic, antiseptic	[15,47]
Salicaceae	<i>Populus alba</i> L.	leaves, bark	infusion	antipyretic, sciatica pain	[15,30]
Salicaceae	<i>Populus euphratica</i> Oliv.	flower	infusion	intestinal discomfort, sweaty hands and feet	[26]
Salicaceae	<i>Populus nigra</i> L.	bark	decoction	diuretic, diaphoretic, tonic, digestive, astringent, antiseptic, kidney disorders, urinary tract infection, anti-rheumatic, gout, antiseptic, carminative, mouthwash, antiseptic	[30]
Salicaceae	<i>Salix aegyptiaca</i> L.	leaves, flower	infusion	heart tonic, dysmenorrhea, fever	[15,25,26]
Salicaceae	<i>Salix alba</i> L.	leaves, bark	infusion, decoction	antiphlogistic, sedative, antipyretic, antirheumatics, astringent, wart removal, anthelmintic, creating jaundice, antitussive	[1,20,35]
Salicaceae	<i>Salix caprea</i> L.	flower, bark	infusion, decoction, powder, juice	antipyretic, anticonvulsant, dysmenorrhea, premature ejaculation, insomnia, appetizer, antiseptic, antirheumatic, gout, influenza, dysentery, analgesic, gangrene	[30]
Salicaceae	<i>Salix excelsa</i> S.G.Gmel.	manna	maceration, infusion	antipyretic, creating jaundice, constipation	[15,16,25]
Salvadoraceae	<i>Salvadora oleoides</i> Decne.	fruit, seed, bark, root	liniment	antimicrobial, dental plaque remover, anthelmintic, gonorrhoea, carminative, diuretic, rheumatoid arthritis, spleen enlargement	[15]
Salvadoraceae	<i>Salvadora persica</i> L.	leaves, bark, fruit, seed	liniment, decoction	antimicrobial, dental plaque remover, anthelmintic, gonorrhoea, carminative, diuretic, rheumatoid arthritis, spleen enlargement	[15]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Santalaceae	<i>Viscum album</i> L.	fruit, leaves	tincture	hypertension, control heartbeat, anxiety, sedative, increase concentration, tinnitus, epilepsy, anticancer, atherosclerosis	[15]
Sapindaceae	<i>Acer turcomanicum</i> Pojark.	bark	decoction	foot pain	[38]
Sapindaceae	<i>Dodonaea viscosa</i> (L.) Jacq.	leaves	powder, juice	sprain injury, burn, rheumatoid arthritis, anthelmintic, gout, astringent	[15]
Simaroubaceae	<i>Ailanthus altissima</i> (Mill.) Swingle	bark, root cortex	maceration	Anthelmintic, antidiarrhea, control ovary discharge, gonorrhoea, antimalaria, asthma, antispasmodic	[15]
Smilacaceae	<i>Smilax excelsa</i> L.	root	infusion	diuretic, diaphoretic, blood purifier, eczema	[15]
Solanaceae	<i>Lycium depressum</i> Stocks subsp. <i>angustifolium</i> Schoenbeck-Temesy	leaves	infusion	depressant, antispasmodic, tuberculosis, prostate enlargement	[15]
Solanaceae	<i>Solanum dulcamara</i> L.	fruit	infusion	analgesic, decrease sexual desire, anti-inflammatory, purgative, diaphoretic, antiviral, antiseptic, astringent, diuretic, expectorant, sedative, hypnotic, narcotic, anticancer	[15]
Solanaceae	<i>Withania somnifera</i> (L.) Dunal	root, fruit, leaves	powder, decoction, poultice, juice	abortion, analgesic, antibacterial, antiaging, antigenemic, anti-inflammatory, antitumour, antioxidant, antipyretic, antianxiety, antispasmodic, tonic, decrease sexual desire, diuretic, sedative, hypnotic, liver tonic, immunomodulator, tonic anthelminic	[15]
Tamaricaceae	<i>Myricaria germanica</i> (L.) Desv.	bark	decoction	cathartic, jaundice	[15]
Tamaricaceae	<i>Tamarix aphylla</i> (L.) H.Karst.	gall, bark	powder, liniment	astringent, aphrodisiac, eczema, syphilis	[15]
Taxaceae	<i>Taxus baccata</i> L.	fruit, leaves	juice	antitussive, laxative, antidiabetic, antirheumatic, jaundice, emmenagogue, rickets, scorbutic, epilepsy, diphtheria	[30]
Thymelaeaceae	<i>Daphne mezereum</i> L.	bark, root	decoction	Stimulant, diaphoretic, diuretic, syphilis, scrofula, skin disorders, rheumatoid arthritis, improve blood circulation	[30]
Ulmaceae	<i>Ulmus glabra</i> Huds.	leaves	infusion	heart discords, fertility discords	[24]

Table 1. Cont.

Family	Scientific Name	Part Used	Preparation	Medical Uses	Reference
Ulmaceae	<i>Ulmus minor</i> Mill.	secondary bark	decoction, poultice, liniment	tonic, diaphoretic, diuretic, astringent, anti diarrhea, gout, antirheumatic, fever, digestive, skin disorder	[30]
Verbenaceae	<i>Aloysia citriodora</i> Palau	leaves, stem	infusion	stomachic, spasmolytic, sedative	[15]
Verbenaceae	<i>Lantana camara</i> L.	leaves	decoction, liniment	arthritis, skin rash, antimalaria	[15]
Viburnaceae	<i>Sambucus nigra</i> L.	bark, flower, fruit	decoction, juice, infusion, maceration	diaphoretic, diuretic, laxative, emetic, antiseptic, wound healing, constipation, antidiarrhea, sedative haemorrhoids, antiallergic, bronchitis, pleurisy, kidney and bladder stones, galactagogue, epilepsy, eczema, elimination of rheumatism, emesis, snake bite	[15,30]
Viburnaceae	<i>Viburnum lantana</i> L.	leaves, fruit, bark	decoction	astringent, dysentery, antidiarrhea, antiallergic and gingivitis	[15,30]
Vitaceae	<i>Vitis vinifera</i> L.	fruit, leaves, young branch	infusion, juice, liniment	analgesic, antiallergic, anti-Alzheimer, asthma, atherosclerosis, anticancer, anti-HIV, anti-inflammatory, antioxidant, antiseptic, prostate disease, laxative, heart tonic, diuretic, expectorant, heart tonic, cholesterol lowering action, immunomodulatory, sedative	[9,15,26]

The analysis of the parts used of reported medicinal trees and shrubs in Iran indicated the parts most used are leaves (22.7%), followed by fruits (21.9%), bark (16.6%), flower (9.7%), seed (9.3%), root (8.1%) and others (wood, gall, stem, gum, root cortex, collectively 11.7%) (Figure 3).

Modes of preparation were grouped into eight different and well-defined categories (infusion, decoction, juice, poultice, liniment, powder, maceration, and tincture). The most used preparation was infusion (33.5%) followed by decoction (25.5%), juice (15.3%), poultice (9.8%), liniment (8.7%) and others (7.3%) (Figure 4).

The highest percentage of plants were used for digestive system treatment (21%), followed by immune system treatment (20%). Among the reported tree and shrub species, 18 percent have been reported in the treatment of nerve diseases, urinary system 8%, endocrine system 7%, reproductive system and cardiovascular system 4%, circulatory system and respiratory system 3% and other diseases 12%. (Figure 5).

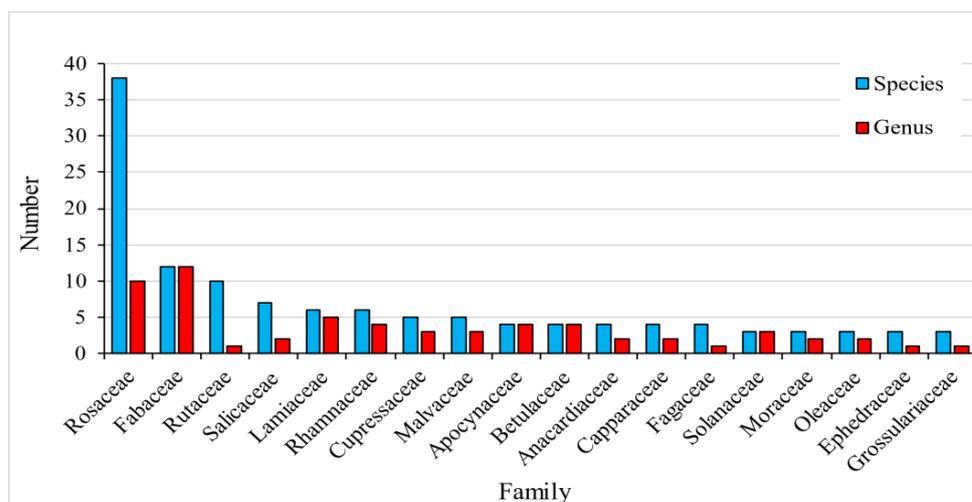


Figure 1. Plant families and the number of genera and species of Iranian medicinal trees and shrubs which have been reported in the literature.

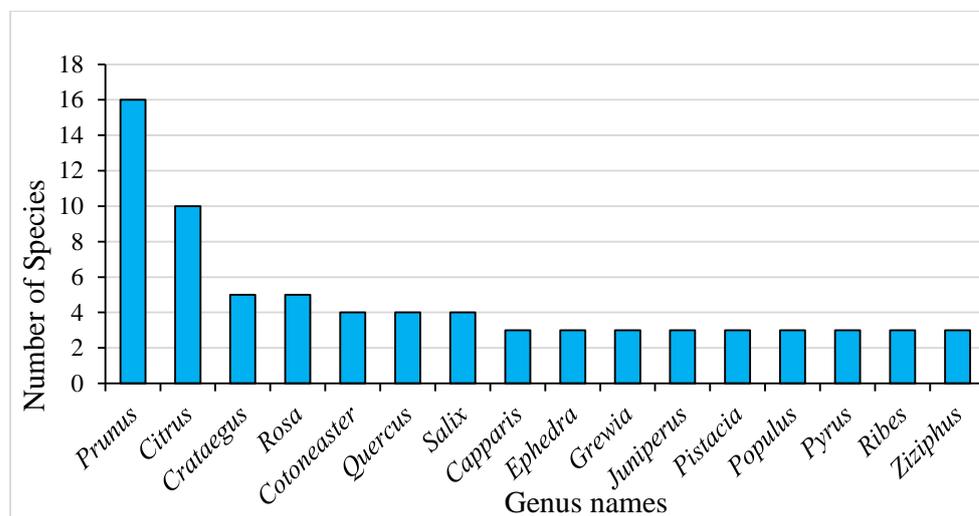


Figure 2. Plant genera with the highest number of species of Iranian medicinal trees and shrubs reported in the literature.

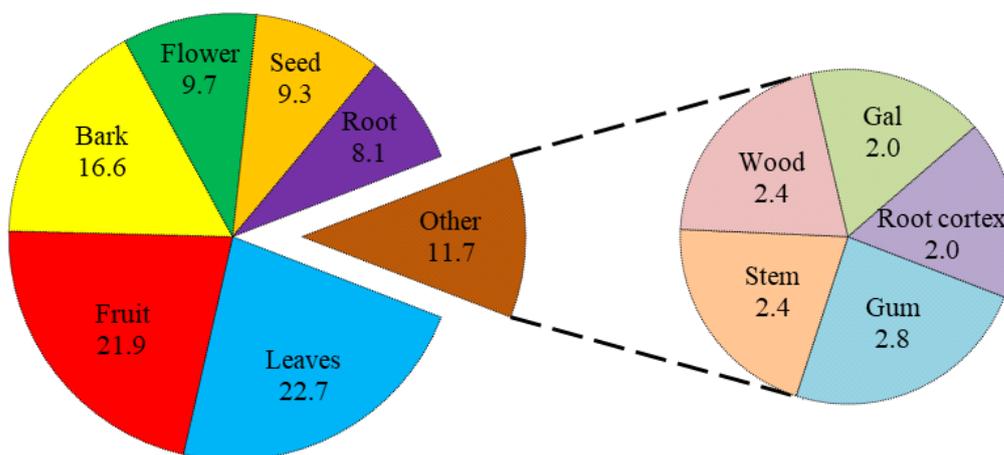


Figure 3. Plant parts used for medicinal applications (expressed as percent of the total) based on data reported in the literature for Iranian medicinal trees and shrubs.

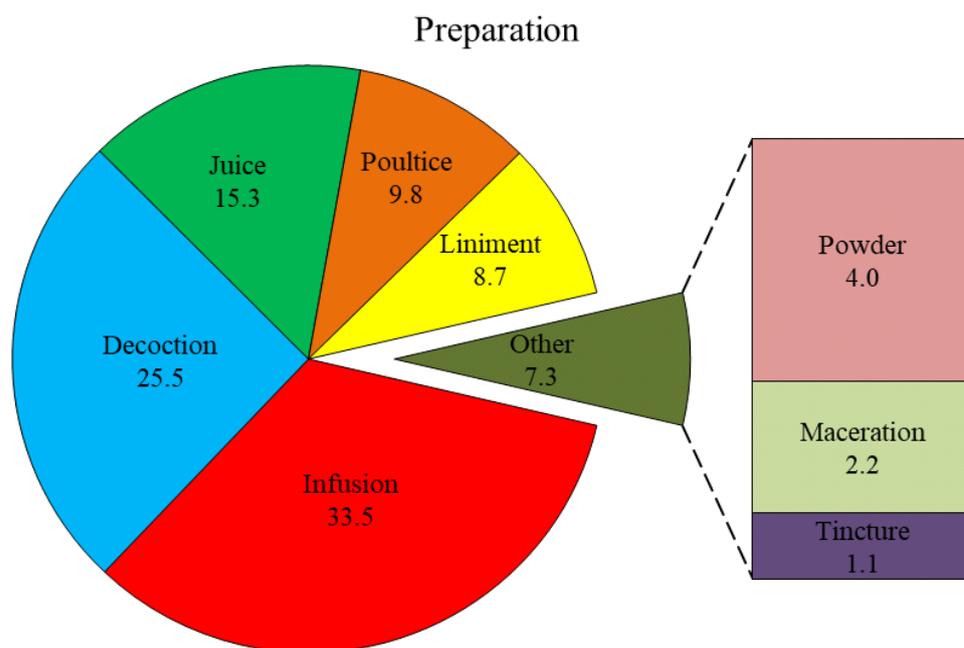


Figure 4. Mode of preparation of plant parts and their percentages based on data reported in the literature for Iranian medicinal trees and shrubs.

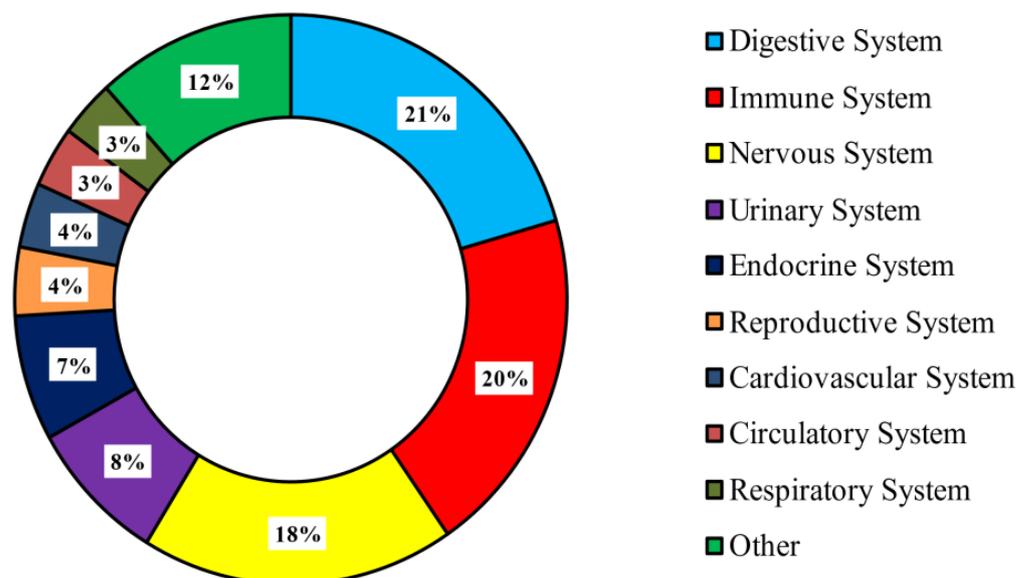


Figure 5. The most frequently cited health problems treated by the trees and shrubs in Iran.

In Figure 6, species with the highest number of uses have been identified. *Berberis vulgaris*, *Citrus limon* and *Betula pendula*, with 24 types of uses, are the highest percentage of medicinal tree and shrub species introduced from Iran. The species that are in the next ranks are: *Calotropis procera* (23 number of uses), *Hedera helix* (23 number of uses), *Hypericum androsaemum* (22 number of uses) and *Vitis vinifera* (21 number of uses).

As stated in Table 2, forty-three species have been also reported for miscellaneous uses including edible, cosmetics, making candy, making baskets, toothbrush, house building, as natural dyes and as flavors in food, etc.

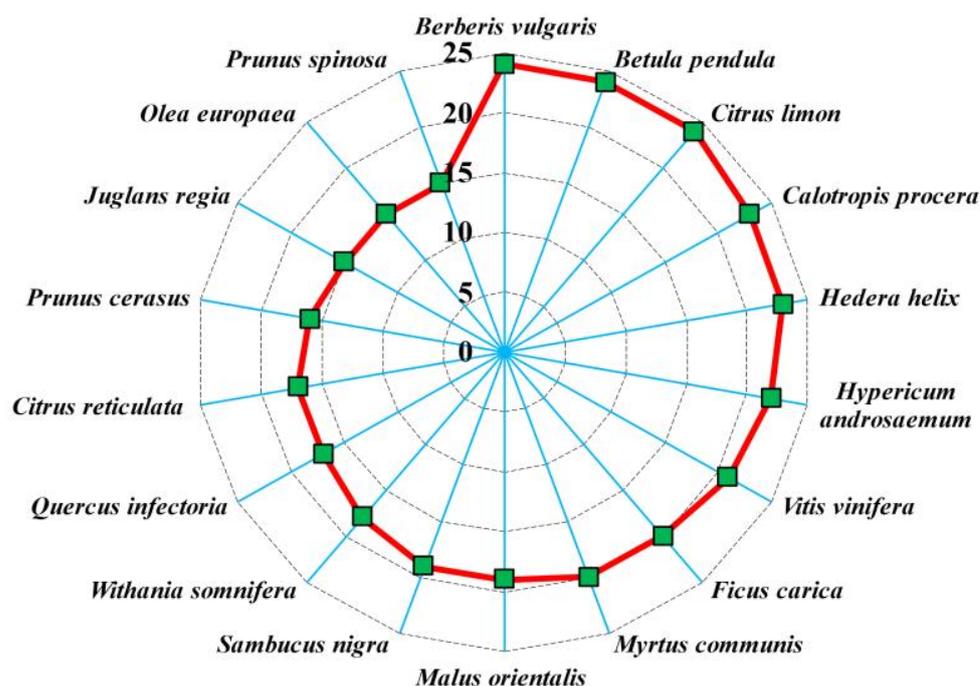


Figure 6. Trees and shrubs species with the largest number of uses in Iran.

Table 2. List of tree and shrub species in Iran for other ethnobotanical uses.

Family	Scientific Name	Non-Medical Use
Anacardiaceae	<i>Pistacia atlantica</i> Desf.	gum preparation
Araliaceae	<i>Hedera helix</i> L.	it makes hair dark, silk, and black
Arecaceae	<i>Nannorrhops ritchieana</i> (Griff.) Aitch.	making mat and bags and hats
Arecaceae	<i>Phoenix dactylifera</i> L.	oil extraction
Berberiadaceae	<i>Berberis integerrima</i> Bunge	edible, used with rennet for cheese production
Betulaceae	<i>Alnus glutinosa</i> subsp. <i>barbata</i> (C.A.Mey.) Yalt.	dyeing, tanning, dry milk discharge
Betulaceae	<i>Betula pendula</i> Roth	essential oils in medicine and the skin industry
Betulaceae	<i>Corylus avellana</i> L.	oil extraction
Cannabaceae	<i>Celtis caucasica</i> Willd.	woodworking enterprises, extraction of colored materials from the roots and skin, extraction of oily materials from the grain
Capparaceae	<i>Capparis spinosa</i> L.	edible
Cornaceae	<i>Cornus sanguinea</i> L.	wood and oil used for industrial consumption
Cupressaceae	<i>Cupressus sempervirens</i> L.	aromatization
Elaeagnaceae	<i>Elaeagnus angustifolia</i> L.	making aromatic soda, alcohol production

Table 2. Cont.

Family	Scientific Name	Non-Medical Use
Ephedraceae	<i>Ephedra major</i> subsp. <i>procera</i> (C.A.Mey.) Bornm.	leather conditioner
Fabaceae	<i>Alhagi pseudalhagi</i> (M. Bieb.) Desv. ex B. Keller & Shap.	sweetening the taste of medicine
Fabaceae	<i>Cercis siliquastrum</i> L.	ornamental
Fabaceae	<i>Parkinsonia aculeata</i> L.	paper making
Fagaceae	<i>Quercus brantii</i> Lindl.	house building, bread making
Fagaceae	<i>Quercus infectoria</i> subsp. <i>veneris</i> (A.Kern.) Meikle	industrial consumption, bread making
Grossulariaceae	<i>Ribes uva-crispa</i> L.	preparation of jelly
Juglandaceae	<i>Juglans regia</i> L.	oil for painting, preparation of soap, coloring leather and fabric, removing ants and ticks
Lamiaceae	<i>Vitex agnus-castus</i> L.	aromatization
Lamiaceae	<i>Volkameria inermis</i> L.	beauty products
Lythraceae	<i>Lawsonia inermis</i> L.	color white wood and leather and wool, aromatization
Lythraceae	<i>Punica granatum</i> L.	edible, dyeing yarns
Moraceae	<i>Morus alba</i> L.	edible
Myrtaceae	<i>Myrtus communis</i> L.	edible
Oleaceae	<i>Fraxinus excelsior</i> L.	edible
Oleaceae	<i>Olea europaea</i> L.	edible
Rhamnaceae	<i>Ziziphus spina-christi</i> (L.) Desf.	shampoo preparation
Rosaceae	<i>Prunus amygdalus</i> Batsch	beauty products
Rosaceae	<i>Prunus domestica</i> L.	aromatization
Rosaceae	<i>Prunus laurocerasus</i> L.	beauty products
Rosaceae	<i>Prunus scoparia</i> (Spach) C.K.Schneid.	branches for making baskets
Rosaceae	<i>Pyrus communis</i> L.	preparation of compote
Rosaceae	<i>Rosa × damascena</i> Mill.	rose water, cosmetics, aromatization
Rosaceae	<i>Sorbus aucuparia</i> L.	preparation liquor
Rutaceae	<i>Citrus reticulata</i> Blanco	cosmetics
Rutaceae	<i>Citrus sinensis</i> (L.) Osbeck	cosmetics
Salicaceae	<i>Salix excelsa</i> S.G.Gmel.	prepare candy
Sapindaceae	<i>Acer turcomanicum</i> Pojark.	bark is used to produce violet color, washing dishes
Sapindaceae	<i>Dodonaea viscosa</i> (L.) Jacq.	toothbrush
Verbenaceae	<i>Aloysia citriodora</i> Palau	production of volatile oil
Viburnaceae	<i>Sambucus nigra</i> L.	destroy baby insects and various pests of vegetables

3. Discussion

Iran, renowned as one of the earliest civilizations in the world, possesses a worthwhile history in traditional medicine, dating back to the Babylonian–Assyrian civilization era. Iran is not only rich in its biodiversity, but it is also well known as a country with high ethnic diversity. It is a multi-ethnic country with various ethnic groups including Persians, Kurds, Arabs, Lurs, Turkmen, Baluch, and Azari communities. Due to the ancient civilization and various ethnicities, as well as its situation at the heart of the Silk Road that connected it with other countries, Iran enjoys a variety of cultures, providing a rich backbone for the expansion of ethnobotanical knowledge and plant-based medicines [1].

In the last decades, several ethnobotanical investigations have been reported in various geographical regions of the country [55]. However, there are no distinct references on the ethnobotanical applications of Iranian woody plants and most of the publications and documents are scattered. Thus, we compiled these scattered data together in a single document for the next scientific works with ethnobotanical interests. To our knowledge, this paper presents the first comprehensive report associated with the ethnobotanical uses of woody plants in Iran.

In this review, a total of 174 species of trees and shrubs belonging to 56 families were recorded and found to be useful to cure various ailments in different regions of Iran (Table 1).

From the taxonomical point of view, woody plants that are being used for ethnobotanical purpose in Iran belong to gymnosperms (9 species from Cupressaceae, Ephedraceae, and Taxaceae) and angiosperms (monocots contain 3 species and Dicots contain 162 species). Our results revealed that the maximum number of ethno-medicinal plant species belongs to family Rosaceae (38 species) followed by Fabaceae (12 species) and Rutaceae (10 species). In ethnofloristic works conducted in Iran, these three families are always predominating at the top of the list [1,55].

Family Rosaceae comprises of ca. 91 genera and 2950 species/infraspecific taxa in the world [56]. Among the chemical components, sugar alcohols, terpenoids, tannins, cyanogenic glycosides, saponins, mucilage, and cyclitols have been reported in this family [57]. Rosaceae is the first large family in case of diversity and endemism of trees and shrubs in Iran, including many medicinal woody species. Different species of this family including *Cotoneaster nummularius* Fisch. & C.A.Mey., *Cydonia oblonga* Mill., *Rosa beggeriana* Schrenk ex Fisch. & C.A.Mey., *Rosa × damascena* Mill., *Rosa foetida* Herrm., and *Sorbus aucuparia* L. are the most popular in Iranian folk medicine, and are often used for the treatment of digestive ailments, neurological complaints, urinary disorders, and diabetes [1,55,57,58].

The genus *Rosa* L. is one of the most important genera in this family, which includes approximately 200 shrubby species distributed widely throughout the temperate and subtropical habitats of the northern hemisphere. Roses have worldwide economic importance as a source of essential oils for perfumes, for medicinal properties, as ornamental plants, and in the cut flower industry. Several species of this genus are being used for ethnobotanical purpose in Iran. Rose water is used as dietary supplements and alternative medicine and is commonly used for flavoring in baking and other cooking. Rose water is referred to the liquid obtained from the cooled steam (distillation) of *Rosa × damascena* (Tables 1 and 2). Furthermore, the fruits (hips) of different species of *Rosa* genus have a long history of traditional use in folk medicine in different parts of the world. In Iranian traditional medicine, the fruits of *R. canina* and *R. beggeriana* are used as a diuretic and for the treatment of hypertension and kidney stones [50,51,59].

Fabaceae (Leguminosae) is the third major family of vascular plants in the world and contains ca. 751 genera and 19,500 species/infraspecific taxa [56]. Among the chemical components, unusual aminoacids and tannins occur in the family, often with alkaloids and sometimes cyanogenic. It is the largest plant family in Iranian flora, including many medicinal plants. Various woody species of this family including *Alhagi* spp., *Astragalus* spp., *Colutea buhsei* (Boiss.) Shap., *Indigofera oblongifolia* Forssk., *Prosopis cineraria* (L.) Druce, *Indigofera argentea* Burm.f., and *Sophora mollis* (Royle) Graham ex Baker, are the most popular

plants in Iranian traditional remedies and are often used for the cure of urinary disorders, gastrointestinal ailments, respiratory diseases, and metabolic problems [1,25]. *Astragalus* L. comprises of ca. 2900 annual and perennial species which is the largest genus in the plant kingdom and widely utilized as ornamental, medication, food, and fuel. The resins from *A. gummifer* were used for the production of Katira, which is mainly applied as a hair tonic [1,42,57,60].

Among the Fabaceae spp., different *Alhagi* species, have notable traditional medicinal properties in various regions of the country. Tarangabin, a kind of manna which is produced on some *Alhagi* species, is collected mostly in Iran and Afghanistan, and exported from these areas to other countries [61]. It is sweet, yellowish white in color and semi-liquid exudate, created on the aerial parts of some *Alhagi* species which is produced by an insect called *Poophilus nebulosus* Leth. The medicinal properties of Tarangabin have been mentioned in some major Materia Medica manuscripts in the Islamic era. Tarangabin has various pharmacological properties including antioxidant, anti-inflammatory, antipyretic, diaphoretic, diuretic, expectorant, analgesic, and gastrointestinal effects [61].

Family Rutaceae comprises of ca. 148 genera and 2070 species/infraspecific taxa in the world [56]. It comprises a wide variety of alkaloids, volatile oils, rhamno-glucosides, coumarins and terpenoids. Alkaloids include alkaloidal amines, imidazole, indole isoquinoline, pyridine, pyrrolidine, quinazoline types. Many of the fruits are rich in citric acid and other acids including vitamin C [57]. It includes many economically and medicinally important species [1,57]. In the ethnobotanical diversity of trees and shrubs of Iran, the dominance of Rutaceae is basically explained by the genus *Citrus*. It is one of the world's major fruit crops with global availability and popularity contributing to human health and diets [53]. In Iran, different species of this genus are consumed in food, beverage, cosmetic and therapeutic applications (Tables 1 and 2) [53].

Some of the reported plants in this paper were well-known for the people of the region and have a long reputation in Iran. Our survey showed that there were several *Quercus* spp. with different applications and many recent papers confirmed some of their activities [62]. For example, *Quercus brantii*, *Q. infectoria* and *Q. robur* bearing galls have been traditionally used for centuries by the people of Iran (Tables 1 and 2). The regions of the Zagros Mountains in the west of Iran, are the main producer of the oak galls. The galls are even smuggled out of the country illegally because of their high economic value. Gallic acid and its derivatives isolated from *Quercus* species demonstrated a broad range of beneficial effects in prevention and/or management of several disorders; also, their acceptable safety and stability profiles make them significant options to be introduced as dietary supplements. These compounds have been reported to have therapeutic activities in gastrointestinal, neuropsychological, metabolic, and cardiovascular disorders [42,62].

Moreover, some of the plants listed in this study were only used in Iranian folk medicine. For instance, *Ribes khorasanicum* Saghafi & Assadi, known as Ghareh Ghat, that grows only in Iran and was prescribed for the treatment of diabetes and as antihypertensive. Another example is *Amygdalus lycioides* Spach is a species of almond that grows only in Iran and was used by Lor people for the treatment of diabetes, cough, nausea, intestinal worms, toothache, and infectious wounds [42]. *Prunus eburnea* and *P. haussknechtii* are another example; they are endemic popular medicinal plants that are used by traditional healers for treating alopecia, hyperlipidemia, hypertension, toothache, and as a laxative.

Our results showed that people reported using medicinal plants mostly for the treatment of gastrointestinal problems. Similarly, this pattern can be seen in ethnofloristic works conducted in various areas of the country. The prevalence of gastrointestinal problems such as constipation, indigestion, diarrhea, vomit, gastroenteritis, and reflux is very high in Iran. In addition, because of the side effects inherent to synthetic drugs, the exploration of new natural drugs with minimum adverse effects is highly welcomed. For this purpose, medicinal plants are good candidates especially since they are more compatible with human nature [55].

In addition to the potential therapeutic application of trees and shrubs of Iran, many other woody plants are also used for food (edible oils, flavorings, beverages, etc.), perfumery and cosmetics, natural dyes, handicraft, house building, insecticides and ornamentals. Most of the wild fruits and seeds (mostly *Berberis integerrima*, *Pistacia* spp., *Quercus* spp., *Crataegus pontica*, *Prunus mahaleb*, *Myrtus communis*, *Rosa canina*, *Rubus caesius*, *Cornus mas*, *Corylus avellana*) are used for food (Tables 1 and 2). In Iran, traditional food is known to be an important source of dietary energy for local and ethnic people. For example, one of the famous foods, commonly known as “Qovato” which is prepared by a mixture of fruits and seeds powder of 19 plants, particularly *Pistacia vera* L., *Juglans regia* L., *Myrtus communis* L., *Coriandrum sativum* L., and *Sesamum indicum* L. Indigenous people believe that it will strengthen male potency and improves intelligence and memory [31,63]. Another example is acorn seeds (particularly *Quercus brantii* and *Quercus infectoria*) that are used for bread production by local people in southern and western Iran (especially in the provinces of Kurdistan and Luristan). Indigenous people use a corn flour for the preparation of flatbreads and cakes, particularly when other resources are lacking. *Quercus* species are considered as a nutritionally rich source of energy (source of carbohydrates, proteins, and fat), justifying their use as food or ingredient food for thousands of years in the human diet, such as in bread production or as an ingredient for making coffee [64,65].

Therefore, this review demonstrates that various species of trees and shrubs of Iran have great traditional uses in different ethnobotanical practices throughout the country. However, despite the rich knowledge that lies behind the folk uses of the Iranian ethnoflora, few attempts have been made to evaluate the phytochemical and biological potential of endemic woody species such as *Ribes khorasanicum*, *Prunus eburnea* and *P. haussknechtii*. According to the results of our study, some species should be given precedence in subsequent investigations, particularly for the treatment of some globally prevalent diseases such as diabetes, including *Ribes khorasanicum* Saghafi & Assadi, *Rhizophora mucronata* Poir., *Berberis integerrima* Bunge, *Prunus spinosa* L., *Quercus brantii* Lindl., *Vaccinium arctostaphylos* L., *Rhus coriaria* L., and *Ziziphus jujuba* Mill. (Table 1). In this context, the best and quickest way to species selection for phytochemical, biological and pharmacological studies is by reviewing the ethnobotanical literature, which highlights the importance of such studies [66].

Finally, some Iranian tree and shrub species have a narrow distribution and collection from wild populations will threaten these taxa. Some rare and endemic species of trees and shrubs including *Ribes khorasanicum* Saghafi & Assadi, *Prunus eburnea* (Spach) Aitch. and *P. haussknechtii* C.K.Schneid. are frequently used in Iranian traditional medicine (ITM), which was one of this study’s most intriguing findings. *Ribes khorasanicum* is an important endemic medicinal plant, which has been severely harvested and is now endangered (EN) with narrow distribution and low abundance. *Prunus eburnea* and *P. haussknechtii* are threatened medicinal plants belonging to the Rosaceae family. Continued overutilization and habitat degradation of these invaluable species for therapeutic and food purposes may lead to the eradication from the area. Due to overharvesting, these species are calling a wake-up alarm for conservation.

4. Methods

The relevant articles about ethnobotanical uses of trees and shrubs species by the Iranian people were searched from 1937 to 2022. The literature survey was performed using various electronic databases (Medline, PubMed, Science Direct, Scopus, and Google Scholar websites). In addition, some Persian papers, botanical and folk medicine books [15,30] were considered. The following keywords were selected: “trees and shrubs species in Iran”, “Iranian medicinal plants”, “ethnobotanical uses of trees and shrubs in Iran”. After a comprehensive search, we reviewed a total 66 publications that provided beneficial information about different application of these medicinal trees and shrubs in human and livestock, in Iran. In this review, scientific and author names of medicinal trees and shrubs were checked for the latest changes according to the database www.theplantlist.org. All statistical analysis was carried out with Microsoft Excel 2019 software.

5. Conclusions

Ethnobotany is the organized survey of plants and their applied usages through the folklore information of an autochthonous culture and people. Ethnobotanical studies have been conducted in many areas of Iran and by collecting them, knowledge of the use of plants in the treatment of diseases can be well-maintained. To conclude, the information in this scientific literature review, related to documented traditional medicinal practices and ethnobotanical knowledge of shrub and tree species in Iran, represents a useful tool to species collection for phytochemical and pharmaceutical surveys and such data should be preserved for the production of plant-based medicine research in the future. In our opinion, there is still a large space for scientific research that could deepen the above-stated aspects, encouraging further research in this field. Further comprehensive pharmacological, ecological, and clinical studies as well as phytochemical investigations of Iranian endemic medicinal trees and shrubs are recommended. Furthermore, several endemic taxa of trees and shrubs of Iran are potentially threatened species. Special consideration should be given to these plants in the area and protection from extinction by excessive utilization. Some of these invaluable species have very limited distribution in the country and need special conservation strategies for their survival. If overexploitation and habitat destruction of such invaluable medicinal plants is continued, they may vanish from the area within a few years.

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