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Traditional ethno-botanical uses of medicinal plants from coastal areas of Pakistan

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PEER REVIEW

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Comments

This investigation has enlightened the fact that documentation of therapeutic uses of herbal remedies with new phyto-medicinal claim is very important. This study will form the bases for detailed studies on the bioactive compounds in these plants by pharmacologists. It may result in the discovery of novel compounds for health services

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ABSTRACT

Objective: To document the traditional uses of wild plants as medicine by the villagers along the coastal highway from Karachi to Uthal.

Methods: Information presented in this research was gathered from the local people using an integrated approach of floral collections, discussions with the elderly people and traditional medicinal practitioners using semi-structured questionnaire.

Results: Ethno-medicinal surveys indicated the medicinal importance of 54 plant species from 27 families in the targeted area. Majority of the plants (54%) from this coastal plant diversity were xerophytes followed by halophytes/xero-halophytes (40%) and glycophytes (6%). The most important uses included gastrointestinal diseases, pain killer, arthritis, skin and sexual disorders, asthma and expectorant. The above-ground parts of plants *i.e.* leaf, stem and fruit/seed as decoction are used most commonly to cure 23 ailments but root was also used in some cases.

Conclusions: This study helps in documenting therapeutic uses of herbal remedies with new phyto-medicinal claim and it is hoped that it will lead to detailed chemical and pharmacological evaluations. This may also lead to a discovery of novel bioactive compounds for food and pharmaceutical industries.

KEYWORDS

Arabian Sea, Halophytes, Herbal medicine, Karachi, Salt tolerant, Uthal

1. Introduction

Awareness about the therapeutic properties of plants is existing since few thousand years ago[1]. However, use of plants to cure diseases and relieve physical sufferings dates back to the earlier times of mankind's history probably starting from the first moment when a human being or their animal got ill. It is also reported that expeditions, undertaken by those interested in the cultural attributes of primitive societies, obtained valuable information regarding the uses of plants for medicine[2]. The use of plants as medicine by traditional people laid basis for the evolution of modern medicine[3]. The American Shaman Inc. is an example of a company that has focused on traditional medical systems in their drug discovery programs.

Herbal therapy has come of age and today, medicinal plants play a significant role in human health care globally[4]. In USA about 25% of all prescriptions dispensed in public pharmacies contain drugs extracted from higher plants and about 64% of the total global population remains

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dependent on traditional medicine for their healthcare needs[3]. In India alone, approximately 7 500 medicinal plants are traditionally used against various ailments while Korea, Japan, China, and Malaysia together with few other southeast Asian countries are the other leading in the world in the use of herbal medicines[5,6]. Flora of Pakistan reported to consist of about 5 000 species and less than 10% of them are used either as herbal medicine or used in about 350 classical formulations to treat various diseases[7]. Pakistan represented a classical case study for investigating the role of traditional medicine for multiple healthcare settings. It is a predominantly rural country with 67% population living in remote areas taking advantage of local flora in pluralistic means[8]. Rural settlements along coastal belt of Pakistan (Sindh and Balochistan provinces) presented a classical example of having rich history of using herbal medicine. The area is a native home of herbal plants renowned for providing primary health care in traditional system. A variety of wild plants have been collected and sold in the local market by native communities. However, very limited scientific knowledge is available on the potential herbs, which can be cultivated and utilized for different purposes. This is however, practiced without any technical knowledge and hence there is a need to adopt a scientific approach for preserving this heritage.

Phyto-geographical studies conducted in the coastal areas of Sindh and Balochistan revealed that most of the plants found here were either halophytes or xero-halophytes, due to arid/semi-arid environment and saline nature of the soil[9,10]. To cope with abiotic stresses under such conditions, plants are known to synthesize secondary metabolites which can be a rich source of medicinally important compounds such as flavonoids, terpenoids, tannins, alkaloids *etc*[11]. Furthermore, these plants are source of food, fodder, medicine, biofuels, edible oil *etc*. in this region and they are proving their potentials to be cultivated as cash crops in many parts of the world[10-16]. Despite these credentials, these plants had been relatively under explored for exploiting their potential.

Therefore, this study has been undertaken to gather available information on the medicinal uses of these plants by rural communities along coastal areas to treat different diseases and to provide scientific basis for their effectiveness.

2. Materials and methods

The traditional ethno-medicinal information was collected from Karachi (Sindh) to Uthal (Balochistan) during 2008 to 2011 to document the medicinal uses of wild plants. The area is characterized by dry and saline land; where brackish underground water is available and the dominant vegetation was either halophytic or xerophytic.

Information was collected from traditional healers, herbalists and rural dwellers of the villages and interviews were conducted by using semi-structured questionnaire[17]. For this purpose, priority was given to elders because they have better knowledge than young generation. During these interviews and transect walks, information about particular plants was collected for their part used *i.e.* above or below ground, method of preparation, details of administration, the dosage *etc*. Plant materials were collected from their natural populations during organized tours accompanied by herbalists or any knowledgeable rural dwellers. Plants initially identified by their local names but later proper identification was done at the herbarium, University of Karachi. Identified plants were deposited in the herbarium as voucher specimens for later access.

3. Results

3.1. The plants and their medical application

The present study have shown that traditional medicine is still playing a significant role in meeting fundamental healthcare needs of inhabitants around coastal area of Pakistan. The survey gathered information on 54 plant species reported by the informants for their medicinal uses (Table 1 and Table 2). The reported species were distributed among 27 botanical families (Table 1). Amaranthaceae (6 species) was most represented family, followed by Mimosaceae (4 species) while Asclepidaceae, Asteraceae, Caesalpinaceae, Papilionaceae and Poaceae comprises 3 species (each) and rest of the families included two and one member.

The most important uses related to gastrointestinal diseases (12% species), followed by pain killer (9% species), arthritis (8% species), skin diseases and sexual disorders (7% species), asthma and expectorant (6% species). The rest were used to treat internal and external problems such as alexipharmic, eye infections, hepatitis, jaundice, malaria, tuberculosis, UGT disorders and ulceration (Figure 1).

Analysis of the data revealed that a single species is used for multiple health problems like *Citrullus colocynthis* and *Eucalyptus glandulosa* were applied extensively against wide range of ailments (Table 2). They were used against

six and five different ailments respectively (Figure 1). The rest of the medicinal plants had one to four medicinal uses (Figure 1).

Stomach disorder was the most common health care problem reported in this study (Figure 1). About 12 different plant species were used to treat different digestive disorders. In this regard the most frequently used plants were *Acacia nilotica*, *Capparis decidua*, *Chenopodium album*, *Desmostachya bipinnata*, *Grewia tenax*, *Indigofera oblongifolia* and *Prosopis cineraria*. The mode of preparation of the remedy was decoction in water whereas in case of fruits it was consumed directly.

Utilization of medicinal plants as a remedy to cure pain is quite common only second to stomach disorder. About 9 species have been reported to utilize in this category in which *Calotropis procera*, *Fagonia indica*, *Haloxylon stocksii*, *Solanum surattense*, *Tribulus terrestris and Zizyphus nummularia* were some common examples.

Table 1

List of medicinal plants with respect to their family, local name, habit, life form and plant type.

Name of specie	Family	Local name	Habit	Life Form	Plant Type
Abutilon indicum (L.) Sweet, Hort. Brit.	Malvaceae	Khangi	Shrub	Perennial	Xerophyte
Acacia nilotica (L.) Delile	Mimosaceae	Babool/Desi Keekar	Tree	Perennial	Xerophyte
Acacia senegal L.	Mimosaceae	Kumbat	Tree	Perennial	Xerophyte
Achyranthes aspera L.	Amaranthaceae	Kandii	Herb	Annual	Xerophyte
Aeluropus lagopoides (L.) Trin. ex Thw.	Poaceae	Pooji Chabbar	Grass	Perennial	Halophyte
Aerva javanica (Brum. f.) Juss. Ex J.A. Schultes var. *bovei* Webb.	Amaranthaceae	Boo	Herb	Perennial	Xerophyte
Aerva javanica (Brum. f.) Juss. ex J.A. Schultes var. *javanica*	Amaranthaceae	Boo	Herb	Perennial	Xerophyte
Aizoon canariense L.	Aizoaceae	Welaiti battar/Dotak	Herb	Annual	Xerohlophte
Alhaji maurorum Medic.	Papilionaceae	Kandaira	Shrub	Perennial	Halophyte
Ammi visnaga (L.) Lam.	Apiaceae	Spairkai	Herb	Annual	Xerophyte
Artemisia scoparia Waldst. & Kit.	Asteraceae	Jaanh/Jaukay	Herb	Perennial	Xerophyte
Arthrocnemum indicum (Willd.) Moq.	Amaranthaceae	Namak zor	Herb	Perennial	Halophyte
Azadirachta indica Adr. Juss.	Meliaceae	Neem	Tree	Perennial	Xerophyte
Caesalpinia bonduc (L.) Roxb.	Caesalpiniaceae	Karbat	Tree	Perennial	Xerophyte
Calotropis procera (Ait.) Ait.	Asclepidaceae	Aak	Shrub to tree	Perennial	Xerophyte
Capparis decidua Forssk.	Capparidaceae	Kareer	Shrub to tree	Perennial	Xerophyte
Cassia holosericea Fresen	Caesalpiniaceae	Goora wall	Shrub	Perennial	Xerophyte
Chenopodium album L.	Amaranthaceae	Lullar	Herb	Annual	Halophyte
Citrullus colocynthis (L.) Schrad	Cucurbitaceae	Timmay or Too	Herb	Perennial	Xerophyte
Cleome viscosa L.	Capparidaceae	Kinni Buti	Herb	Annual	Xerophyte
Convolvulus glomeratus Choisy	Convolvulaceae	Rakewall	Herb	Perennial	Xerophyte
Corchorus depressus (L.) Stocks	Tiliaceae	Mundairy	Herb	Perennial	Xerophyte
Cressa cretica L.	Convolvulaceae	Bukkan	Herb	Annual	Halophyte
Cymbopogon jwarancusa (Jones) Schult.	Poaceae	Nadak	Grass	Perennial	Halophyte
Cyperus rotundus L.	Cyeraceae	Dodi Ghass	Grass	Annual	Halophyte
Desmostachya bipinnata (L.) Stapf	Poaceae	Drub	Grass	Perennial	Halophyte
Enicostema hyssopifolium (Willd) Verdoo	Gentianaceae	Mamraycho	Herb	Annual	Xerohalophyte
Eucalyptus camaldulensis L.	Myrtaceae	Baam or Safaida	Tree	Perennial	Halophyte
Euphorbia caducifolia Haines	Euphorbiaceae	Thowwar	Shrub	Perennial	Xerophyte
Euphorbia hirta L.	Euphorbiaceae	Kippo	Herb	Annual	Xerophyte
Fagonia indica ssp. schweinfurthia Hadidi	Zygophyllaceae	Kandayra	Shrublet	Perennial	Xerophyte
Glossonema varians (Stocks) Hook. f.	Asclepiadaceae	Munga	Herb	Annual	Xerophyte
Grewia tenax (Forsk.) Fiori	Tiliaceae	Gangi	Shrub	Perennial	Xerophyte
Haloxylon stocksii (Boiss.) Benth. & Hook.	Amaranthaceae	Khaar	Shrub	Perennial	Xerohalophyte
Indigofera oblongifolia Forsk.	Papilionaceae	Chiel	Shrub	Perennial	Xerohalophyte
Indigofera cordifolia Heyne ex Roth	Papilionaceae	Mangoli	Herb	Annual	Xerohalophyte
Inula grantioides Boiss	Asteraceae	Colmeer	Herb	Perennial	Xerophyte
Launaea resedifolia (L.) Kuntze	Asteraceae	Badtar	Herb	Annual	Halophyte
Leptadenia pyrotechnica (Forssk.) Dcne.	Asclepidaceae	Kheep	Shrub	Perennial	Xerophyte
Mangifera indica L.	Anacardiaceae	Aam	Tree	Perennial	Glycophyte
Parkinsonia aculeata L.	Caesalpiniaceae	Welaiti keekar	Tree	Perennial	Xerohalophyte
Portulaca oleracea L.	Portulacaceae	Kulfa	Herb	Annual	Xerophyte
Prosopis cineraria (L.) Druce	Mimosaceae	Kandu	Shrub to tree	Perennial	Xerophyte
Prosopis juliflora (Swartz) DC.	Mimosaceae	Davi	Shrub to tree	Perennial	Xerohalophyte
Punica granatum L.	Punicaceae	Darroo/Annar	Shrub to tree	Perennial	Glycophyte
Salvadora oleoides Dne.	Salvadoraceae	Jaar	Shrub to tree	Perennial	Xerophyte
Salvadora persica L.	Salvadoraceae	Jaar	Shrub to tree	Perennial	Xerophyte
Solanum surrattense Burm. f.	Solanaceae	Kandarii	Herb	Perennial	Xerohalophyte
Syzygium cumini (L.) Skeels	Myrtaceae	Jamman	Tree	Perennial	Glycophyte
Thespesia populneoides (Roxb.) Kostel.	Malvaceae	Peepal	Tree	Perennial	Halophyte
Trianthema portulacastrum L.	Aizoaceae	Itsit	Herb	Annual	Xerohalophyte
Tribulus terrestris L.	Zygophyllaceae	Kandawaro	Herb	Annual	Xerophyte
Withania sominifera (L.) Dunal	Solanaceae	Ashgand	Shrub	Perennial	Xerohalophyte
Zizyphus nummularia (Burm. f.) Wight and Arn.	Rhamnaceae	Jungli Bayri	Shrub to tree	Perennial	Xerophyte

Table 2

Ethno-botanical uses of medicinal plants from coastal areas and vicinity.

Name of specie	Part used	Used against	Preparation	Dosage	R A	Reported uses	References
Abutilon indicum	L	Painful urination and painful menses	Decoction	Twice a day	O	Antimicrobial	[22]
Acacia nilotica	Le/F	Dysentery, diarrhea, vomiting, acidity	Decoction	1 spoon 3 times a day until cure	O	Asthma, diarrhea, demulcent	[11]
Acacia senegal	L	Burns, wounds, inflammation	Paste	Once a day	E	Antimicrobial	[23]
Achyranthes aspera	L	Diarrhea, dysentery, vomiting, abdominal cramp, ulcer	Decoction	3 times a day for a week	O	Antibacterial, Antifungal	[24]
Aeluropus lagopoides	WP	Wound healing, pain killer	Apply paste	Until cure	E	Not reported	
Aerva javanica var *bovei*	I	Alexipharmic	Take inflorescence, warm it and place it on the site of bite	Use until cure	E	Diuretic activity	[25]
		Asthma, headache, rheumatism	Make pillow of inflorescence	Use until cure	E	Antioxidant	[26]
Aerva javanica var *javanica*	I	Alexipharmic	Take inflorescence, warm it and place it on the site of bite	Use until cure	E	Wounds, Jaundice, Diabetes, cough	[11]
		Asthma, headache, rheumatism	Make pillow of inflorescence	Use until cure	E		
Aizoon canariensis	WP	Jaundice, hepatitis	Take 250-300 g plant material in 1/2 liter of rapeseed oil and massage on chest	3-4 times a day	E	Not reported	
Alhagi maurorum	WP	Laxative, expectorant	Decoction	Twice a day	O	Antiinflammatory, Antipyretic, Antioxidant	[27]
Ammi visnaga	F	Heart problems, expectorant	Decoction	Twice a day	O	Antioxidant	[28]
Artemisia scoparia	WP	Burns	Smoke is used against Burns	Twice a day	E	Antifungal, Insecticidal	[29,30]
Arthrocnemum indicum	WP	Alexipharmic	Ash of plant	Until cure	E	Alexipharmic	[31,11]
Azadiracta indica	L	Headache	Paste	Use until cure	E	Antioxidant, Antiviral	[32]
	F	Hemorrhoids	Eat raw fruits	Use until cure	O	Antibacterial	
Caesalpinia bonduc	S	Resettlement of disturbed joints and bones specially after trauma, arthritis	Decoction	1 cup daily	O	Antimicrobial	[33]
Calotropis procera	L	Pain killer specially for chest and ribs	Add few drops of oil on leaf then warm it and bandage over affected area	3 times a day	E	Antioxidant, Antibacterial	[34]
	R	Malarial fever	Decoction of root with black pepper	2-3 times a day	O	Tooth and stomach aches	[11]
Capparis decidua	F	Laxative, stomach worms	Eat unripe fruits without seeds	Few fruits once in a day	O	Antifungal, Carminative, aphrodisiac, ulcer, cough, asthma	[35] [11]
	S	Toothache, gum infection	Powder of young stem	Twice a day	ATG		[36]
	L	Hepatitis, jaundice, ulcers,	Decoction	Twice a day	O	Cathartic activity	[37]
Cassia holosericea	L	Laxative	Decoction	Once a day in fasting	O		
	Se	Laxative	Decoction	Once a day in fasting	O		
Chenopodium album	WP	Dysentery, diarrhea, headache	Decoction	Twice a day	O	Antimicrobial Anthelmintic	[38]
	F	T.B, asthma, whooping cough	Fruit filled with Ajwain seeds and left for a week in dark then use the Ajwain seeds	1 spoon daily	O	Antioxidant, Anti-diabetic, Antiinflammatory	[39,40]
Citrullus colocynthis	F	Whole body swelling/elephantiasis	Massage with paste of fruits	Once a day	E	Toothache, Constipation, Piles	[11]
	F	Eye irritation, inflammation	Take an eye pick and embedded in fruit then apply on eyes	Twice a day	E	Leucorrhea, Asthma	
	R	Toothache, gum inflammation, infection	Miswak of roots	2-3 times a day	ATG		
Cleome viscosa	L	Infertility	Infusion	Once a day	O	Anthelmintic	[41]
Convolvulus glomeratus	WP	Laxative	Decoction with two drops of *Calotropus procera* latex	Two spoons only	O	Not reported	
Corchorrus depressus	WP	Spermatorrhoea, painful urination, sexual disorders, impotenc	Infusion	One glass daily for one week	O	Antipyretic Analgesic	[42]
Cressa cretica	WP	Expectorant, asthma	Decoction	Twice a day	O	Antiinflammatory, Antioxidant, Antiviral	[43]
Cymbopogon jwarancusa	WP	Productive cough, chest itching, Bronchitis, pharyngitis	Decoction	One cup twice a day	O	Antipyretic activity	[44]
Cyperus routundus	R	Boils, blisters	Powder	Twice a day	E	Antioxidant, Antiinflammatory	[45]
Desmostachya bipinnata	R	Dysentery	Decoction	3 times a day	O	Antimicrobial, Carbuncle	[11,46]
Enicostema hysopefolium	WP	Malarial and Dengue fever	Decoction	1 glass 3 times a day	O	Antimicrobial	[47]
		Pain killer	Paste	Massage	E	Hypoglycemic activity	[48]
Eucalyptus camaldulensis	L/S	Fever, cough, sneezing, spasmodic, malarial shivering	Decoction of leaves and paste of stem	2 times a day	O/N	Antimicrobial	[49]
	L	Pain killer specially for bones and joints	Paste	Massage twice a day	E	Larvicidal	[50]
	La	Pain killer specially for bones	Milky Latex use for massage	Twice a day	E	Milk clotting activity	[11,51]
Euphorbia caducifolia	S	Alexipharmic	Cut stem, warm it and place on the site of bite	Use until cure	E	Increase male sexual vigor	
Euphorbia hirta	WP	Asthma	Decoction	Taken frequently	O	Antibacterial	[52]
Fagonia indica	WP	Severe itching	Decoction	Take bath	O	Antitumor activity	[53]
	WP	Pain killer	Decoction in milk	One glass twice a day	O	Analgesic Antimicrobial	[54]
Glossonema varians	L	Painful urination	Infusion	One glass for 10 days	O	Not reported	
Grewia tenax	F/Se	Stomachache specially in stomach ulcer	Raw	10-20 g daily	O	Antibacterial	[55]
Haloxylon stocksii	WP	Arthritis, resettlement of disturb joints	Decoction used for massage	Massage	E	Paraplegic limbs	[11]
Indigofera oblongifolia	R	Dysentery, diarrhea, vomiting, acidity, ulcer	Decoction	3 times a day	O	Antibacterial Antifungal	[56]

Table 2 continued,

Ethno-botanical uses of medicinal plants from coastal areas and vicinity.

Name of specie	Part used	Used against	Preparation	Dosage	RA	Reported uses	Reference
	L	Boils, blisters	Paste of leaves	Apply paste and bandage	E	Antiinflammatory, Cytotoxic activity	[57]
Indigofera cordifolia	WP	Dysentery, diarrhea, vomiting	Decoction	2 spoons 3 times a day	O	Wound healing activity, Antiviral	[58]
Inula grantioides	WP	Prolong fever, rheumatism	Boil in water and bath	Take bath daily	B	Not reported	
		Abortifacient	Decoction	Only 2 glass	O		
Launea residifolia	L	Jaundice, leucorrhoea	Decoction	1 spoon 3 times a day	O	Antibacterial	[59]
Leptadenia pyrotechnica	S/WP	For UGT disorders, Dysmenorrhea, Spermathoria, impotency	Decoction	Half cup twice a day for a week	O	Antioxidant Antimicrobial	[60]
Mangifera indica	B	Dysentery, diarrhea, vomiting	Infusion	1-2 times daily	O	Antibacterial	[61]
Parkinsonia aculeata	L	Arthritis, rheumatism, pain killer	Infusion	1 glass twice a day for 2 weeks	O	Antidiabetic Antimalaria	[62]
Portulaca oleracea	L F/Se	Blood purification Toothache	Decoction Paste	One cup daily twice a day	O ATG	Antioxidant, Antibacterial	
Prosopis cineraria	L	Diarrhea, dysentery, vomiting, abdominal cramp	Raw and decoction	Few leaves or 1 spoon 3 times a day	O	Hypoglycemic, Antioxidative Antimicrobial	[64]
Prosopis juliflora	S	Boils, blisters, skin infections	Burn young stem from one side, it release extract on the other side. Apply extract on infected area.	3-4 times	E	Immunomodulating, Antidermatophytic, Antibacterial	[65]
	L	Nail infection	Crush leaves and add few ml of sunflower oil and bandage over infected area	Once	E	Cytotoxic activitiy, Antiinflammatory, Antimicrobial	[66]
Punica granatum	FS	Dysentery, vomiting, food poisoning	Infusion	Twice a day	O	Antimicrobial	[67]
	F	Heart attack, cardiovascular problems	Fruit	Fistful twice a day	O	Antioxidant	[68]
Salvadora oleoides	S	Toothache, gum infection	Use as Miswak or stem powder	3 times a day	ATG	Antiinflammatory	[69]
Salvadora persica	S	Toothache, gum infection	Use as Miswak or stem powder	3 times a day	ATG	Antiinflammatory	[70]
Solanum surattense	F	Arthritis, resettlement of disturb joints	Paste with egg white	Massage	E	Antibacterial	[71]
Syzygium cumini	L	Dysentery, diarrhea, bloody stools	Infusion	3 times a day	O	Antidiarrhoeal	[72]
Thespesia populnea	L L	Skin infections, wounds Hepatitis, jaundice, ulcers	Paste Decoction	Twice a day Twice a day	E O	Antimicrobial	[73]
Trianthema portulacastrum	L	Asthma	Decoction	Half cup Twice a day	O	Antioxidant Antiinflammatory	[74]
Tribulus teristris	F	Arthritis, backache	Make a sweet dish (Halwa)	3 times a day	O	Antimicrobial	[75]
	F	Spermatorrhoea, impotence	Powder of dry fruits with sugar and black pepper	Twice a day	O	Aphrodisiac activity, Skin diseases	[76,77]
Withania somnifera	R	Spermathoria, debility	Root powder with honey and long pepper	One spoon daily	O	Antimicrobial, Body vigor	[78,79]
Zizyphus nummularia	F	Arthritis, backache	Make a sweet dish (Halwa)	3 times a day	O	Antibacterial, Antifungal	[80]

Key: B-Bark; F-Fruit; FS-Fruit Skin; I-Inflorescence; L-Leaves; La-Latex ; Le-Legume; R-Root; S-Stem; Se-Seed; WP-Whole plant; E-Externally; O-Orally; O/N-Oral and Nasal Breath; ATG; Apply on Teeth and Gums; RA-route of Administration.

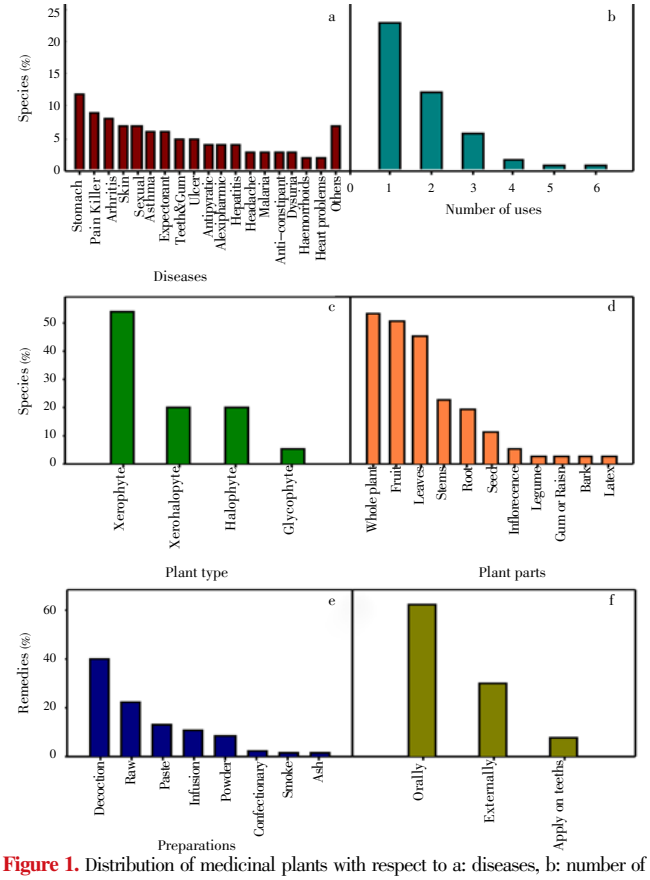

Figure 1. Distribution of medicinal plants with respect to a: diseases, b: number of uses, c: plant type, d: plant part used, e: mode of preparation, f: route of administration.

Consequently, a number of preparations were offered to treat infertility, vaginal infections, child bearing, delivery, painful urination and painful menses, impotency and debility, where on the other hand, some other healers provided women with prescriptions for abortion and contraception. Child health received considerable attention from healers and a number of herbs were prescribed for treating baby indigestion, cramps, jaundice, dehydration, constipation, eye infections and flu (Table 2).

3.2. Plant type, life form and habit of the medicinal plants

Distribution of medicinal plants with respect to their plant type showed (Figure 1) that about 54% of the reported taxa belonged to xerophytes and 40% from halophytes (including halophytes and xerohalophytes) and few of them were glycophytes (6%). The predominant habit (Figure 1) reported in this study was herbs (43%) followed by shrubs (31%) trees (19%) and grasses (7%). Most of the reported plants were perennials (72%) followed by annuals (28%) since rainfall is a rare and unpredictable event in arid and semi-arid areas.

3.3. Plant part used and mode of preparation

All parts of the various plants were used for the preparation

of different herbal formulations; however, whole plant (24%), fruit (23%) and leaves (21%) were the most frequently plant parts used. Sometimes, the stem (10%), root (9%), seeds (5%) and inflorescence (3%) were also used (Figure 1). The legume, gum or raisin, bark and latex were also reported in some cases.

Fresh or dry plant samples both were used to prepare herbal formulations. The most commonly used method was decoction (40%) followed by direct consumption of raw plant parts (23%) then paste of plant material (13%) and in some cases maceration technique as infusion in water (11%) was also used. Furthermore powder of a plant material, preparation of a sweet dish (Halwa), ashes and smoke of the plants were also used in herbal medication (Figure 1).

3.4. Route of administration and dosage

The formulation and administration of herbal remedy depends upon the type of therapeutic condition. Remedies prescribed for curing skin diseases and traumas were applied externally, whereas medication of internal problems exclusively involves oral administration. However, some of skin diseases and certain traumas also require oral administration. Therefore, most of the drugs prescribed by traditional healers are administered orally. About 62% of local remedies were taken orally, followed by 30% which are of external use (applied topically on skin) and 8% are applied exclusively on teeth and gums (Figure 1).

4. Discussion

This research summarized ethno-botanical uses of medicinal plants distributed around the coastal areas of Pakistan (from Karachi to Uthal). The area is characterized by high salinity, temperature and light intensity with low rain fall. Plants growing in such environments are mostly halophytes and xerophytes which are well adapted to survive under extreme conditions[10,11]. They evolve multiple mechanisms including synthesis of diverse group of distinctive compounds which help them to grow in conditions where other plants failed to survive[9,13]. These chemicals when utilized can serve as potent medicine against different ailments. Their range of active ingredients utilized traditionally to combat deadly ailments and these plants serve as a successful home remedy for deprived people living along the coast. A Field-based, ethnographic observation of coastal areas revealed that most of the rural people do not have access to health care professionals. They used a wide range of locally available plant species against multiple diseases[10,11]. The common uses were against stomach related problems, body pain, arthritis, skin and sexual disorders, asthma *etc*. The most widespread problem was digestive disorder which reflected the real condition of rural settlements. Lack of basic amenities along with poor sanitation, unhygienic conditions and consumption of contaminated water are some basic reasons for digestive system disorders which may the root causes for most of the internal diseases[18].

Present investigation also revealed that the local people make good use of a wide range of plants from their surroundings. All the 54 plants had one or more medicinal uses where some of them used for 6 different conditions in which every plant part used as exclusive medicinal remedy[7]. To attain a positive response of local medication, one should select the appropriate part of a plant that contains the active ingredients and properly prepare the formulation[4]. Among all these preparations, a standardized decoction method was widely used. Decoction is a most traditional method in which the plant material is boiled in water to extract all essential compounds and other medicinal substances to get fast relief. However, lack of precision was observed to determine the dose to be taken and it was considered a drawback of herbal medication. In most of the cases the medicinal formulations were taken orally and it was also observed that most of the documented preparations were drawn from a single plant where mixtures were used rarely.

It is also a matter of deep concern that the transmission of traditional knowledge is decreasing through several generations because of no proper way of documenting this heritage except to specific individuals interested in preserving their traditions[8]. On the other hand the local medicinal plants are under threat due to anthropogenic and developmental activities such as urbanization; road buildings, growth of mega-structures *etc*. are examples of direct assault on nature resulting in the loss of local flora[1,3]. Therefore, it is strongly recommended that the proper documentation of traditional knowledge, utilization of natural resources and conservation of unique floral wealth should be done in a scientific way to prevent their losses.

Present study concluded that communities along the coast line of Pakistan inherit a rich traditional knowledge and provided novel information pertaining to local medicinal flora. This study provides detailed account of therapeutic uses of herbal remedies including 54 species with new phyto-medicinal claims, which would be a significant ethno-pharmaceutical contribution. These plants need immediate consideration for carrying out detailed chemical and pharmacological evaluations. Such investigations may lead to the discovery of novel bioactive compounds that will help to assess the efficacy of herbal remedies.

Conflict of interest statement

We declare that we have no conflict of interest.

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Comments

Background

Halophytes are plants which grow all over the world, in different climatic regions on areas with high soil salinity and play an important role in the ecological balance as well as preservation of habitats. Their economic potential has emerged very slowly and is attracting the attention of many researchers to understand their role in the development of human resources.

Research frontiers

Modern medical facilities in rural areas are generally lacking in the villages and people have to rely on herbal drugs. An attempt has been made here to document the traditional uses of wild plants as medicine by the villagers along the coastal highway from Karachi to Uthal in Pakistan.

Related reports

As a general practice of the ethnobotanical knowledge colleection information here too has been gathered from the locals living in the area, floral collections undertaken, and a semi-structured questionnaire filled up during the discussions with the elderly people and traditional medicinal practitioners.

Innovations and breakthroughs

In all 54 plant species from 27 families have been collected from the coast, majority being xerophytes followed by halophytes/xero-halophytes. The report is first attempt from this unique habitat. It is well documentd with tables and figures.

Applications

Most important applications are gastrointestinal diseases, pain killer, arthritis, skin and sexual disorders, asthma and expectorant. The leaf, stem and fruit/seed as decoction are most commonly used to cure 23 ailments.

Peer review

This investigation has enlightened the fact that documentation of therapeutic uses of herbal remedies with new phyto-medicinal claim is very important. This study will form the bases for detailed studies on the bioactive compounds in these plants by pharmacologists. It may result in the discovery of novel compounds for health services

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