

ORIGINAL RESEARCH ARTICLE

Biodiversity of medicinal plants in the dry deciduous (thorny scrub) forest of Karnataka, India

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ABSTRACT

Tropical dry deciduous forests are noted for their numerous uses. They are rich repositories of medicinal plants used as raw materials in the industry and mostly harvested from the forests. The only way to preserve plant resources' core knowledge for future generations is to document medicinal plants. The present survey is designed to study the biodiversity of medicinal plants in the dry deciduous (thorny scrub) forest of Karnataka, India. This study resulted in the documentation of 64 ethnomedicinal plant species, which belong to 37 families and 59 genera. The documented families of medicinal plants in the study area are Asphodelaceae, Acanthaceae, Amaranthaceae, Annonaceae, Anacardiaceae, Apocynaceae, Aristolochiaceae, Asclepiadaceae, Asparagaceae, Asteraceae, Bixaceae, Colchicaceae, Combretaceae, Convolvulaceae, Fabaceae, Hypoxidaceae, Lamiaceae, Loganiaceae, Malvaceae, Martyniaceae, Meliaceae, Menispermaceae, Myrtaceae, Nyctaginaceae, Oleaceae, Oxalidaceae, Phyllanthaceae, Plumbaginaceae, Rhamnaceae, Rubiaceae, Rutaceae, Santalaceae, Sapindaceae, Solanaceae, Verbenaceae, Vitaceae, and Zygophyllaceae. The report shows that the Fabaceae family has high species richness, while Gardenia gummifera has shown high species evenness in a defined area. However, the documented plants include common, rare, endemic, and endangered categories of species.

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INTRODUCTION

Medicinal plants have been used in traditional health care systems since prehistoric times, and 70 to 80 percent of people worldwide use them to meet their primary health care needs (Upreti *et al.*, 2010). Medicinal plants can be a substantial source of revenue for rural people in developing nations, mainly through selling wild-harvested material, which accounts for 15 to 30 percent of impoverished households' total income (Hamilton, 2004). Medicinal plants are a valuable part of nature's resources, and they are now acknowledged all around the world. This category includes

an estimated 30,000 species. Tribal peoples use approximately 90 percent of the species, and 10 percent of the world's recognized medicinal plants are traded nationally and worldwide. Tropical forests are home to over 70 percent of the world's known vegetation, while temperate, alpine, and high-altitude settings account for the remaining 30 percent of vegetation (KBB, 2012). Moreover, few raw pharmaceuticals in the country come from cultivated sources. Only 36 medicinal plant species are entirely derived through cultivation, out of 178 with a high volume of commerce of > 100 MT per year. However, among 36 species,

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large-scale cultivation of isabgol, senna, henna, and aswagandha has been practiced in the country. sweet flag, muskdana, *Aloe vera*, and Malabar nut have stabilized agro-technology practices and have already entered local agricultural systems (Ved and Goraya, 2008). Around 860 medicinal plant species are traded in India, with 70 percent obtained from the wild. Due to inefficient agriculture and quality control methods, a lack of processing, research and development, product standardization, and a regulatory framework in the medicinal plant trade, India's share in worldwide exports of herbs and herbal products is low (IBEF, 2020).

Karnataka, India's southernmost state, has 3.83 million hectares of forest land, accounting for nearly 20 percent of the state's total land area. It has the most diverse collection of medicinal plants in the country. Karnataka is expected to have around 4,800 flowering plant species, with roughly 2,000 of these being medicinal (FRLHT, 2010). However, their importance as a component of biodiversity has recently been recognized in the forestry industry, as it has been revealed that roughly 85 percent of the country's known and recorded medicinal plant diversity is found in forests and wild environments (FRLHT, 2006). The International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species includes over 560 plant species from India. Two hundred forty-seven of these species are endangered (Sharma and Thokchom, 2014). It's also becoming apparent that wild sources account for 82 percent of high-consumption botanicals (> 100 MT per year) in the trade (Ved and Goraya, 2008). As a result of this insight, the forestry industry is concerned about medicinal plant resources. There is a great deal of pressure on forests to harvest medicinal plants as raw materials for herbal medicines, which has resulted in a significant loss of medicinal plants (Babu and Basha, 2007). There have been numerous attempts to protect therapeutic plant-rich forest areas. One example is the declaration of medicinal plant conservation areas in Karnataka state. The abundance of medicinal flora in the forest must be explored and recorded to meet the demands of the developing herbal medicinal industry (Sandhya, 2004). Surveying and recording the prevalence of these plants in each of the documented forest regions is critical. This study is an attempt to assess the occurrence, distribution, and diversity of these plants in the dry deciduous (thorny scrub) forest of

Karnataka state, India.

MATERIALS AND METHODS

The present study was conducted at Channapatna (Tenginakallu, SF) range forest in the Ramanagara division, Bengaluru circle, Karnataka, India. The Ramanagara division contains dry deciduous and scrub-type forests. In contrast, the Tenginakallu forest range is an open low forest dominated by thorny, typically hard-wooded species such as *Acacia catechu*, *Acacia pennata*, *Albizia amara*, *Chloroxylon swietenia*, *Wrightia tinctoria*, *Acacia suma*, *Azadirachta indica*, *Erythroxylum monogynum*, *Ziziphus jujuba*, *Pterolobium indicum*, *Dodonaea viscosa*, and others are some examples of this type of plant. Plants were identified using Flora (Gamble, 1995; Ramaswamy *et al.*, 2011) and medicinal plant literature (Prajapati *et al.*, 2003). The plants were photographed and identified with the help of taxonomists.

RESULTS AND DISCUSSION

In the current study, plants with medicinal uses were studied and identified. A total of 64 plant species were documented from the different parts of the study area. Those 64 plants include trees, herbs, and shrubs. The documented plant species consist of 37 families with 59 genera, while 59 species belong to the dicot families and five belong to monocot families. The present study shows that tree vegetation is dominating the area. The high species richness was recorded in the families such as Fabaceae (11) followed by Lamiaceae (05), Apocynaceae, Rubiaceae, Rutaceae (3 each), Asparagaceae, Anacardiaceae, Phyllanthaceae, Menispermaceae, Verbenaceae, Combretaceae, Malvaceae (2 each), Acanthaceae, Asphodelaceae, Amaranthaceae, Annonaceae, Aristolochiaceae, Asclepiadaceae, Asteraceae, Bixaceae, Colchicaceae, Convolvulaceae, Hypoxidaceae, Loganiaceae, Martyniaceae, Meliaceae, Myrtaceae, Nyctaginaceae, Oleaceae, Oxalidaceae, Plumbaginaceae, Rhamnaceae, Santalaceae, Sapindaceae, Solanaceae, Vitaceae, and Zygophyllaceae (1 each) (Figure 1). However, the documented medicinal plants also endemic, and endangered species such as *Decalepisha miltonii* (Reddy and Murthy, 2013) (Fig. 2C) and *Curculigo orchioides* (Thangavel and Ravichandran, 2002; Chauhan *et al.*, 2010) (Fig. 2G) as well as endemic species such as *Gardenia gummifera* (CAMP, 1998)

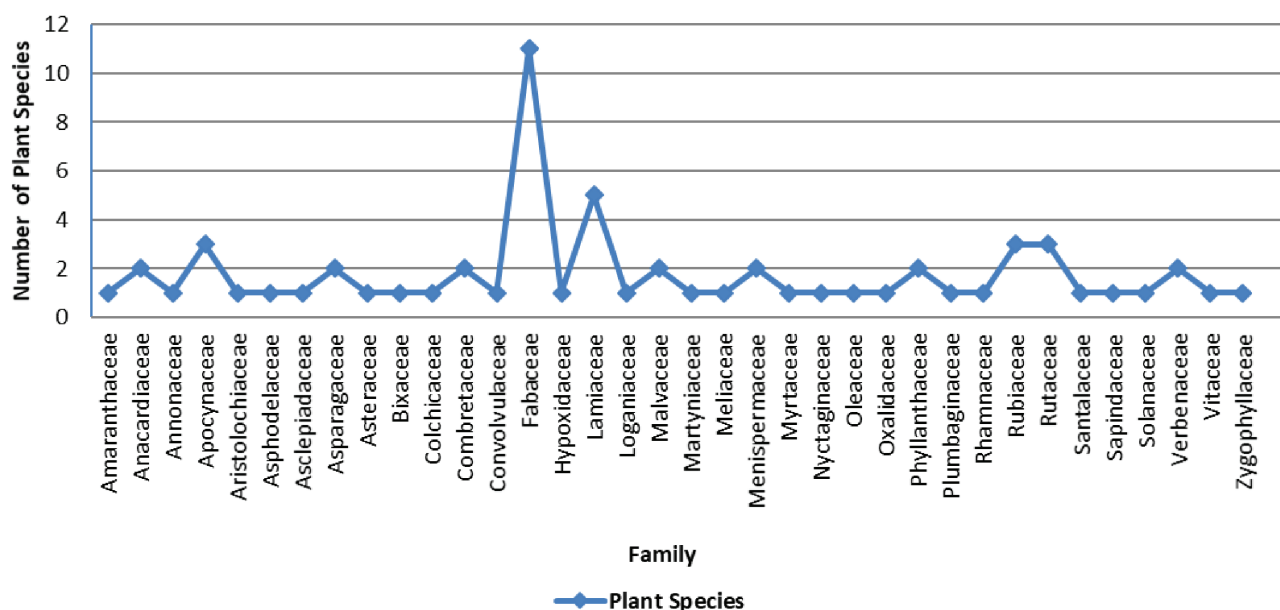


Figure 1: The number of medicinal plant species in each family.

(Fig. 2 B). The plant species that fall under the rare and endangered categories are due to various external factors. Hence, these wild plant species should be conserved and encouraged for large-scale cultivation and to develop many herbal gardens for medicinal plants.

Bioactive substances, such as alkaloids, terpenoids, coumarins, flavonoids, nitrogen-containing compounds, organosulfur compounds, phenolics, and other bioactive chemicals, have a broad spectrum of activities and are used for therapeutic purposes (Mustafa *et al.*, 2017). The documented medicinal plants are used in the treatment of various ailments like asthma, arthritis, boils, bleeding hemorrhoids, diarrhea, dysentery, gastric ulcers, headaches, toothaches, swelling, inflammation, skin diseases, stomach disorders, cholera, colds, coughs, rheumatism, ringworm, smallpox, urinary infections, stomach disorders, antioxidants, antibacterial, anti-inflammatory, antipyretic, hepatoprotective, antidiabetic, antiulcer, etc. The root, leaf, fruit, flower, bark, or whole plant is used to cure disease depending upon the type of plant (Shiddamallayya, 2010; Petrovska, 2012; Sofowora *et al.*, 2013; Singh, 2015) (Table 1).

Medicinal plants are local medicines' main ingredients and are vital in traditional healthcare. People use medicinal plant species to sustain their

conventional healthcare systems both logistically and economically. In terms of conservation, the species recovery program consists of conserving the habitat of threatened medicinal plants and taking steps to enhance production. It seems to be the only solution to stop further degradation. The Karnataka Forest Department has initiated various programs for conserving medicinal herbs, shrubs and trees associated with traditional methods of medicine. The traditional knowledge-based Indian ethnic medicine system can help in improving general wellness. As a result, promoting *in situ* conservation of these medicinal plants in natural resources is critical. It is also necessary that these plants are made available for people to meet their needs for medicinal plants. Hence, *in-situ* and *ex-situ* conservation strategies are required (FRLHT, 2006).

CONCLUSION

The current study gives basic information regarding medicinal plant species and distribution and descriptive information, which will be valuable for future research and fieldwork in the dry deciduous (thorny scrub) forest. Many helpful plant species are on the edge of becoming rare, endangered, or extinct, and these wild medicinal plant species are recommended to be conserved within their habitat.



Figure 2:A) A out view of the forest; B) *Gardenia gummiifera*; C) *Decalepis hamiltonii*; D) *Jasminum cuspidatum*; E) *Aloe barbadensis*; F) *Asparagus recemosus*; G) *Curculigo orchioides*; H) *Drimia indica*.

Table 1: A list of medicinal plants, along with their common, botanical, family names, and medicinal uses:

Sl. No.	Class	Common name	Botanical name	Family	Important medicinal uses
1.	M	Aloe vera	<i>Aloe barbadensis</i>	Asphodelaceae	Leaves in piles, vomiting and blood disorders.
2.	M	Satavar	<i>Asparagus recemosus</i>	Asparagaceae	Root in diarrhea, cough, piles, fever, defects in vision, epilepsy, urinary diseases, hyperacidity, nervous system diseases, gastritis, diabetes and cough; leaf in skin diseases.
3.	D	Golden apple	<i>Aegle marmelos</i>	Rutaceae	Fruit in diarrhea, stomach disorders, jaundice, vomiting, obesity, deafness, eye diseases, pediatric diseases, fever, digestive problems and piles.
4.	D	Rosary pea	<i>Abrus precatorius</i>	Fabaceae	Whole plant in tetanus and rabies; leaves in fever, cough and cold; root in jaundice and hemoglobinuria bile; dry seeds in worm infection
5.	D	Indian birthwort	<i>Aristolochia indica</i>	Aristolochiaceae	Leaves and bark in the bowel complaints of children, diarrhea and intermittent fevers; root in skin diseases, heals wounds and destroys the toxic effect of all poisons.
6.	D	Malabar nut	<i>Adhatoda vasica</i>	Acanthaceae	Leaves in dysentery and diarrhea; flowers in respiratory tract infections; fruit and seeds in ear pain; root in tuberculosis and whooping cough.
7.	D	Neem	<i>Azadirachta indica</i>	Meliaceae	Whole plant in piles, wound, skin diseases, eye diseases, toothache and antiseptic.
8.	D	White siris	<i>Albizia procera</i>	Fabaceae	Leaves in night blindness, helminthiasis conjunctivitis, gonorrhea, earache, corneal opacity and gastralgia; stem bark in ulcers, cough, migraine, jaundice, leprosy, numbness, boils and furuncles, pruritus, paralysis, facial palsy, orchitis, and neurological diseases.
9.	D	Sugar apple	<i>Annona squamosa</i>	Annonaceae	Seeds in abolish lice; leaves in boils and ulcers; fruit in heart ailments, alleviate vomiting and treat tumors.
10.	D	Flame of the forest	<i>Butea monosperma</i>	Fabaceae	Bark in liver disorders, dysmenorrhoea and gonorrhea; Seeds in anthelmintic; flowers in leprosy, gout, skin, and eye diseases.
11.	D	Spreading hogweed	<i>Boerhavia diffusa</i>	Nyctaginaceae	Whole plant in asthma, urinary disorders, piles, anemia, cardiac diseases, and stomach disorders.
12.	D	Chironji	<i>Buchanania lanzan</i>	Anacardiaceae	Leaves in skin diseases; roots in diarrhea; fruits in coughs and asthma.
13.	D	Butterfly tree	<i>Bauhinia purpurea</i>	Fabaceae	Seeds in intestinal parasites; flowers and leaves in blood purification.
14.	M	Golden eye-grass	<i>Curculigo orchoides***</i>	Hypoxidaceae	Root in cough, jaundice, asthma, and piles.
15.	D	Golden shower	<i>Cassia fistula</i>	Fabaceae	Whole plant in fever, cardiac disorders, jaundice, wounds, and accidental wound.
16.	D	Lesser balloon vine	<i>Cardiospermum halicacabum</i>	Sapindaceae	Root in nervous diseases, piles and cardiac diseases; leaves in lumbago and glandular swellings.

17.	D	Mature tea tree	<i>Cassia auriculata</i>	Fabaceae	Root in skin troubles; seeds in eye troubles and diabetes.
18.	D	Devil's backbone	<i>Cissus quadrangularis</i>	Vitaceae	Stem in fracture, infertility, scurvy, and piles.
19.	D	Velvet leaf	<i>Cissampelos pareira</i>	Menispermaceae	Whole plant cure ulcers, wounds, rheumatism, fever, asthma, cholera, diarrhea, inflammation, snakebite, malaria, and rabies.
20.	D	Glory flower	<i>Clerodendrum serratum</i>	Verbenaceae	Leaves in bronchial asthma, cough, piles, goiter and burning sensation; root in the accidental wound.
21.	D	Silk cotton tree	<i>Cochlospermum gossypium</i>	Bixaceae	Leaves in cough, gonorrhea, syphilis and trachoma
22.	D	Mexican tea	<i>Chenopodium ambrosioides</i>	Amaranthaceae	Used in infusions for inflammatory problems, contusions, and lung infections, and as purgative, analgesic, as a vermifuge to expel roundworms and hookworms, and as an antifungal.
23.	D	Swallow root	<i>Decalepis hamiltonii</i> ***	Apocynaceae	Tuber in dysentery, uterine hemorrhages, skin diseases, chronic rheumatism, anemia, coughs and bronchitis.
24.	M	Sea onion	<i>Drimia indica</i>	Asparagaceae	Bulb in dropsy, cough, respiratory ailments, jaundice, skin problems, leprosy, calvities, gastric disorders, cancer, epilepsy, joint pain and using as an antidote
25.	D	Amla	<i>Emblica officinalis</i>	Phyllanthaceae	Fruits in inflammation, cancer, osteoporosis, neurological disorders, hypertension together with lifestyle diseases, parasitic and other infectious disorders
26.	D	Dwarf morning-glory	<i>Evolvulus alsinoides</i>	Convolvulaceae	Whole plant in hair growth, sterility in females, skin diseases, piles, and cough.
27.	D	Australian cow plant	<i>Gymnema sylvestre</i>	Apocynaceae	Leaves in headache, hydrocele, leprosy and poisoning.
28.	M	Flame lily	<i>Gloriosa superba</i>	Colchicaceae	Used in cancer, gout, and scrofula and act as antipyretic, anthelmintic, purgative and anti-abortion
29.	D	Cambi gum tree	<i>Gardenia gummifera</i> *	Rubiaceae	Resin intermittent fever, nervous disorders, diabetes, skin diseases, liver disorders and wounds.
30.	D	Beechwood	<i>Gmelina arborea</i>	Lamiaceae	Root in fever, dyspepsia, hemorrhoids, stomachalgia, heart diseases, nervous disorders, piles and burning sensation; Bark in fever and dyspepsia.
31.	D	Indian sarsaparilla	<i>Hemidesmus indicus</i>	Apocynaceae	Root in the wound, spider poisoning, urinary diseases, skin diseases, anemia, jaundice, diabetes and glandular swellings.
32.	D	True indigo	<i>Indigofera tinctoria</i>	Fabaceae	leaves in epilepsy, nervous disorders, asthma, bronchitis, fever, complaints of the stomach, liver, kidney and spleen; root in antidote against snakebites and to treat insect and scorpion stings
33.	D	Pointed-Leaf Jasmine	<i>Jasminum cuspidatum</i>	Oleaceae	Flowers in heart disease, diabetes, bilious, burning sensation, thirst, diseases of blood and skin, ulceration of mouth, teeth and eye.

34.	D	Wood-apple	<i>Limonia acidissima</i>	Rutaceae	Fruit is stomachic, stimulant, astringent, aphrodisiac, diuretic, cardiotonic, tonic to liver and lungs, cures cough, hiccup and is suitable for asthma, consumption, tumors, ophthalmia and leucorrhoea.
35.	D	Cat's claw	<i>Martynia diandra</i>	Martyniaceae	Leaves in epilepsy, dysentery, cardiac problems, worm infestation, constipation, hemorrhage, antibacterial infection, dysuria, fever, and ulcer.
36.	D	Indian mulberry	<i>Morinda tinctoria</i>	Rubiaceae	Fruit in high blood pressure, arthritis, ulcers, depression, sprains, menstrual cramps, pain relief, inflammation, burns, fever, food poisoning, intestinal worms, and joint problems.
37.	D	Holy basil	<i>Ocimum sanctum</i>	Lamiaceae	Leaves in acute respiratory problems, malaria, indigestion, headache, hysteria, insomnia and cholera.
38.	D	Hoary basil	<i>Ocimum americanum</i>	Lamiaceae	Leaves in arthritis, anti-aging, skin, liver, oral and lung cancers.
39.	D	Sweet basil	<i>Ocimum basilicum</i>	Lamiaceae	Leaves in headaches, coughs, diarrhea, constipation, warts, worms, urinary infection, and kidney malfunction
40.	D	Yellow wood sorrel	<i>Oxalis stricta</i>	Oxalidaceae	Used topically to cool skin and soothe the stomach as a diuretic and astringent.
41.	D	Gale of the wind	<i>Phyllanthus amarus</i>	Phyllanthaceae	Whole plant in eye diseases, hiccup, anemia, jaundice, thirst, leprosy and urinal disorders.
42.	D	Ceylon leadwort	<i>Plumbago zeylanica</i>	Plumbaginaceae	Root in piles, filaria, diarrhea, stomach diseases, cough, anemia and obesity.
43.	D	Bastard teak	<i>Premna tomentosa</i>	Lamiaceae	Leaves, stem bark, and roots in asthma, rheumatism, neuralgia, diarrhea, stomach disorder, hyperglycaemic, and obesity
44.	D	Indian kino	<i>Pterocarpus marsupium</i>	Fabaceae	Leaves in fractures, constipation, hemorrhages, skin diseases, depurative, ophthalmology, leprosy, rectalgia, leucoderma, rheumatoid arthritis, skin diseases, and gastrointestinal disorders.
45.	D	Pongam oil tree	<i>Pongamia pinnata</i>	Fabaceae	Leaves in vomiting; seeds in cough, wounds and skin diseases.
46.	D	Indigo berry	<i>Randia aculeate</i>	Rubiaceae	Leaves and fruits in snake bite, muscular tissue damage and the diminution of red blood cells.
47.	D	Fringed rue	<i>Ruta chalepensis</i>	Rutaceae	Whole plant in earache, epilepsy, indignation, stomachache and skin diseases.
48.	D	Indian sandalwood	<i>Santalum album</i>	Santalaceae	Heartwood in vomiting, burning sensation and skin eruption; oil in eye diseases, worm infection, fever, dysentery and piles.
49.	D	Marking nut tree	<i>Semecarpus anacardium</i>	Anacardiaceae	Fruits in astringent, rubifacient, counter irritant and aphrodisiac properties.
50.	D	Clearing -nut tree	<i>Strychno spotatorum</i>	Loganiaceae	Seeds in eye diseases, diarrhoea, diabetes, gonorrhea, piles and cough.
51.	D	Blue snakeweed	<i>Stachytarpheta urticifolia</i>	Verbenaceae	Leaves and flowers in gastrointestinal dysfunctions, liver-related disease, and respiratory problems.

52.	D	Common wire weed	<i>Sida acuta</i>	Malvaceae	Leaves and flowers in asthma, tuberculosis, the common cold, flu, headaches, nasal congestion, cough and wheezing, urinary tract infections, sore mouth, and fluid retention.
53.	D	Flannel weed	<i>Sida cordifolia</i>	Malvaceae	Root in diarrhea, goiter, bleeding piles and nervous disorders; leaf in cardiac disorders; bark in urinary troubles.
54.	D	Jamun	<i>Syzygium cumini</i>	Myrtaceae	Seeds in diarrhea, cough and thirst; bark in diabetes and wound healing; leaves in vomiting.
55.	D	Humming bird tree	<i>Sesbania grandiflora</i>	Fabaceae	Leaves in thirst scabies; bark in promoting memory, ulceration of tongue and alimentary canal disorders; flowers in night blindness and improve vision.
56.	D	Heart-leaved moon seed	<i>Tinospora cardifolia</i>	Menispermaceae	Root in vomiting; leaves in fever, cough, irregular fever, jaundice, eye diseases and diabetes; stem in anemia.
57.	D	Antamool	<i>Tylophora indica</i>	Asclepiadaceae	Leaves in allergies, asthma, cancer, congestion, constipation, cough, inflamed skin, diarrhea, bloody diarrhea, gas, hemorrhoids, tender joints, yellowed skin, joint disorder, whooping cough, making someone vomit, and to cause sweating.
58.	D	Tamarind tree	<i>Tamarindus indica</i>	Fabaceae	Bark and leaves in antiparasitic; fruits in antipyretic; leaves in malaria.
59.	D	Arjuna	<i>Terminalia arjuna</i>	Combretaceae	Seeds in wounds, piles and cough.
60.	D	Bedda nut tree	<i>Terminalia bellirica</i>	Combretaceae	Fruits in cough, cold, asthma, jaundice, leprosy, anemia, cardiac problems, diabetes and urinary problems
61.	D	Devil's -thorn	<i>Tribulus terrestris</i>	Zygophyllaceae	Leaves and fruits in bright's disease, water pill, skin disorders, and psoriasis.
62.	D	Ironweed	<i>Vernonia cinerea</i>	Asteraceae	Flower in stomachic, asthma, fever, cough, boils, vomiting, blood disorders, skin diseases and filaria.
63.	D	Ashwagandha	<i>Withania somnifera</i>	Solanaceae	Root in rejuvenating, bronchial asthma, cardiac disorder, suppression of urine, cough, dropsy, ulcers, blood disorders, scabies, and tonic; leaf in painful swelling and sore eyes
64.	D	Indian jujube	<i>Ziziphus jujuba</i>	Rhamnaceae	Fruits in joint pain, dandruff, acne, chronic constipation, antiseptic, sedative, hypnotic and cardiac diseases.

M = Monocotyledons, D = Dicotyledons; *** = rare, endemic, and endangered; * = endemic.

Conflict of interest

The author declares that they have no conflict of interest.

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