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Ethnomedicinal practices in the arid zone of India: A study in urban and semi-urban areas of Bhuj, Gujarat

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ABSTRACT

Plants are a vital and life-sustaining natural resource as they provide many ecosystem services and supply food, fibre, fuel, medicine, etc. They are distributed heterogeneously in different ecosystems. With the increasing urbanization in all parts of the world, the vegetation overlapped with urban localities like parks, gardens, roadsides, wasteland and other human habitations. Among this vegetation, many of them are used in ethnomedicine or in ayurvedic medicine by people for a long period of time. These valuable plant resources are now under threat due to various anthropogenic activities in the urban landscape. Bhuj is a small historic city in the arid zone of India with a rich diversity of medicinal plants. With the increasing human population and associated developmental activities within the city, many of these plants are under threat of extinction. Therefore, an attempt was made to document these medicinal plants distributed in different parts of the city and their uses for ethnomedicinal purposes. The plants were intensively surveyed and documented using a questionnaire survey, discussion and cross-checked with available literature. A total of 123 species of ethnomedicinal plants were documented and analysed for their uses in curing different health problems and conservation purposes in the urban landscape.

Keywords: Medicinal plant, Ethno-medicine, Urban landscape, Arid zone, Bhuj

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INTRODUCTION

Traditional Ayurveda is a sophisticated system of medicine that has been practiced in India for over 2,500 years (Sakarkar *et al.*, 2003). The traditional knowledge is enriched with new knowledge of practice by succeeding generations and becomes a part of the tradition, culture, art, belief, folklore and knowledge base of these traditional communities. Medicinal plants are globally valuable sources of herbal products, and they are disappearing at a high speed (Chen *et al.*, 2016). Medicinal plants are globally valuable sources of new drugs and traditional medicine based on herbal remedies has always played a key role in the health systems of many countries (Verma *et al.*, 2007). With the increasing demand for herbal drugs, natural health products, and secondary metabolites of medicinal plants, the use of medicinal plants is growing rapidly throughout the world (Hamilton, 2004). It is estimated that 70-80% of people worldwide rely chiefly on traditional, largely herbal, medicine to meet their primary healthcare needs (Farnsworth & Soejarto, 1991; Pei, 2001). The global demand for herbal medicine is not only large but growing (Srivastava, 2017). Interestingly, of the

about 3 lakhs of plant species on earth, only 7% of the vascular flora have been exploited for their medical potential (Iverson, 1988). The market for Ayurvedic medicines is estimated to be expanding at 20% annually in India (Subrat *et al.*, 2002). These values concern the contributions that medicinal plants can make to healthcare, financial income, cultural identity and livelihood security (Hamilton, 2004).

The floristic diversity of India is possessing over 45,000 species including 15,000 species of flowering plants of which almost one-third are endemic. At present about 1500 plant Species are being used in the ancient Indian system of medicine, i.e. ayurveda and dietary supplements (Patwardhan *et al.*, 2005). The presence of a sizable strength of ayurvedic pharmaceuticals and the popularity of a wide range of traditional ethnobotanical practices reveal evidence of the rich medicinal flora of Gujarat especially in the tribal belt of the state (Pandey *et al.*, 2005). Kachchh has its unique biogeography and floral diversity due to its geographical location and its climatic features. The entire district falls under the arid-biogeographic zone of the country. The medicinal plants and their ethnomedicinal uses have been reported by some

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authors (Thaker, 1926; Silori & Rana, 2000; Vyas, 2001; GUIDE, 2002; Silori *et al.*, 2004; Patel *et al.*, 2013a, 2013b).

Urban areas like towns and cities are rapidly increasing in area and population all over the world and are projected to triple by 2030 (Batty, 2008). Most urbanization is occurring in regions identified as biodiversity hotspots (Seto *et al.*, 2012). The increasing urbanization leads to profound effects on ecological patterns and processes, including habitat destruction, degradation, and fragmentation; changes to biological assemblages and ecological communities (Nilon *et al.*, 2017). Urban landscapes are nowadays recognized for their wide variety of species, distributed on street edges, in the wasteland/dumpsites, under rocks, in houses, the roofs of houses, gardens, green areas, wetlands, and many other places.

Bhuj is a small urban city located in the northwestern part of Gujarat and the district headquarters of Kachchh. The native vegetation of the city belongs to the tropical thorn forest type. The landscape of the city is undulating and surrounded by a chain of hills like Bhujia Dungar and Tapkeshwari hills. Thus, wide varieties of plant species are distributed in this urban landscape including medicinal plants. The plant diversity of this city is not only providing vital ecosystem service to the urban populace, but they are also a source of many ethnomedicines from time immemorial. Nowadays, these valuable plant resources are facing several threats from the rapid urban development activities of this city. Therefore, a study was attempted to document and assess the medicinal plants and their ethnomedicinal uses in the city.

MATERIALS AND METHODS

Study Area

Kachchh district is located in the westernmost part of India and falls under the desert bio-geographical zone of India (Rodgers & Panwar, 1988). The vegetation of this district is characterized by tropical thorn forests (Champion & Seth, 1968). The district has diverse habitats like; grassland, savannah, mangroves, Rann or saline desert and freshwater wetlands along with tropical thorn forest (Singh, 1998). The plant diversity of the arid and semi-arid region is less diverse in comparison with other tropical forest regions of India, as this region faces high temperatures and very low precipitation.

Bhuj is the district headquarters of Kachchh District, Gujarat, India. It is located at 23° 14' 48.41" N latitude and 69° 40' 23.43" E longitude (Figure 1). The human population of the city is 143286 as per the census, 2011. Bhuj is a historical city located in the heart of the Kachchh District, Gujarat, India. It falls in the arid & semi-region of Gujarat State, India. The city is surrounded by Bhujjiyo Dungar on the eastern side which demarcates Bhuj City and Madhapar town and the southern side lies with the chain of Tapkeshwari hills.

The climate of the city is dry and humid with erratic rainfall. The average annual rainfall of the city is 326 mm and temperature

varies between a minimum of 8°C during winter to a maximum of 45°C during peak summer days.

Field Survey

The field survey for inventory and documentation of medicinal plants will be conducted by demarcating the study area into urban areas and 5km periphery of the city classified as sub-urban areas (Figure 1). A GIS-based map of the study area was prepared for understanding the distribution of medicinal plants and their survey purpose. The field survey covered different seasons. During the field visit the survey of data collection was made in different places of Bhuj city i.e. gardens, parks, roadsides, hedges, wastelands, bare lands, playgrounds, agricultural farms, wetlands, etc.

For unidentified plants, plant specimens collected and were brought to the institute for identification. The herbaria of plant specimens were prepared and further identified with the help of Gujarat flora (Shah, 1978) and other taxonomic literature. Apart from collecting plant specimens from the field, photographs of uncommon and rare plant species were also taken for database development. All plants were collected, identified, and vouchers were stored at the herbarium of the Gujarat Institute of Desert Ecology, Bhuj.

Interviews with Knowledge Holders

Ethnomedicinal uses of the plants were first extracted from the relevant literature and the ethnomedicinal uses mentioned in that literature were then cross-checked through interviews with local inhabitants specifically with traditional healers and practitioners residing in urban, suburban and surrounding villages of Bhuj. The ethnomedicinal uses of medicinal flora by the people were documented through a questionnaire survey using an open-ended questionnaire datasheet. The information about the ethnomedicinal importance of each of the documented species was gathered based on interviews and discussions with key informants such as *Vaidhyas* (traditional healers), ayurvedic practitioners, *Maldharies* (Pastoralists), and Farmers. The key informants were belonging to suburban and adjoining villages. Key informant interviews and participatory observations were made to explore information about the existing indigenous knowledge, practice and skills focused on their knowledge of the traditional use of plants for medicinal plants.

RESULTS AND DISCUSSION

The intensive survey highlighted that a total of 123 species under 101 genera of 47 families of medicinal plants were found in the study area which is reported to be used in ethnomedicine by the people and traditional healers. Among the total recorded medicinal plant species, 41 species were trees, 31 species of shrubs, 19 species of climbers, 28 species of herbs and 4 species of grass (Table 1). The survey revealed that the abundance of 49 species (39.84%) of medicinal plants was common whereas 52 species (42.28%) were uncommon and 22 species (17.89%) are rare within the study area (Table 1).

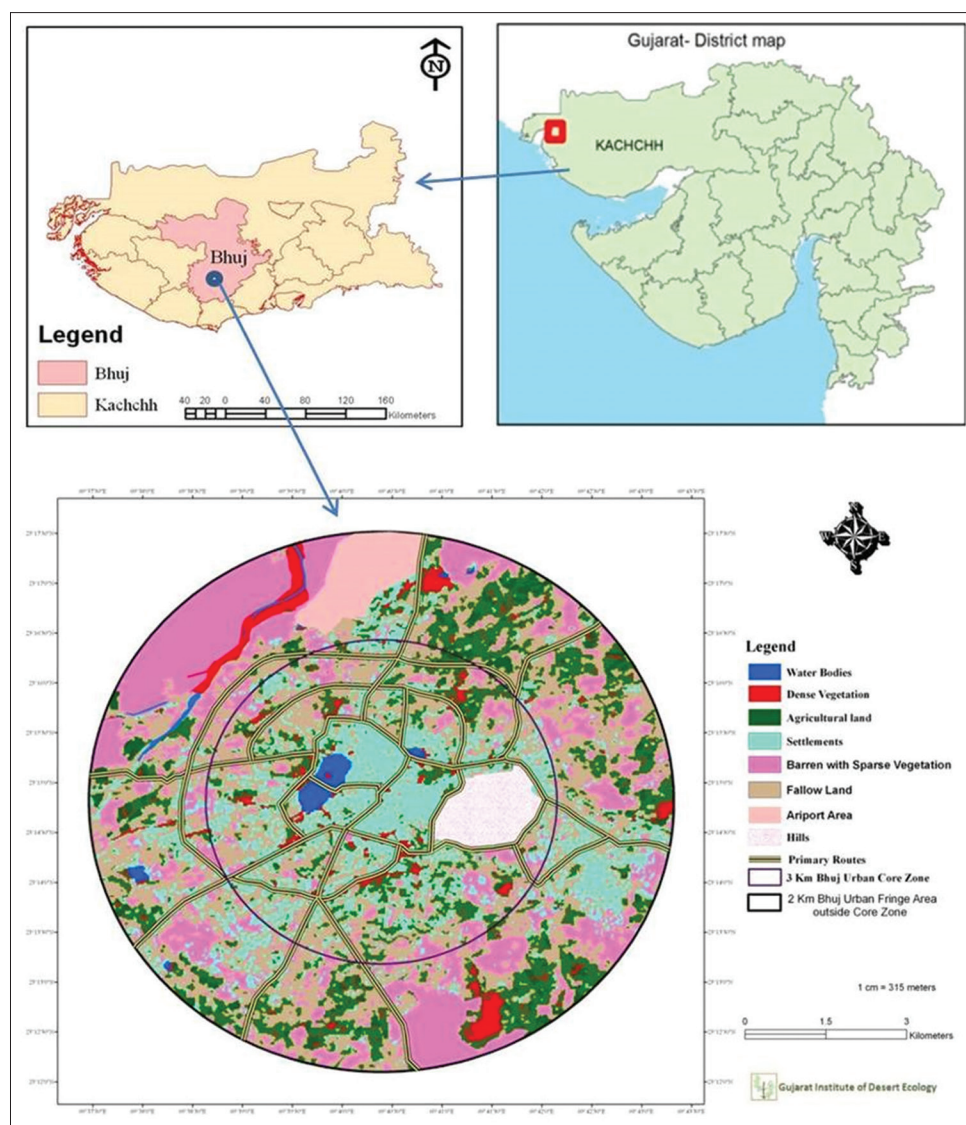


Figure 1: GIS Image of the study area showing urban and suburban areas of Bhuj city, Gujarat

Analysis of the data gathered from interviews with the local communities and ethnomedicinal practitioners on various parts of medicinal plants and their derivatives uses in curing various health problems, revealed that only one plant part of 18 species, two plant parts of 32 species, three parts of 30 species, four parts of 14 species and whole plants of 11 species are used as ethnomedicinal by the communities and traditional practitioners (Figure 2 & Table 1).

On valuation of various plant parts used in ethnomedicine, the study highlighted that leaves of maximum plant species are used in the preparation of ethnomedicine, followed by root, bark, seed, fruit, etc. respectively. Similarly, among the derivatives of medicinal plants, the latex of 12 species, oil of 8 species and ash of two species are used in preparing ethnomedicine by the communities and practitioners of the study area (Figure 3 & Table 1).

Similarly, analysis of the use values of each of the medicinal plants, it was revealed that 8 species uses in curing one health

problem, 16 species are in two health problems, 15 are in three health problems, 19 species are in four health problems, 2 species (*Basella rubra* and *Thespesia populnea*) in 10 health problems, 2 species (*Leptadenia reticulata* and *Ocimum sanctum*) in 11 health problems with and two species (*Moringa oleifera* and *Tinospora cordifolia*) are uses in curing 13 different health problems respectively as ethnomedicine (Figure 4 & Table 1).

Based on the ethnomedicinal uses of recorded plants in the study area, the study categorised the theme into curing 18 different health problems. On analysis of the uses of medicinal plants in different health problems, it was found that a total of 81 species of the recorded plants are used in curing digestive problems, 79 species in skin problems, 51 species in respiratory problems, 46 species in inflammation, and 29 species in cancer and respectively on curing different health problems (Figure 5 & Table 1).

Since, prehistoric times people have been inherently linked with plants for their medicinal and other beneficial properties

Table 1: Status and part uses of the ethnomedicinal plants of Bhuj and its uses in curing various diseases and health problems by the communities

Sl. No.	Medicinal plant species	Habit	Status	Plant parts and derivatives uses														
				Common	Uncommon	Rare	Whole Plant	Shoot	Leaf	Stem & branches	Flower	Fruit	Seed	Root	Bark	Pod	Latex	Oil
1	<i>Abrus precatorius</i>	C	-	+	+	-	*	*	✓	*	*	*	*	*	*	*	*	*
2	<i>Abutilon indicum</i>	S	-	+	-	-	*	*	*	✓	*	*	*	*	*	*	*	*
3	<i>Acacia chundra</i>	T	-	-	+	*	*	✓	*	*	*	✓	*	*	✓	*	*	*
4	<i>Acacia nilotica</i>	T	+	-	-	*	*	✓	*	*	✓	*	*	✓	*	*	*	*
5	<i>Achyranthes aspera</i>	H	+	-	-	*	*	*	*	*	✓	*	*	*	*	*	*	*
6	<i>Adansonia digitata</i>	T	-	-	+	*	*	✓	*	*	*	*	*	*	*	*	*	*
7	<i>Adhatoda zeylanica</i>	S	-	+	-	*	*	✓	*	*	*	*	*	*	*	*	*	*
8	<i>Aegle marmelos</i>	T	-	+	+	-	*	*	✓	✓	*	*	*	*	*	*	*	*
9	<i>Albizia lebeck</i>	T	-	+	-	*	*	*	*	*	*	*	✓	*	*	*	*	*
10	<i>Aloe barbadensis</i>	S	-	+	-	*	*	✓	*	*	*	*	*	*	*	*	*	*
11	<i>Andrographis paniculata</i>	H	-	-	+	✓	*	*	*	*	*	*	*	*	*	*	*	*
12	<i>Annona squamosa</i>	S	-	-	+	*	✓	✓	*	✓	*	✓	✓	*	*	*	*	*
13	<i>Arygveia nervosa</i>	C	-	-	+	*	*	✓	*	*	✓	*	*	*	*	*	*	*
14	<i>Asparagus racemosus</i>	C	-	+	-	*	*	*	*	*	*	*	*	*	*	*	*	*
15	<i>Azadirachta indica</i>	T	+	-	-	*	✓	✓	✓	✓	✓	✓	✓	*	✓	*	*	*
16	<i>Basella rubra</i>	C	-	-	+	*	✓	✓	*	*	*	*	*	*	*	*	*	*
17	<i>Bauhinia purpurea</i>	T	-	+	-	*	*	*	✓	✓	✓	✓	✓	*	*	*	*	*
18	<i>Bauhinia tomentosa</i>	T	-	-	+	*	*	✓	*	✓	✓	✓	✓	*	*	*	*	*
19	<i>Bryonia laciniosa</i>	C	-	+	-	✓	*	*	*	✓	✓	*	*	*	*	*	*	*
20	<i>Butea monosperma</i>	T	+	-	-	*	*	✓	*	✓	✓	*	✓	✓	*	*	*	*
21	<i>Calotropis procera</i>	S	+	+	-	*	*	✓	✓	✓	✓	✓	✓	*	✓	*	*	*
22	<i>Capparis cartilaginea</i>	S	-	-	+	*	*	✓	*	*	✓	*	*	*	*	*	*	*
23	<i>Capparis decidua</i>	S	+	-	-	*	✓	✓	✓	✓	✓	✓	✓	✓	*	*	*	*
24	<i>Carica papaya</i>	S	+	-	-	*	*	✓	✓	✓	✓	✓	✓	*	✓	*	*	*
25	<i>Carissa congesta</i>	T	-	+	-	*	*	*	*	✓	✓	✓	✓	*	*	*	*	*
26	<i>Cassia auriculata</i>	S	+	-	-	*	*	✓	*	*	*	*	✓	*	*	*	*	*
27	<i>Cassia fistula</i>	T	-	+	-	*	*	✓	✓	✓	*	*	✓	*	*	*	*	*
28	<i>Catharanthus roseus</i>	S	+	-	-	✓	✓	✓	*	*	*	*	*	*	*	*	*	*
29	<i>Cenchrus biflorus</i>	G	-	+	-	*	*	*	*	✓	*	*	*	*	*	*	*	*
30	<i>Cissus quadrangulare</i>	C	-	-	+	*	*	✓	*	*	*	*	*	*	*	*	*	*
31	<i>Citrullus colocynthis</i>	C	-	-	+	*	*	*	*	✓	*	*	*	*	*	*	*	*
32	<i>Cleome viscosa</i>	H	-	+	-	*	*	✓	*	*	✓	✓	✓	*	*	*	*	*
33	<i>Clitoria ternatea</i>	C	+	-	-	*	*	✓	✓	✓	✓	✓	✓	*	*	*	*	*
34	<i>Coccinia grandis</i>	C	+	-	-	*	*	✓	*	✓	✓	✓	✓	*	*	*	*	*
35	<i>Commelina benghalensis</i>	H	+	-	-	*	*	✓	✓	*	*	*	*	*	*	*	*	*
36	<i>Commiphora wightii</i>	S	+	-	-	*	*	*	*	*	*	*	*	*	✓	*	*	*
37	<i>Commiphora stocksiana</i>	S	-	+	-	*	*	✓	*	*	✓	✓	✓	✓	✓	*	*	*
38	<i>Corchorus capsularis</i>	H	+	-	-	*	*	✓	*	*	*	*	*	*	*	*	*	*
39	<i>Corchorus depressus</i>	H	-	+	-	✓	*	✓	*	*	*	*	*	*	*	*	*	*
40	<i>Cordia dichotoma</i>	T	-	-	+	*	*	✓	*	*	*	*	*	*	*	*	*	*
41	<i>Cordia monoica</i>	T	-	+	-	*	*	✓	*	*	*	*	✓	*	*	*	*	*
42	<i>Cycas revoluta</i>	S	-	-	+	*	✓	✓	*	*	*	*	*	*	*	*	*	*
43	<i>Cymbopogon citratus</i>	G	-	-	+	*	*	✓	*	*	*	*	*	*	*	*	*	*
44	<i>Cymbopogon martinii</i>	G	-	-	+	✓	*	*	*	*	✓	*	*	*	*	*	✓	*

(Contd....)

(Contd...)

Table 1: (Continued)

Sl. No.	Medicinal plant species	Habit	Status	Plant parts and derivatives uses														
				Common	Uncommon	Rare	Whole Plant	Shoot	Leaf	Stem & branches	Flower	Fruit	Seed	Root	Bark	Pod	LateX	Oil
45	<i>Datura metel</i>	H	+	-	-	-	*	*	✓	*	✓	*	*	*	*	*	*	
46	<i>Delonix elata</i>	T	-	+	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
47	<i>Derris indica</i>	T	+	-	-	-	*	*	✓	*	✓	✓	✓	*	*	✓	*	
48	<i>Digera muricata</i>	H	+	-	-	-	*	*	*	✓	*	*	*	*	*	*	*	
49	<i>Enicostema axillare</i>	H	-	+	-	-	*	*	✓	*	*	*	*	*	*	*	*	
50	<i>Eucalyptus globulus</i>	T	-	+	-	-	*	*	✓	*	*	*	*	*	*	✓	*	
51	<i>Eugenia jambolana</i>	T	-	+	-	-	*	*	*	✓	*	*	*	*	*	*	*	
52	<i>Fagonia schweienfurthii</i>	H	+	-	-	-	*	*	*	*	*	*	*	*	*	*	*	
53	<i>Ficus amplissima</i>	T	-	+	-	-	*	*	✓	*	✓	✓	✓	*	✓	*	*	
54	<i>Ficus benghalensis</i>	T	+	-	-	-	*	*	✓	✓	✓	✓	✓	*	✓	*	*	
55	<i>Ficus religiosa</i>	T	-	+	-	-	*	*	✓	*	*	*	✓	*	*	*	*	
56	<i>Gliricidia sepium</i>	T	-	+	-	-	*	*	✓	*	*	*	✓	*	*	*	*	
57	<i>Goniogyna hirta</i>	H	+	-	-	✓	*	*	*	*	*	*	*	✓	*	*	*	
58	<i>Grewia tenax</i>	S	+	-	-	-	*	*	*	*	*	*	✓	*	*	*	*	
59	<i>Hibiscus rosa-sinensis</i>	S	-	+	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
60	<i>Indigofera oblongifolia</i>	S	-	+	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
61	<i>Ipomoea pes-caprae</i>	C	-	+	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
62	<i>Ipomoea quamoclit</i>	C	-	-	+	✓	*	*	*	✓	✓	✓	✓	*	*	*	*	
63	<i>Jasminum multiflorum</i>	C	+	-	-	-	*	*	*	*	✓	✓	✓	*	*	*	*	
64	<i>Justicia procumbens</i>	H	+	-	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
65	<i>Launaea resedifolia</i>	H	+	-	-	✓	*	*	*	*	✓	✓	✓	*	*	*	*	
66	<i>Lawsonia inermis</i>	S	-	+	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
67	<i>Leptadenia reticulata</i>	C	-	-	+	✓	*	*	*	*	✓	✓	✓	*	*	*	*	
68	<i>Manilkara hexandra</i>	T	-	+	-	-	*	*	*	✓	✓	✓	✓	*	✓	*	*	
69	<i>Manilkara zapota</i>	T	-	+	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
70	<i>Melia azedarach</i>	T	-	+	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
71	<i>Merremia emarginata</i>	C	+	-	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
72	<i>Mimusops elengi</i>	T	-	+	-	-	*	*	✓	*	*	*	✓	*	*	*	*	
73	<i>Moringa oleifera</i>	T	-	+	-	-	*	*	✓	*	*	*	✓	*	*	*	*	
74	<i>Morus alba</i>	T	-	-	+	*	*	*	✓	*	*	*	*	*	*	*	*	
75	<i>Mucuna pruriens</i>	C	-	-	+	+	*	*	*	*	✓	*	*	*	*	*	*	
76	<i>Murraya koenigii</i>	S	-	+	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
77	<i>Nerium indicum</i>	S	+	-	-	-	*	*	✓	*	*	*	*	*	*	*	*	
78	<i>Ocimum basilicum</i>	H	-	+	-	-	*	*	✓	*	✓	*	*	*	*	*	*	
79	<i>Ocimum sanctum</i>	H	+	-	-	-	*	*	✓	*	*	*	*	*	*	*	*	
80	<i>Opuntia ficus-indica</i>	S	-	-	+	*	*	*	*	✓	✓	✓	✓	*	*	*	*	
81	<i>Parkinsonia aculeata</i>	S	+	-	-	-	*	*	✓	✓	*	*	*	*	*	*	*	
82	<i>Peltoporum pterocarpum</i>	T	+	-	-	-	*	*	✓	*	*	*	✓	*	*	*	*	
83	<i>Pentatropis capensis</i>	C	+	-	-	-	*	*	*	*	✓	✓	✓	*	✓	*	*	
84	<i>Pergularia daemia</i>	C	+	-	-	-	*	*	✓	*	✓	✓	✓	*	*	*	*	
85	<i>Peristrophe bicalyculata</i>	H	+	-	-	-	*	*	*	*	*	*	*	*	*	✓	*	
86	<i>Phoenix sylvestris</i>	T	+	-	-	-	*	*	*	*	*	*	*	*	*	*	*	
87	<i>Phyllanthus fraternus</i>	H	+	-	-	-	*	*	✓	✓	✓	✓	✓	*	*	*	*	
88	<i>Physalis minima</i>	H	-	-	+	-	*	*	✓	✓	✓	✓	✓	*	*	*	*	
89	<i>Pithecellobium dulce</i>	T	+	-	-	-	*	*	✓	*	*	*	✓	*	*	*	*	

(Contd...)

Table 1: (Continued)

SI. No.	Medicinal plant species	Habit	Status	Plant parts and derivatives uses																
				Common	Uncommon	Rare	Whole Plant	Shoot	Leaf	Stem & branches	Flower	Fruit	Seed	Root	Bark	Pod	LateX	Oil	Plant Ash	
90	<i>Plectranthus amboinicus</i>	H	-	-	+	*	*	✓	*	*	*	*	*	*	*	✓	*			
91	<i>Plumeria rubra</i>	T	+	-	-	*	*	✓	*	*	*	*	✓	*	*	*	*			
92	<i>Polyalthia longifolia</i>	T	-	+	-	*	*	✓	*	*	*	✓	*	*	*	*	*			
93	<i>Portulaca tuberosa</i>	H	-	+	+	*	*	✓	*	*	*	✓	*	*	*	*	*			
94	<i>Prosopis cineraria</i>	T	-	+	-	*	*	✓	*	*	*	*	*	*	*	✓	*			
95	<i>Prosopis Juliflora</i>	T	+	-	-	*	*	✓	*	*	*	*	*	*	*	*	*			
96	<i>Punica granatum</i>	S	+	-	-	*	*	✓	*	✓	*	✓	*	*	*	*	*			
97	<i>Pupalia lappacea</i>	S	-	+	-	*	*	*	*	✓	*	✓	*	*	*	✓	*			
98	<i>Rhynchosia minima</i>	C	+	-	-	*	*	✓	*	*	✓	*	*	*	*	*	*			
99	<i>Ruellia tuberosa</i>	H	-	+	-	*	*	✓	*	*	✓	*	*	*	*	*	*			
100	<i>Salvadora persica</i>	T	+	-	-	*	*	✓	*	*	✓	*	*	*	✓	*	*			
101	<i>Senna siamea</i>	T	+	-	-	*	*	*	*	✓	*	*	*	*	*	*	*			
102	<i>Sesbania grandiflora</i>	T	-	-	+	*	*	✓	*	*	*	*	✓	*	*	*	*			
103	<i>Sesbania sesban</i>	S	+	-	-	*	*	✓	*	*	✓	*	*	*	*	✓	*			
104	<i>Sida cordata</i>	H	+	-	-	*	*	✓	*	*	✓	*	*	*	*	*	*			
105	<i>Sida cordifolia</i>	H	-	+	-	✓	*	*	*	*	*	✓	*	*	*	*	*			
106	<i>Sida rhombifolia</i>	H	-	+	-	✓	*	✓	*	*	*	*	*	*	*	*	*			
107	<i>Tamarindus indica</i>	T	-	+	-	*	*	✓	*	✓	*	*	✓	*	*	*	*			
108	<i>Tecoma capensis</i>	S	-	+	-	*	*	✓	*	*	*	*	✓	*	*	*	*			
109	<i>Tecoma stans</i>	S	+	-	-	*	*	✓	*	*	✓	*	*	*	*	*	*			
110	<i>Tephrosia purpurea</i>	S	-	+	-	*	*	✓	*	✓	*	✓	*	*	*	*	*			
111	<i>Terminalia catappa</i>	T	-	+	-	*	*	✓	*	✓	*	✓	*	*	*	*	*			
112	<i>Thespesia populnea</i>	T	-	+	-	*	*	✓	*	✓	*	✓	*	*	✓	*	*			
113	<i>Thevetia peruviana</i>	S	+	-	-	*	*	✓	*	*	*	✓	*	*	*	*	*			
114	<i>Tinospora cordifolia</i>	C	-	+	-	*	✓	✓	*	*	*	*	*	*	*	*	*			
115	<i>Tradescantia pallida</i>	H	-	+	+	*	*	✓	*	*	*	*	*	*	*	*	*			
116	<i>Tradescantia spathacea</i>	H	-	+	-	*	*	✓	*	*	*	*	*	*	*	*	*			
117	<i>Trianthema portulacastrum</i>	H	+	-	-	*	*	✓	*	*	✓	*	*	*	*	*	*			
118	<i>Vernonia cinerea</i>	H	+	-	-	*	*	*	*	*	✓	*	*	*	*	*	*			
119	<i>Vetiveria zizanioides</i>	G	-	+	-	*	*	✓	*	*	✓	*	*	*	*	*	*			
120	<i>Vitex negundo</i>	T	-	+	+	*	*	✓	*	*	✓	*	*	*	*	*	*			
121	<i>Withania somnifera</i>	S	-	+	+	*	*	*	*	✓	✓	*	*	*	*	*	*			
122	<i>Zizyphus mauritiana</i>	S	+	-	-	*	*	*	*	*	✓	*	*	*	*	*	*			
123	<i>Zizyphus nummularia</i>	S	+	-	-	*	*	✓	*	✓	*	*	*	*	*	*	*			
Total				49	52	22	11	10	91	23	27	35	36	64	40	5	12	8	2	
SI. Medicinal plant species Habit				Uses to cure diseases and health problems																
SI. No.	Medicinal plant species	Habit	Plant parts and derivatives uses																	
			Digestion	Lever	Kidney	Heart	Eye	Skin	Diabetic	Respiratory	Nervous	Inflammation	Headache	Orthopaedic	Strength	Cancer	Animal bite	Dental	Hair growth	Fever
1	<i>Abrus precatorius</i>	C	✓	*	*	✓	*	✓	*	*	✓	✓	✓	*	*	*	*	*	✓	*
2	<i>Abutilon indicum</i>	S	✓	*	*	*	*	✓	*	*	*	*	*	✓	*	*	*	*	*	*
3	<i>Acacia chundra</i>	T	✓	*	*	*	*	*	*	*	✓	✓	*	*	*	*	*	*	*	*
4	<i>Acacia nilotica</i>	T	✓	*	*	*	*	✓	*	*	✓	✓	*	*	*	*	*	*	*	*
5	<i>Achyranthes aspera</i>	H	*	✓	*	*	*	*	✓	*	*	*	*	*	*	✓	*	*	*	*
(Contd....)																				

(Contd...)

Table 1: (Continued)

Sl. No.	Medicinal plant species	Habit	Uses to cure diseases and health problems																	
			Digestion	Liver	Kidney	Heart	Eye	Skin	Diabetic	Respiratory	Nervous	Inflammation	Headache	Orthopaedic	Strength & Vigour	Cancer	Animal bite	Dental	Hair growth	Fever
6	Adansonia digitata	T	✓	*	✓	*	*	*	*	*	*	*	*	*	*	✓	*	*	*	
7	Adhatoda zeylanica	S	✓	*	✓	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
8	Aegle marmelos	T	✓	*	*	*	*	*	✓	*	*	*	*	*	*	*	*	*	*	
9	Albizia lebbeck	T	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
10	Aloe barbadensis	S	*	*	*	*	*	✓	*	*	*	*	*	*	*	*	✓	*	*	
11	Andrographis paniculata	H	✓	✓	✓	*	*	✓	*	*	*	*	*	*	*	✓	*	*	✓	
12	Annona squamosa	S	✓	*	*	*	*	*	✓	*	*	*	*	*	✓	*	*	*	*	
13	Arygyreia nervosa	C	*	*	*	*	✓	*	*	✓	*	*	*	*	*	*	*	*	*	
14	Asparagus racemosus	C	✓	*	*	*	*	✓	*	*	*	*	*	✓	*	*	*	*	*	
15	Azadirachta indica	T	✓	*	*	✓	✓	✓	*	*	*	*	*	*	*	*	✓	*	✓	
16	Basella rubra	C	*	*	*	✓	✓	✓	*	*	✓	*	*	✓	*	✓	*	*	✓	
17	Bauhinia purpurea	T	✓	*	*	*	*	*	*	*	*	*	*	✓	*	*	*	*	*	
18	Bauhinia tomentosa	T	✓	*	*	*	✓	✓	*	*	*	*	*	✓	*	*	*	*	*	
19	Bryonia laciniosa	C	*	*	*	*	*	*	✓	*	*	*	*	*	*	*	*	*	*	
20	Butea monosperma	T	*	*	✓	*	*	✓	*	*	*	*	*	*	*	*	*	*	*	
21	Calotropis procera	S	✓	*	*	*	*	✓	*	*	*	✓	*	*	*	✓	*	*	✓	
22	Capparis cartilaginea	S	✓	*	*	✓	*	✓	*	*	*	*	✓	*	*	*	*	*	*	
23	Capparis decidua	S	✓	✓	*	✓	*	*	✓	*	*	*	*	*	*	✓	*	*	*	
24	Carica papaya	S	✓	*	*	*	*	✓	*	*	*	*	*	*	✓	*	*	*	✓	
25	Carissa congesta	T	✓	*	✓	*	✓	*	*	*	*	*	*	*	*	*	*	*	*	
26	Cassia auriculata	S	*	*	✓	✓	✓	✓	✓	*	*	*	*	*	*	*	*	*	*	
27	Cassia fistula	T	✓	*	*	✓	✓	✓	✓	*	*	*	*	*	*	*	*	*	*	
28	Catharanthus roseus	S	*	*	*	✓	*	✓	*	*	*	*	✓	*	*	*	*	*	*	
29	Cenchrus biflorus	G	*	*	*	*	*	*	*	*	*	*	✓	*	*	*	*	*	*	
30	Cissus quadrangulare	C	✓	*	✓	✓	✓	✓	*	*	*	✓	*	✓	*	*	✓	*	✓	
31	Citrullus colocynthis	C	✓	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
32	Cleome viscosa	H	*	*	*	*	*	*	*	*	*	*	✓	*	*	*	*	*	*	
33	Clitoria ternatea	C	✓	*	*	*	✓	✓	✓	*	*	*	*	*	✓	*	*	*	*	
34	Coccinia grandis	C	*	*	*	✓	✓	✓	*	*	*	✓	*	*	*	*	*	*	*	
35	Commelina benghalensis	H	✓	*	*	✓	*	*	*	*	*	*	*	*	*	*	*	*	*	
36	Commiphora wightii	S	✓	*	✓	*	✓	✓	*	*	*	✓	*	*	*	*	*	*	*	
37	Commiphora stocksiana	S	✓	*	✓	✓	✓	✓	*	*	*	✓	*	*	*	*	*	*	*	
38	Corchorus capsularis	H	✓	✓	*	*	*	*	*	*	*	*	*	*	*	*	*	*	✓	
39	Corchorus depressus	H	*	✓	*	*	*	*	*	*	*	✓	*	*	*	*	*	*	*	
40	Cordia dichotoma	T	*	*	*	*	*	✓	*	*	*	*	*	*	*	✓	*	*	*	
41	Cordia monoica	T	✓	*	*	*	*	✓	*	*	*	✓	*	*	*	*	*	*	✓	
42	Cycas revoluta	S	*	*	*	*	*	*	*	*	*	*	*	*	✓	*	*	*	✓	
43	Cymbopogon citratus	G	✓	*	*	*	✓	✓	*	*	*	✓	*	*	*	*	*	*	✓	
44	Cymbopogon martinii	G	*	*	*	*	✓	✓	*	*	*	*	*	*	*	*	*	*	*	
45	Datura metel	H	*	*	*	*	*	✓	*	*	*	✓	*	*	*	*	✓	*	*	
46	Delonix elata	T	✓	*	*	*	*	*	✓	*	*	*	*	*	✓	*	*	*	*	
47	Derris indica	T	✓	*	*	✓	✓	✓	*	*	*	*	*	*	*	✓	*	*	*	
48	Digera muricata	H	✓	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
49	Enicostema axillare	H	✓	*	*	✓	*	*	*	*	*	*	*	✓	*	*	*	*	✓	

(Contd...)

Table 1: (Continued)

Sl. No.	Medicinal plant species	Habit	Uses to cure diseases and health problems																
			Digestion	Liver	Kidney	Heart	Eye	Skin	Diabetic	Respiratory	Nervous	Inflammation	Headache	Orthopaedic	Strength & Vigour	Cancer	Animal bite	Dental	Hair growth
50	<i>Eucalyptus globulus</i>	T	*	*	*	*	*	✓	*	✓	*	*	*	✓	✓	*	*	*	*
51	<i>Eugenia jambolana</i>	T	*	✓	*	*	*	✓	*	✓	*	*	*	✓	*	*	*	*	✓
52	<i>Fagonia schweienfurthii</i>	H	*	✓	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
53	<i>Ficus amplissima</i>	T	*	*	*	*	*	*	*	*	*	*	*	*	*	✓	✓	*	✓
54	<i>Ficus benghalensis</i>	T	*	*	*	*	✓	*	✓	✓	✓	✓	✓	✓	*	✓	*	*	*
55	<i>Ficus religiosa</i>	T	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	✓	*	✓	*	*	*	*
56	<i>Gliricidia sepium</i>	T	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	✓
57	<i>Goniogyna hirta</i>	H	✓	✓	*	*	*	✓	✓	✓	✓	✓	*	*	*	*	*	✓	✓
58	<i>Grewia tenax</i>	S	✓	*	*	*	*	*	✓	✓	✓	*	*	*	*	*	*	✓	*
59	<i>Hibiscus rosa-sinensis</i>	S	*	*	*	*	*	*	*	✓	✓	*	*	*	*	*	*	*	*
60	<i>Indigofera oblongifolia</i>	S	✓	*	*	*	*	*	*	*	✓	*	*	*	✓	*	*	*	*
61	<i>Ipomoea pes-caprae</i>	C	✓	*	*	*	*	*	✓	✓	✓	*	*	*	✓	*	*	*	*
62	<i>Ipomoea quamoclit</i>	C	*	✓	*	*	✓	*	*	*	*	*	*	*	*	*	*	*	✓
63	<i>Jasminum multiflorum</i>	C	*	*	*	*	*	*	*	*	*	*	*	*	✓	*	*	*	*
64	<i>Justicia procumbens</i>	H	*	✓	*	*	*	✓	*	✓	✓	✓	✓	*	*	*	✓	✓	✓
65	<i>Launaea resedifolia</i>	H	✓	✓	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
66	<i>Lawsonia inermis</i>	S	*	*	*	*	*	✓	*	*	*	*	*	*	*	✓	*	*	*
67	<i>Leptadenia reticulata</i>	C	✓	✓	✓	✓	✓	✓	✓	✓	✓	*	*	✓	*	*	✓	*	✓
68	<i>Manilkara hexandra</i>	T	✓	✓	*	*	*	*	*	*	*	*	✓	*	*	*	*	*	*
69	<i>Manilkara zapota</i>	T	✓	✓	*	*	*	✓	*	*	*	✓	*	*	*	*	*	*	✓
70	<i>Melia azedarach</i>	T	✓	*	*	*	*	✓	*	*	*	✓	*	*	✓	*	*	*	*
71	<i>Merremia emarginata</i>	C	✓	✓	*	*	*	✓	*	✓	✓	✓	*	*	*	*	*	*	*
72	<i>Mimusops elengi</i>	T	✓	✓	*	*	*	✓	*	✓	✓	✓	*	*	*	*	*	*	*
73	<i>Moringa oleifera</i>	T	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	*	*	✓	*	✓	✓	✓
74	<i>Morus alba</i>	T	✓	✓	*	*	✓	✓	*	✓	*	*	*	*	*	*	*	*	*
75	<i>Mucuna pruriens</i>	C	✓	*	*	*	*	✓	*	✓	✓	*	*	✓	*	*	*	*	*
76	<i>Murraya koenigii</i>	S	✓	*	*	*	*	✓	*	✓	✓	*	*	*	*	*	*	*	*
77	<i>Nerium indicum</i>	S	✓	*	*	*	✓	✓	*	✓	✓	*	*	*	✓	*	✓	*	*
78	<i>Ocimum basilicum</i>	H	✓	*	*	*	*	✓	*	✓	✓	*	*	*	*	*	*	*	*
79	<i>Ocimum sanctum</i>	H	✓	✓	*	✓	✓	✓	✓	✓	✓	✓	*	*	*	✓	✓	*	✓
80	<i>Opuntia ficus-indica</i>	S	✓	✓	*	✓	*	✓	✓	✓	✓	*	*	*	*	*	*	*	*
81	<i>Parkinsonia aculeata</i>	S	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	✓
82	<i>Peltophorum pterocarpum</i>	T	*	*	*	*	*	✓	*	*	*	*	*	*	*	✓	*	*	*
83	<i>Pentatropis capensis</i>	C	*	*	*	*	*	✓	*	✓	*	*	*	*	*	*	*	*	*
84	<i>Pergularia daemia</i>	C	✓	✓	*	✓	✓	✓	*	✓	✓	✓	✓	*	✓	✓	*	*	*
85	<i>Peristrophe bicalyculata</i>	H	*	*	*	*	*	*	*	*	*	*	*	*	*	*	✓	*	*
86	<i>Phoenix sylvestris</i>	T	✓	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	✓
87	<i>Phyllanthus fraternus</i>	H	*	✓	*	*	*	✓	*	✓	*	*	*	*	*	*	*	*	*
88	<i>Physalis minima</i>	H	✓	*	✓	✓	✓	✓	*	*	*	✓	*	*	*	*	✓	*	*
89	<i>Pithecellobium dulce</i>	T	✓	*	*	*	*	✓	*	✓	✓	*	*	*	✓	*	*	*	*
90	<i>Plectranthus amboinicus</i>	H	✓	*	*	*	*	*	✓	✓	✓	✓	✓	*	*	*	*	*	*
91	<i>Plumeria rubra</i>	T	✓	*	*	*	*	*	*	✓	✓	✓	✓	*	✓	✓	*	*	*
92	<i>Polyalthia longifolia</i>	T	✓	*	✓	*	*	✓	*	*	*	*	*	*	*	*	*	*	*
93	<i>Portulaca tuberosa</i>	H	*	*	✓	✓	✓	✓	✓	✓	*	*	*	*	✓	*	*	*	*

(Contd...)

Table 1: (Continued)

Sl. No.	Medicinal plant species	Uses to cure diseases and health problems																	Habit
		Digestion	Liver	Kidney	Heart	Eye	Skin	Diabetic	Respiratory	Nervous	Inflammation	Headache	Orthopaedic	Strength & Vigour	Cancer	Animal bite	Dental	Hair growth	
94	Prosopis cineraria	✓	*	✓	✓	✓	✓	*	*	*	*	*	✓	*	*	*	*	*	*
95	Prosopis Juliflora	*	✓	✓	*	✓	✓	✓	✓	✓	*	*	*	*	*	*	*	*	*
96	Punica granatum	✓	*	*	✓	*	✓	✓	✓	✓	*	*	✓	*	*	*	*	*	*
97	Pupalia lappacea	✓	*	*	*	*	*	✓	*	*	*	*	*	*	*	*	*	*	*
98	Rhynchosia minima	✓	*	*	✓	*	*	✓	✓	*	*	*	✓	*	*	*	*	*	*
99	Ruellia tuberosa	*	✓	*	*	*	*	✓	✓	*	*	*	✓	✓	*	*	*	✓	*
100	Salvadora persica	✓	✓	✓	*	*	✓	✓	✓	*	*	*	✓	✓	*	*	*	*	*
101	Senna siamea	✓	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
102	Sesbania grandiflora	✓	*	*	*	✓	✓	✓	✓	*	*	*	*	*	*	*	*	*	*
103	Sesbania sesban	*	✓	*	*	*	*	*	*	*	*	*	✓	*	*	*	*	*	*
104	Sida cordata	✓	*	*	*	*	✓	*	*	*	*	*	*	*	*	*	*	*	*
105	Sida cordifolia	✓	✓	*	*	*	✓	✓	✓	*	*	*	*	*	*	*	*	*	*
106	Sida rhombifolia	✓	*	*	*	*	✓	✓	✓	✓	✓	*	*	*	✓	*	*	*	*
107	Tamarindus indica	✓	*	✓	*	*	✓	✓	✓	*	*	*	*	*	*	*	*	*	*
108	Tecoma capensis	✓	*	*	*	*	✓	✓	✓	*	*	*	*	*	*	*	*	*	*
109	Tecoma stans	✓	✓	*	*	*	✓	*	*	*	*	*	*	*	*	*	*	*	*
110	Tephrosia purpurea	✓	*	*	*	*	✓	✓	✓	*	*	*	*	*	*	*	*	*	*
111	Terminalia catappa	✓	✓	✓	*	*	✓	✓	✓	✓	✓	✓	*	*	*	*	*	*	*
112	Thespesia populnea	✓	✓	*	*	*	✓	✓	✓	✓	✓	✓	✓	✓	*	*	✓	*	*
113	Thevetia peruviana	*	*	✓	*	*	✓	*	*	✓	✓	✓	✓	✓	✓	*	*	*	*
114	Tinospora cordifolia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	*	*	*	*	*
115	Tradescantia pallida	*	*	*	*	✓	✓	*	*	✓	*	*	✓	✓	*	*	*	*	*
116	Tradescantia spathacea	*	*	*	*	✓	✓	*	*	✓	*	*	*	*	*	*	*	*	*
117	Trianthema portulacastrum	✓	✓	*	*	*	*	✓	✓	*	*	*	*	*	*	*	*	*	*
118	Vernonia cinerea	*	*	*	*	*	✓	*	*	✓	*	*	*	*	*	*	*	*	*
119	Vetiveria zizanioides	✓	✓	*	*	✓	✓	*	✓	✓	*	*	*	*	*	*	✓	*	*
120	Vitex negundo	*	*	*	*	✓	✓	✓	✓	✓	✓	✓	*	*	*	*	*	✓	*
121	Withania somnifera	*	✓	*	*	*	✓	✓	✓	✓	✓	*	*	*	*	*	*	*	*
122	Zizyphus mauritiana	✓	✓	*	*	*	*	✓	✓	*	*	*	*	*	*	*	*	*	*
123	Zizyphus nummularia	*	*	*	*	*	✓	*	*	*	*	*	✓	*	*	*	*	*	*
Total		81	20	35	28	19	79	26	51	44	46	20	29	24	29	22	20	9	25

Abbreviations/Symbol: T-Tree, S-Shrub, H-Herb, C-Climber, G-Grass, + -Yes, - No, ✓ -Part uses/uses for health problems, * -No uses

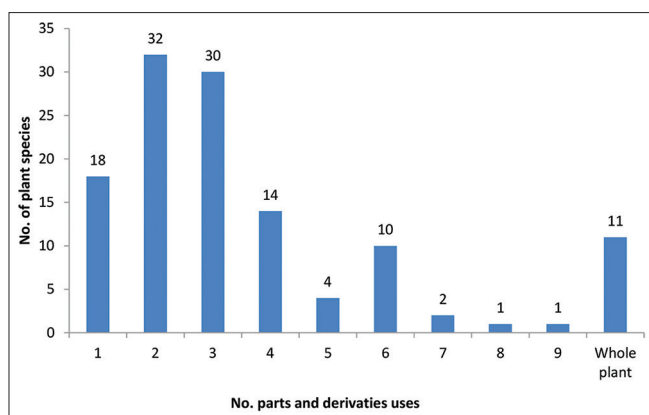


Figure 2: Parts and derivatives of medicinal plant species uses in ethnomedicinal practices

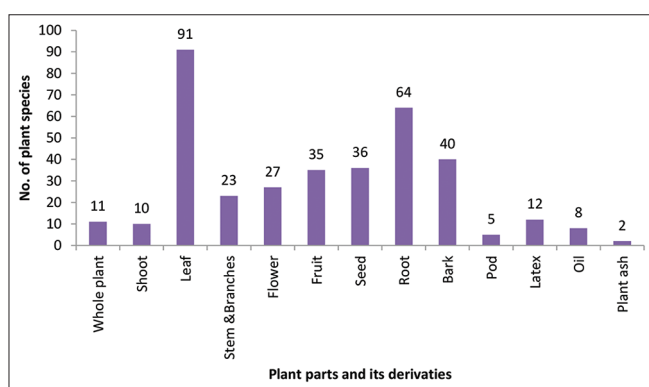


Figure 3: Plant species with their parts and derivatives uses in ethnomedicine at Bhuj

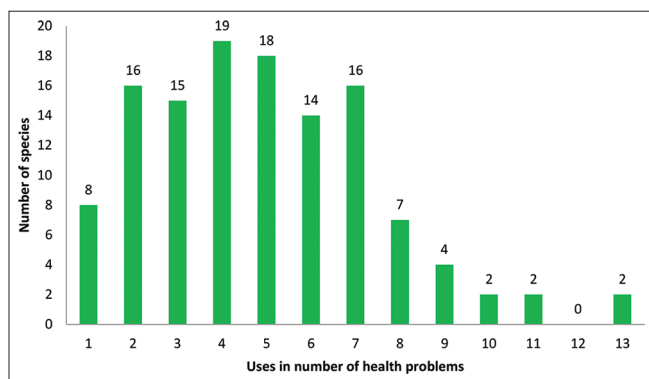


Figure 4: Use values of medicinal plants in curing health related problems in ethnomedicine

(Jain & Saklani, 1991). The research and documentation on traditional knowledge based on various natural resources are found declining due to the loss of plant species diversity and interest in the indigenous community (Silori *et al.*, 2004). The loss of traditional knowledge is also due to change in the perception of the user community, its commercialization and socio-economic transformation (Gadgil *et al.*, 1993). To date most of the studies and survey on medicinal plants and their ethnomedicinal uses all over the world were mainly focused on forests and wilderness areas. Only a few studies reported

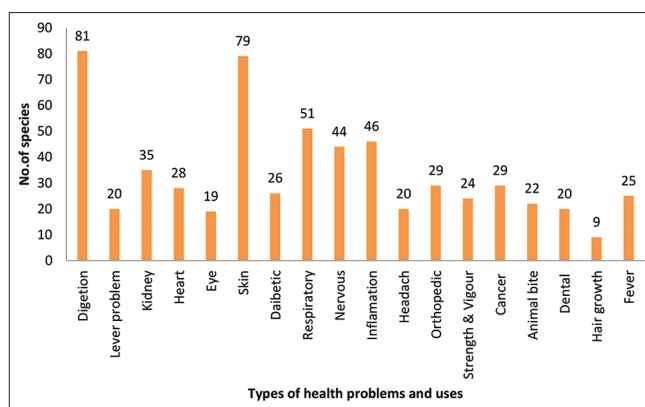


Figure 5: Number of plant species uses in curing different health problems in ethnomedicine

the medicinal plants and their ethnomedicinal uses in urban areas. Among the medicinal plants reported by various studies on urban areas, a total of 28 medicinal important species were reported from two urban areas of Kenya (Njoroge, 2012) and 301 species of medicinal plants were reported in semirural areas near to industrial belt of Catalonia (Gras *et al.*, 2019). Among the studies on medicinal plants in urban areas in India, 72 species of medicinal plants were recorded from the Banaras Hindu University campus (Verma *et al.*, 2007).

The plant diversity of Kachchh is rich as reported by various authors. A total of 511 species under 75 families were recorded by Thaker (1926), 700 species by Rao and Sabnis (1977), 768 species by Shah (1978) and 640 species by GUIDE (2002). Among the studies on medicinal plant diversity, Vyas (2001) documented 46 species of medicinal plants from the Kachchh district. GUIDE (2002) reported 402 species of plants having some medicinal values. A total of 28 medicinal plant species from the Tharawada-Gandher MPCA of Kachchh (Patel *et al.*, 2013a) and 35 species of medicinal plants were reported from the Dhinodhar hills of Kachchh (Patel *et al.*, 2013b). Further, 37 reported ethnomedicinal plant species from Tapkeshwari Hill near Bhuj (Patel *et al.*, 2010). Being an arid area, the medicinal plant diversity of the study area is comparatively high. Compared to the total reported medicinal plant species from the district (GUIDE, 2002), the present study reported about 30 percent of the ethnomedicinal plant from Bhuj city. The study highlighted that urban areas are also very important like forests and wilderness areas for biodiversity conservation. There is also a need for conducting a detailed ethnomedicinal survey of the medicinal plant found in various urban areas for promoting conservation (*in situ* and *ex-situ*).

Medicinal plants are seriously threatened by the loss of their rural condition and their proximity to industrialized areas (Njoroge, 2012). Hence comprehensive planning for urban biodiversity is very much important for biodiversity conservation and meeting the sustainable development goal.

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