Ethnomedicinal study of the flora of Sellay Pattay valley, District Malakand, Khyber Pakhtunkhwa, Pakistan

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Research

Abstract

Background: Plants are the basic source of medicines to treat and remediate different health concerns. The current study was aimed to evaluate the knowledge of folk medicinal Flora in Sellay Pattay valley, district Malakand, Khyber Pakhtunkhwa, Pakistan.

Methods: Ethnomedicinal study was carried out to document the indigenous knowledge about the use of medicinal plants. The data was gathered through interviews with randomly chosen informants in the field. The obtained data from informants were analyzed through various statistical indices such as Frequency citation (RFC), Relative frequency citation (RFC), Use relative (UR), Use value (UV), Fidelity level (FL), and Informant consensus factor (ICF).

Results: A total of 111 plant species belonged to 58 families were documented, amongst them Lamiaceae was the leading family with 12 species. The highest use value (Uv) was recorded for *Justicia adhatoda* L. (0.98), while the lowest value (0.24) was recorded for *Myosotis alpestris* F.W.Schmidt. The highest frequency citation was reported for *Morus alba* L. with a value of 150 and the lowest was depicted for *Calotropis procera* (Aiton) Dryand. with a value of 28. The highest relative frequency citation was recorded for *Morus alba* L. 0.50, and lowest value for *Malvastrum coromandelianum* (L.) Garcke with 0.08. The plants including *Amaranthus viridis* L., *Rumex hastatus* D. Don*, Eucalyptus camaldulensis* Dehnh., *Justicia adhatoda* L., and *Ajuga bracteosa* Wall. ex Benth. had the highest FL with 98.88% against specific disorders and *Acacia modesta* Wall*., Olea ferruginea* Wall. ex Aitch., *Ziziphus oxyphylla* Edgew., *Morus nigra* L., and *Dysphania botrys* (L.) Mosyakin & Clemants were having more than 80% FL. Diabetes was the top ranked disease with a relatively higher Informant consensus factor (ICF) of 0.91, followed by muscular and sexual diseases with ICF of 0.88. It was observed that leaves of the plants play an important role in the treatment of various disorders and their percentage contribution was recorded as 66%.

Conclusions: Sellay Pattay valley has a huge diversity of medicinal plants. The maximum number of therapeutic taxa were used in the mode of decoction for effective work against specific disorders accounts for 54% percent of all medicinal plants. The dependency of people were relied on therapeutic plants due to easy availability and low prices. However, the use of these taxa showed no side effects with proper recipes.

Keywords: Ethnomedicinal, Flora, Malakand, Pakistan, Traditional

Background

The ethnomedicinal study refers to the indigenous and traditional uses of plants for medicinal purpose. Plants were used as a chief source for medicinal purpose against different disorders (Kumar *et al.* 2009; Okello *et al.* 2010; Chintamunnee and Mahomoodally, 2012; Ahmad *et al.* 2016). The important ethnomedicinal information were transferred from various groups, generations, and families to their offspring that were dependent on plant resources (Dweba and Mearns, 2011; Sher *et al.* 2022, 2023; Iftikhar *et al.* 2019). People of rural areas mostly rely on naturally growing plant resources and have shortage of recent medical facilities (Sandhya and Rajamohan, 2008). The application of therapeutics plants for medication still is important in rural areas and also considered the most prestigious way to cure various disorders (Bussmann and Sharon, 2006; Albuquerque and Hanazaki, 2009; Ali *et al.* 2017).

Plants have been considered as the most important natural resource to sustain normal life on the earth's crust (Murad *et al.* 2013). The diversity of medicinal plants depends on the soil structure and proper conservation which provides suitable habitat for them (Heil *et al.* 1997). Most of the wild plants exhibit some medicinal importance for the betterment of the people of the world (Dubey *et al.* 2004; Irfan *et al.* 2017b; Musa *et al.* 2022). Roughly, 70% of the developing nations and 50% of the industrialized countries of the world rely on herbal medicines (Bodeker and Kronenberg, 2002). In Pakistan more than 80% of the people depends on the medicinal values of herbal medicine for health security in rural areas (Ibrar *et al.* 2007). Globally, the lifestyle pattern of medicinal plants consumption changes from time to time, causing a serious threat to local plants knowledge.

Different practices of traditional healing treatments of the ethnobotanical studies of plants indicated a collective knowledge, and skills basis on ideas, the concept as well as individual knowledge established as well as utilized through native people various cultures that advance healthiness status to avoid as well as minimize ailments and its spread (Younis *et al.* 2018; Herndon *et al.* 2009; Rahman *et al.* 2023). Most of the traditional values of the plants are still used for the complete cure of physical and mental growth of health (Fabricant and Farnsworth, 2001; Gurib-Fakim, 2006; Irfan *et al.* 2017a; Ullah *et al.* 2018, 2022).

Additionally, about 80% of Pakistan's total population growth relies on the medicinal values of traditional local plants for remedies of human health, and more these medicinal plants are still used for medical practices (Gurib-Fakim, 2006; Irfan *et al.* 2108a). However, the use of traditional plants for medicinal values has been limited to rural areas and the countryside of Pakistan (Ibrar *et al.* 2007; Ibrar and Hussain, 2009; Haq *et al.* 2011; Ali *et al.* 2023). This limitation in the restriction of medicinal values plants has resulted in the human being towards present modernized health services and facilities in urban regions of the world (Awan and Murtaza, 2013).

Moreover, the lifestyle of humans is also changing with time and nowadays the knowledge of Ethnomedicinal and cultural uses of traditional plants shows deterioration as a result of an investment of modern technological advancement in a health center in ruler areas of Pakistan (Khan *et al.* 2011; Jan *et al.* 2021). In Pakistan, about 6000 plants species have been reported of which 600-700 species have medicinal importance (Shinwari and Gilani, 2003; Shinwari *et al.* 2011; Irfan *et al.* 2018b; Irfan *et al.* 2019, 2023).

Materials and Methods

Study area

Sellay Pattay valley is situated in district Malakand, Khyber Pakhtunkhwa, Pakistan with 34^{o} to 35^{o} N and 71^{o} to 72^{o} E (Fig. 1). Its elevation ranges from 1200-2800 m and is bounded by district Dir and Swat in the North, Bajor and Mohmand districts in the Northwest, district Mardan and Charsada in the South, and Buner district in the East. The prime source of ground water in the area is rain and snowfall, while Agriculture, livestock, and mineralized rock drilling and its trade is the main business and income source of the local inhabitants (Akhtar *et al.* 2013).

Collection and preservation

Plants species were collected, pressed, dried, and placed in newspapers, poisoning of plants was performed using 0.1g mercuric chloride with 70% ethanol for long term preservation purposes. The collected specimen were identified with help of Flora of Pakistan. Field photographs of medicinal plants, as well as collection sites were captured for future reference. Field notes were used to record the plant collection date, locality, habit, habitat, voucher number, and flowering period of plants.

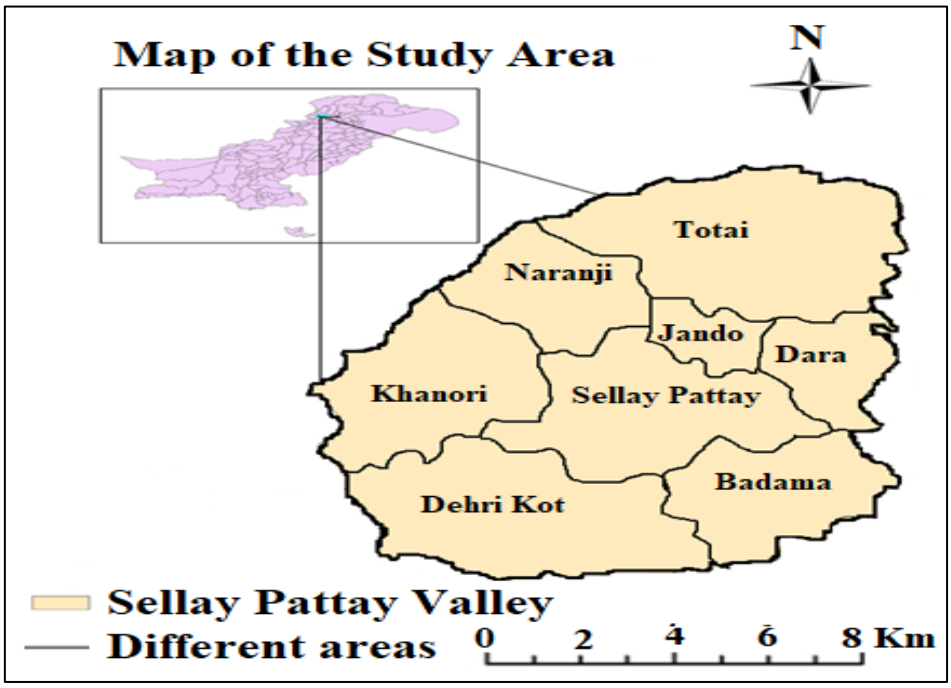

Figure 1 Map of Sellay Pattay valley, district Malakand, Khyber Pakhtunkhwa, Pakistan.

Ethnomedicinal information

The ethnobotanical information was collected by visiting local communities (farmers, traditional healers) of Sellay Pattay valley, following a semi-structured interview method with informed consent. The interview was conducted in the field as well as plant photographs were shown for identification (Mahomoodally *et al.* 2016).

Plants identification

The Flora of Pakistan (Nasir and Ali, 1970; Ali & Qaiser, 1986) were used for identification, authentication, and further comparison with the Herbarium of Hazara University, Pakistan. Accession numbers were given to each sample deposited in the Herbarium of Hazara University, Mansehra, Pakistan (HUP).

Quantitative Ethnobotanical Data

Frequency citation (FC)

The frequency citation states the amount of informers interviewed for a plant species which quote its applications (Hilou *et al*. 2014). The total of informers describing the applications of single plant species throughout the investigation is expressed as Frequency Citation. That index differs from zero, when no one refers to the plant species as helpful to one during the case while here have been a highest number of informers who believed a plant species useful (Ahmad *et al.* 2018).

Relative frequency citation (RFC)

The RFC parameters were calculated based on the previous citation for predicting the importance and the resident vitality of each taxon. The index was calculated according to the equation of (Ali-Shtayeh *et al.* 2008) below.

$$(0 < RFC < 1)\frac{\mathrm{FC}}{N} = \mathrm{RFC}$$

Relative popularity level (RPL)

RPL is a parameter that predicts the ratio between the numeral of diseases cured by a specific plant and the total numeral of informants of any ailment. The index was approached with previous examination of (Ali-Shtayeh *et al.* 2008) on the basis of popular and unpopular.

Use value (UV)

The use value specified the relative importance of plants familiar locally. It was calculated by using the following equation:

$$UV = \Sigma Ui/N$$

Where Ui is the number of uses reported by local informants for species and N is the total number of informants (Mahomoodally *et al*. 2016).

Fidelity level (FL)

It is the percent of respondents who describe the plant used for a specific disease. Fidelity level was calculated by the following equation:

$$FL\ (\%) = (\frac{Np}{N}) \times 100$$

Np is the no of informants give information regarding the use of plant species for specific disease whereas N is the total no of informants (Mahomoodally *et al.* 2016).

Informant consensus index (ICF)

It is used to study the uniformity among informants interviewed to cure the disease categories using reported plant species and it also focuses on the crucial diseases in the study area. ICF was calculated by using the following equation:

$$ICF = Nur - Nt/(Nur - 1)$$

Wheres Nur shows a total number of use reports on each disease category, Nt is a number of taxa used in the category (Mahomoodally *et al.* 2016).

Results

Socio-Demographic Data

In current study a total of 100 informants were questioned, these informants were belonged to the various communities. Gender wise male with (80%) and only (20%) female were interviewed due to the restricted rules of Pashtun community (Table 1).

Age-wise distribution of the respondents

The older people had the diverse knowledge as compared with the young generation. The assessed informants data was categorized into three ages in which the older informants were frequently interviewed. The 13 informants were between 20-34 while 27 informants were between 26-50 years, and 60 informants were above 50 years (Table 1).

Dependency upon Allopathy and Medicinal Plants

The importance of medicinal plants indicated by the dependency of informants on medicinal plants. Among them, the 5 dependent informants on medicinal plants age were in the range of 15-25 years while 27 dependent informants were in the 26-50 years range. However, the 60 dependent informants' age were above 50 years. Although according to allopathic use, the 23 informants' ages were in the range of 15-25 years while the 26-50 years and the 47 were above 50 years (Table 1).

Table 1.Dependency upon medicinal flora of Sellay Pattay valley, district Malakand, Pakistan.

Age group	Informants	Dependent upon medicinal plants	Allopathic users
15-25 years	13	5	23
26-50 years	27	40	30
Above 50 years	60	55	47

Ethnomedicinal plant diversity

In the current study 111 plant species were documented belonged to 58 families. Lamiaceae was the leading family with 12 species (10.81%), followed by Solanaceae with 7 species (6.30%), Amaranthaceae with 6 species (5.4%), Asteraceae with 5 species (4.5%), Moraceae, Rosaceae, Fabaceae, and Rhamnaceae with 4 species each (14.41%), Poaceae, Pteridaceae, Malvaceae, Euphorbiaceae, and Boraginaceae with 3 species each (13.51%), Polygonaceae, Verbenaceae, Cyperaceae, Apocynaceae and Acanthaceae with 2 species each (10.09%), while the reaming families viz. Arecaceae, Araceae, Asparagaceae, Aspleniaceae, Asclepiadaceae, Apiaceae, Berberidaceae, Cannabaceae, Caryophyllaceae, Chenopodiaceae, Celastraceae, Cucurbitaceae, Convolvulaceae, Rutaceae, Fageceae, Geraniaceae, Hypericaceae, Menispermaceae, Myrsinaceae, Meliaceae, Myrtaceae, Nyctaginaceae, Onagraceae, Oxalidaceae, Oleaceae, Pinaceae, Platanaceae, Punicaceae, Ranunculaceae, Sapindaceae, Sapotaceae, Scrophulariaceae, Saxifragaceae, Simaroubaceae, Tiliaceae, Urticaceae, Viburnaceae, Violaceae, Vitaceae and Zygophyllaceae had one species each with (36.03%) (Table 2).

Table 2. Medicinal flora of Sellay Pattay valley, district Malakand, Khyber Pakhtunkhwa, Pakistan.

Botanical name	Family	Part Used	Disease Treated	Method of Preparation	FC	RFC	RPL	UV
Adiantum capillus-veneris L.	Pteridaceae	Leaves	Aphrodisiac Body Cooling Agent	Infusion	46	0.15	0.40	0.87
Abutilon indicum (L.) Sweet	Malvaceae	Whole Plant	Ulcers, Fever, and Chest infection	Extract	47	0.16	0.73	0.85
Achyranthes Aspera L.	Amaranthaceae	Whole Plant	Diabetes, Malarial Fever, and Dysentery	Juice	84	0.28	1.43	0.49
Asplenium dalhousiae Hook.	Aspleniaceae	Whole Plant	Eczema, Anthelmintic, and Vermifuge.	Decoction	75	0.25	0.42	0.56
Acacia modesta Wall.	Fabaceae	Gum and Bark	Cough, Bacterial Infections, and Backache.	Powder	50	0.17	1.3	0.6
Acacia nilotica (L.) Delile	Fabaceae	Flowers and Leaves	Aphrodisiac, Alzheimer, and Diarrhea Diseases.	Powder	30	0.1	1.2	0.66
Amaranthus viridis L.	Amaranthaceae	Whole Plant	Eye Disorders, Liver Disorders, and Diabetes	Decoction	41	0.14	0.3	0.73
Ailanthus altissima (Mill.) Swingle	Simaroubaceae	Bark and Leaves	Diarrhea Tapeworm, and Leucorrhea	Infusion	60	0.2	0.45	0.75
Ajuga bracteosa Wall. ex Benth.	Lamiaceae	Whole Plant	Amenorrhea and Rheumatism	Decoction	85	0.28	0.56	0.66
Arisaema utile Hook.f. ex Schott	Araceae	Fruits and Rhizome	Dermatological Disorders, Antioxidant, and Antifungal.	Infusion	43	0.14	0.39	0.91
Asparagus gracilis Salisb.	Asparagaceae	Leaves	Stomach Ulcers, Diarrhea, and Anxiety	Decoction	39	0.13	0.29	0.74
Aerva javanica (Burm.f.) Juss. ex Schult.	Amaranthaceae	Aerial Parts	Purgative, Antidiarrheal, and Anthelmintic	Decoction	56	0.19	0.43	0.77
Aerva sanguinolenta (L.) Blume	Amaranthaceae	Leaves	Antioxidant, Anti Inflammatory, and Diuretic	Extract	84	0.28	0.3	0.36
Berberis lyceum Royle	Berberidaceae	Fruit, Bark, and Stem.	Diabetes, Eye Infections, and Fractured Bones,	Decoction	65	0.22	1.32	0.49
Buddleja crispa Benth.	Scrophulariaceae	Whole Plant	Colds, Skin Infection, and Wound Healing	Powder	63	0.21	0.45	0.71
Bidens pilosa L.	Asteraceae	Whole Plant	Glandular Sclerosis, Hepatitis, Colds, and Flu.	Paste	70	0.23	0.42	0.6
Bergenia ciliata (Haw.) Sternb.	Saxifragaceae	Roots	Kidney Stones Gastrointestinal Disorders	Juice Powder	84	0.28	0.29	0.36
Boerhavia procumbens Banks ex Roxb.	Nyctaginaceae	Roots and Leaves	Edema and Liver Disorders.	Extract	55	0.18	0.39	0.71

Cajanus platycarpus (Benth.) Maesen	Fabaceae	Whole Plant	Laxative, Blood Pressure, and Diabetes	Decoction	76	0.25	0.14	0.26
Chenopodium ambrosioides L.	Amaranthaceae	Whole Plant	Lung Infections and Vermifuge to Expel Round-Worms.	Decoction	54	0.18	0.37	0.69
Calotropis procera (Aiton) Dryand.	Asclepiadaceae	Stem and Leaves	Snake Bite Sinus, Fistula rheumatism Mumps.	Infusion	28	0.09	0.15	0.54
Cynodon dactylon (L.) Pers.	Poaceae	Whole Plant	Dysentery, Hemorrhage Epilepsy, and Cancer.	Infusion	54	0.18	0.45	0.53
Clematis graveolens Lindl.	Ranunculaceae	Fruit and Flowers	Joint Pain, Headaches, and Skin Disorders.	Mixture	83	0.28	0.4	0.48
Citrus medica L.	Rutaceae	Leaves and Seeds	Used For Hypoglycemia and Skin Infection.	Decoction	55	0.26	0.77	0.45
Conyza bonariensis (L.) Cronquist	Asteraceae	Whole Plant	Wounds Healing and Antioxidant	Powder	102	0.34	0.33	0.31
Colebrookea oppositifolia Sm.	Lamiaceae	Leaves and Stem	Eye Problems, Epilepsy, and Cough.	Infusion	73	0.24	0.41	0.56
Cannabis sativa L.	Cannabaceae	Leaves and Branches	Depression, Asthma, and Insomnia.	Decoction,	56	0.19	0.45	0.8
Cyperus esculentus L.	Cyperaceae	Whole Plant	Dysentery Indigestion Diarrhea	Edible	48	0.16	0.47	0.98
Cissampelos pareira L.	Menispermaceae	Leaves	Ulcer, Wound, Rheumatism, and Fever.	Powder	72	0.24	0.55	0.76
Chrozophora tinctoria (L.) A. Juss.	Euphorbiaceae	Whole Plant	Cough Emetic, Cathartic, and Digestive Problems.	Extract	95	0.32	0.57	0.6
Cyperus rotundus L.	Cyperaceae	Leaves, and Rhizome	Diarrhea, Diabetes Malaria, and Stomach Diseases.	Powder	57	0.19	0.48	0.84
Citrullus vulgaris Schrad.	Cucurbitaceae	Fruit	Skin Eruptions, Laxative, and Diuretic.	Decoction	59	0.2	0.49	0.77
Coriandrum sativum L.	Apiaceae	Seed and Fresh Leaves	Carminative, Gas Bowels, and Expulsion.	Infusion	55	0.25	0.78	0.36
Caralluma adscendens var. *fimbriata* (Wall.) Gravely & Mayur.	Apocynaceae	Stem	Stomach Pain, Leprosy, Hepatitis B and C.	Decoction	57	0.19	0.56	0.98
Dodonaea viscosa (L.) Jacq.	Sapindaceae	Leaves and Bark	Analgesic, Anti-Ulcer, and Antispasmodic.	Infusion	98	0.33	1.62	0.63
Duchesnea indica (Jacks.) Focke	Rosaceae	Fruit	Snake, Insect Bites, Ringworm, and Eczema.	Decoction	76	0.25	0.4	0.53
Desmostachya bipinnata (L.) Stapf	Poaceae	Stem and Leaves	Diuretic, Dysentery, and Menorrhagia.	Decoction	49	0.16	0.29	0.59

Datura innoxia Mill.	Solanaceae	Leaves and Seeds	Body Pain, Treating Fever, and Heart Disorders.	Decoction	54	0.18	0.4	0.74
Digera muricata (L.) Mart.	Amaranthaceae	Leaves and Shoots	Asthma, Eczema, and Arthritis.	Decoction	57	0.19	0.32	0.56
Dalbergia sissoo DC.	Fabaceae	Bark Leaves Roots	Skin Ailments Gonorrhea, and Eye Infection.	Decoction	43	0.14	0.15	0.47
Dicliptera bupleuroides Nees	Acanthaceae	Whole Plant	Skin Infection and Stomach Disorder.	Decoction	63	0.21	0.3	0.48
Dysphania botrys (L.) Mosyakin & Clemants	Chenopodiaceae	Fruit	Antispasmodic, Carminative, and Diuretic.	Decoction	67	0.22	0.39	0.58
Euphorbia hirta L.	Euphorbiaceae	Whole Plant.	Cough, Coryza, and Bronchitis.	Extract	88	0.29	0.3	0.34
Eucalyptus camaldulensis Dehnh.	Myrtaceae	Leaves and Bark	Cough, Diarrhea, and Stomach Disorders.	Powder	53	0.18	0.6	0.57
Eleusine indica (L.) Gaertn.	Poaceae	Leaves	Anti-Helminthic and Venereal Infections	Infusion	45	0.15	0.37	0.82
Ficus palmata Forssk.	Moraceae	Fruit and Latex	Gastrointestinal Tract and Urinary Tract Infections.	Edible	33	0.11	0.25	0.76
Ficus virens Aiton	Moraceae	Fruit and Leaves	Urine Disease, Diabetes, and heart disease.	Edible	46	0.15	0.25	0.54
Forsskaolea tenacissima L.	Urticaceae	Whole Plant	Antidiabetic, Antispasmodic, and Antipyretic.	Extract	39	0.13	0.27	0.69
Grewia optiva J.R.Drumm. ex Burret	Tiliaceae	Leaves, Bark, and Fruit	Indigestion, Gastric Problems, Diuretic.	Decoction	92	0.31	0.7	0.76
Geranium ocellatum Jacquem. ex Cambess.	Geraniaceae	Flower and Leaves	Astringent, Diuretic, Amoebic, and Dysentery.	Extract	54	0.18	0.45	0.83
Gymnosporia royleana Wall. ex M.A.Lawson	Celastraceae	Leaves and Fruit	Toothache, Malaria, and heart diseases.	Decoction	62	0.21	0.45	0.73
Heliotropium strigosum Willd.	Boraginaceae	Whole Plant.	Laxative, Diuretic Insects, Snake Bites.	Extract	74	0.25	0.7	0.41
Hypericum perforatum L.	Hypericaceae	Flowers and Leaves	Anxiety, Depression and Insomnia.	Powder Decoction	69	0.23	0.49	0.71
Ipomoea multifida (Raf.) Shinners	Convolvulaceae	Leaves and Flower	Antioxidant, Antidiabetic, and Anticancer.	Decoction	65	0.22	0.41	0.63
Isodon rugosus (Wall. ex Benth.) Codd	Lamiaceae	Leaves	Abdominal Pain, Gastric Pain, and Body Pain.	Decoction	49	0.16	0.85	0.51

Isodon coetsa (Buch.-Ham. ex D.Don) Kudô	Lamiaceae	Leaves	Blood Pressure, Heart Diseases, and Kidney Stones.	Extract	96	0.32	0.58	0.6
Justicia adhatoda L.	Acanthaceae	Leaves and Stem	Bronchitis, Asthma, Cough, and Cold.	Decoction	53	0.18	1.52	0.98
Lantana camara L.	Verbenaceae	Whole Plant.	Cancers, Chicken Pox, Measles, and Asthma.	Decoction	73	0.24	0.48	0.66
Malvastrum coromandelianum (L.) Garcke	Malvaceae	Whole Plant.	Hepatitis, Liver Infection, and Enteritis.	Powder	25	0.08	0.1	0.8
Morus alba L.	Moraceae	Fruit and Leaves	Dizziness, Insomnia, and Kidney Disorders.	Infusion	150	0.5	0.98	0.65
Minuartia hybrida (Vill.) Schischk.	Caryophyllaceae	Fruit	Kidney Stone, Epilepsy, and Stomach Diseases.	Extract	46	0.15	0.35	0.76
Mallotus philippensis (Lam.) Müll.Arg.	Euphorbiaceae	Leaves, Bark, and Fruit	Bronchitis, Abdominal Diseases and Spleen Enlargement.	Infusion	90	0.3	0.56	0.62
Mentha longifolia (L.) L.	Lamiaceae	Whole Plant	Headaches And Digestive Disorders	Direct, Powder	76	0.25	0.58	0.76
Myrsine africana L.	Myrsinaceae	Leaves and Fruit	Dysmenorrhea, Dropsy, and Colic.	Decoction	56	0.19	0.95	0.63
Micromeria biflora (Buch.-Ham. ex D.Don) Benth.	Lamiaceae	Leaves	Sinusitis, Nose Bleeds, and Toothache.	Decoction	65	0.22	0.47	0.72
Rosa moschata Herrm.	Rosaceae	Leaves and Fruit	Abdominal Spasm and Diarrhea.	Infusion	50	0.17	0.45	0.90
Myosotis alpestris F.W.Schmidt	Boraginaceae	Flowers and Bark	Lung Problems, Body Pain, and Skin Problems.	Powder	84	0.28	0.11	0.24
Mentha arvensis L.	Lamiaceae	Leaves	Heart Disease, Indigestion, and Rheumatic Pains.	Direct, Powder	56	0.19	0.36	0.64
Morus nigra L.	Moraceae	Fruit and Seed	Eye Infections, Bronchitis, and Hypertension.	Edible	82	0.27	0.29	0.35
Melia azedarach L.	Meliaceae	Fruit and Leaves	Antioxidative, Analgesic and Anti-Inflammatory.	Extract	35	0.12	0.95	0.43
Malva neglecta Wallr.	Malvaceae	Whole Plant	Asthma, Stomachache, and Diarrhea.	Edible	82	0.27	0.41	0.5
Nannorrhops ritchieana (Griff.) Aitch.	Arecaceae	Fruit	Dysentery and Diarrhea.	Maceration	64	0.21	0.35	0.55
Nerium oleander L.	Apocynaceae	Leaves and Bark Flower	Asthma, Epilepsy, and Malaria.	Maceration	76	0.25	0.57	0.75
Oenothera speciosa Nutt.	Onagraceae	Bark	Diabetes, Microbial Infections, and Ulcers	Decoction	38	0.13	0.16	0.53

Olea ferruginea Wall. ex Aitch.	Oleaceae	Fruit and Leaves	Skeleton Disorders, Headache, and Fever.	Infusion	49	0.16	1.39	0.8
Oxalis corniculata L.	Oxalidaceae	Fruit, Leaves, and Roots	Digestive, Diuretic, Antibacterial, and Antiseptic.	Decoction	66	0.22	0.45	0.68
Origanum vulgare L.	Lamiaceae	Whole Plant	Antimicrobial, Antifungal, and Antioxidant.	Infusion	92	0.31	0.45	0.49
Parthenium hysterophorus L.	Asteraceae	Stem and Leaves	Skin Inflammation and Rheumatic Pain.	Powder	55	0.18	0.5	0.91
Pteris cretica L.	Pteridaceae	Whole Plant	Skin Diseases, Diarrhea, and Dysentery.	Edible	78	0.26	0.39	0.5
Pteris vittata L.	Pteridaceae	Whole Plant	Skin Diseases, Diarrhea, and Dysentery.	Paste	64	0.21	0.3	0.47
Pinus roxburghii Sarg.	Pinaceae	Whole Plant	Hemostatic, Stimulant, Anthelmintic, and Digestive.	Infusion	86	0.29	0.63	0.73
Punica granatum L.	Punicaceae	Fruit and Bark	Coughs, Urinary Infections, and Digestive Disorders.	Mixture	74	0.25	0.59	0.8
Phlomoides spectabilis (Falc. ex Benth.) Kamelin & Makhm.	Lamiaceae	Leaves	Malaria and Kidney Stones.	Extract	94	0.31	0.45	0.48
Platanus orientalis L.	Platanaceae	Bark and Stem	Pain and Inflammation reliever	Powder,	48	0.16	0.29	0.6
Physalis divaricata D. Don	Solanaceae	Whole Plant	Diuretic Analgesic And Heart Diseases.	Decoction	32	0.11	0.28	0.88
Prunus armeniaca L.	Rosaceae	Seeds Oil	Asthma, Antispasmodic, and Sedative.	Decoction	70	0.23	0.31	0.43
Quercus baloot Griff.	Fageceae	Flower and Seeds	Blood Pressure and Intestinal Problems.	Extract	102	0.34	1.61	0.6
Rumex dentatus L.	Polygonaceae	Root and Seed.	Eczema, Acariasis, Diarrhea and Skin Disorders	Extract	86	0.29	0.43	0.5
Rubus plicatus Weihe & Nees	Rosaceae	Leaves And Roots	Diarrhea, Colds, and Stomach Complaints.	Edible	65	0.22	0.45	0.69
Rydingia limbata (Benth.) Scheen & V.A.Albert	Lamiaceae	Leaves	Mouth Sores, Throat Pains, and Wound Healing.	Powder	70	0.23	1.47	0.64
Rumex hastatus D. Don	Polygonaceae	Leaves.	Fever, Asthma, and Cough.	Infusion	72	0.24	0.41	0.57
Salvia moorcroftiana Wall. ex Benth.	Lamiaceae	Leaves, Seeds, and Roots	Colds, Coughs, Dysentery, and Hemorrhoids.	Extract	68	0.23	0.5	0.74
Sageretia thea (Osbeck) M.C. Johnst	Rhamnaceae	Whole Plant	Cancer and Digestive Problems	Infusion	48	0.16	0.2	0.42
Sideroxylon mascatense (A.DC.) T.D.Penn.	Sapotaceae	Fruit and Leaves	Hematinic, Laxative, and Digestive-gastro-Urinary Disorders.	Edible	64	0.21	0.25	0.39
Solanum nigrum L.	Solanaceae	Fruit and Leaves	Pneumonia, Stomachache, and Fever.	Powder	81	0.27	1.41	0.51

Solanum surattense Burm. f.	Solanaceae	Leaves and Fruit	Diabetes, Asthma, Cough, and Fever.	Infusion	68	0.23	1.36	0.44
Sonchus asper (L.) Hill	Asteraceae	Whole Plant	Ulcers, Blood Purifier, and Antioxidant.	Decoction	51	0.17	0.17	0.33
Solanum incanum L.	Solanaceae	Leaves, Roots, and Seeds	Liver Pain, Malaria, and Stomach Problem.	Powder	101	0.34	0.69	0.68
Tribulus terrestris L.	Zygophyllaceae	Leaves and Fruits	Sexual Problems and Hormonal Disbalance.	Decoction	63	0.21	0.52	0.75
Trichodesma indicum (L.) Lehm.	Boraginaceae	Flower, Roots, and Leave	Joint Disorders, Carminative, and Inflammation.	Powdered, Infusion	67	0.22	0.85	0.67
Teucrium massiliense L.	Lamiaceae	Flower and Leaves	Malaria, Asthma, and Diabetes.	Infusion	57	0.19	0.54	0.95
Viburnum cotinifolium D. Don	Viburnaceae	Leaves and Fruit	Chest Infection, Malaria, and Epilepsy.	Decoction	91	0.3	0.54	0.59
Vitis jacquemontii R. Parker	Vitaceae	Fruits, and Leaves	Skin Problems, Ulcers, and Wound Healings.	Decoction	81	0.27	0.51	0.63
Verbesina encelioides (Cav.) Benth. & Hook.f. ex A.Gray	Asteraceae	Stem and Leaves	Skin Problems, Gastro-Intestinal, and Cancer.	Extract	105	0.35	0.64	0.61
Viola canescens Wall.	Violaceae	Leaves and Flower	Fever, Malaria, and Anti-cancerous.	Paste	48	0.16	0.35	0.73
Vitex negundo L.	Verbenaceae	Leaves and Stem	Anti-Inflammatory, Expectorant, and Antispasmodic	Direct	44	0.15	0.23	0.52
Withania coagulans (Stocks) Dunal	Solanaceae	Fruit	Diabetes, Antioxidant, and Anti-Inflammatory.	Decoction	98	0.33	0.25	0.26
Withania somnifera (L.) Dunal	Solanaceae	Whole Plant	Heart Problems, Diabetes, and Hepatitis.	Powder	70	0.23	1.25	0.36
Ziziphus nummularia (Burm.f.) Wight & Arn.	Rhamnaceae	Leaves Wood Fruit	Diarrhea, Colic, Influenza, and Dysentery.	Infusion	88	0.29	0.23	0.26
Ziziphus mauritiana Lam.	Rhamnaceae	Shoot Fruit Leaves	Wounds, Ulcer, and Diarrhea.	Powder	68	0.23	0.28	0.41
Ziziphus oxyphylla Edgew.	Rhamnaceae	Whole Plant	Skin Infections, Digestive Disorders, and Diabetes.	Decoction	49	0.16	0.8	0.82

Habit

Habit wise distribution the herbs were dominant with 61 species (54.95%), followed by shrubs with 29 species (26.13%), and trees with 22 species (18.92%) (Fig. 2).

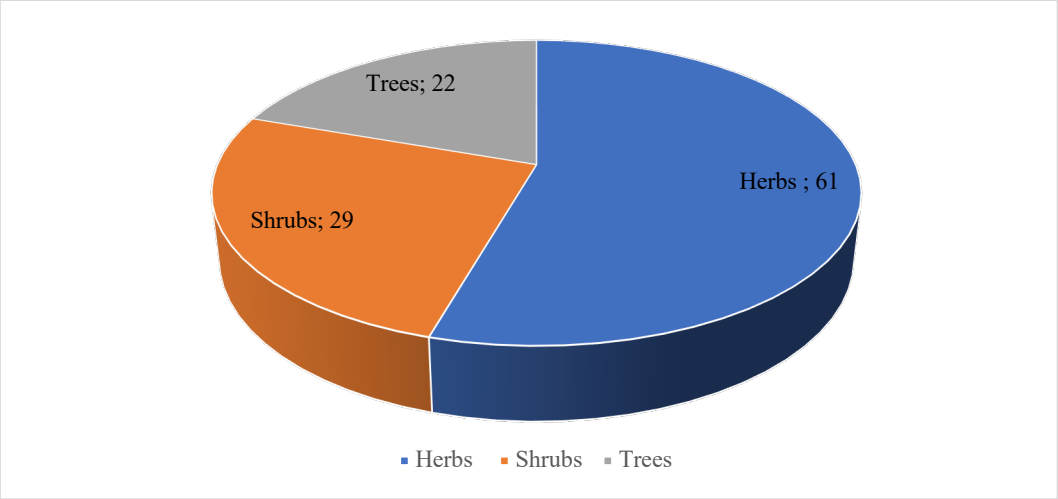

Figure 2. Habit wise distribution of the medicinal flora of Sellay Pattay valley, district Malakand, Khyber Pakhtunkhwa, Pakistan.

Plant parts used

For curing different disorders, specific plant parts were used, dominantly the leaves were used of 66 species with (59.4%), and secondly the roots were used of 35 species with (31.5%), whole plant body and fruits were used of 30 species each (27.02%). In addition to that the stem were utilized of 20 species with (18.01%), flowers of 13 species with (11.71%), bark of 10 species with (9.09%), seeds of 9 species with (8.1%), Gums of 6 species (5.4%), rhizome and oil of 2 species each (1.80%) were used (Fig. 3).

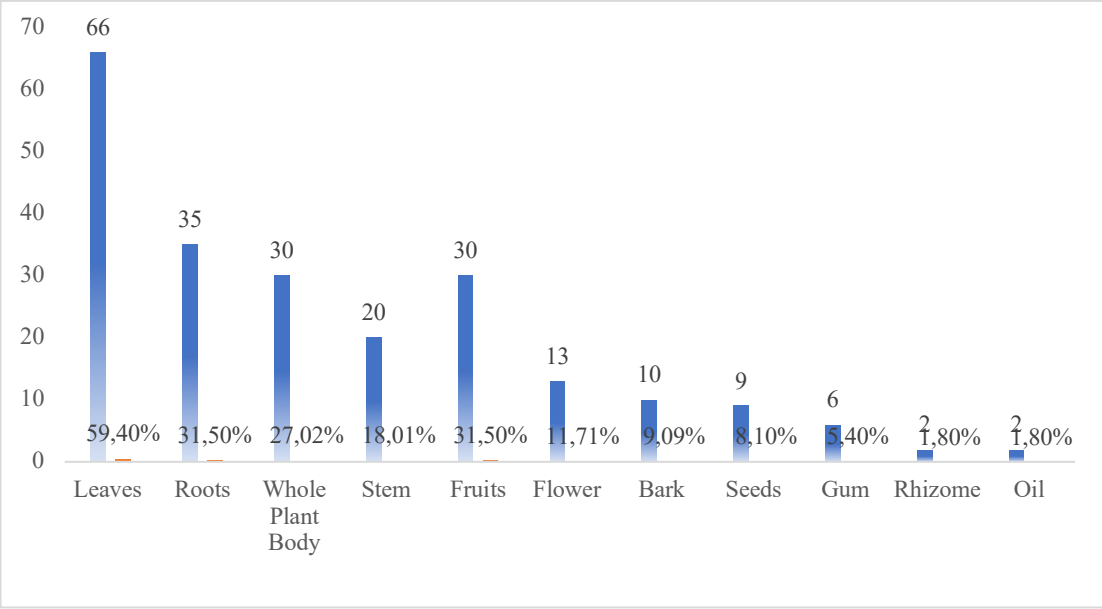

Figure 3. Percentage of part used of the flora of Sellay Pattay valley, district Malakand, Khyber Pakhtunkhwa, Pakistan.

Mode of recipes

In the assessment, the recipes were also documented that were helpful for the effective work against different ailments. Numerous approaches were determined through interviews concerning to the cure of diseases. The decoction were the leading method with 66 species (59.45%), second leading recipes was extract with 30 species (27.02%), followed by infusion method with 15 species (13.51%), paste and power utilized of 6 species (5.4%) were utilized.

Therapeutic Flora persistence in study area

With the passage of time, the native knowledge of the therapeutic flora is declining especially in young people due to the progression of facilities. Amongst all informants, 154 respondents have decreasing response, while 18 approved that the utilize of therapeutic plants were increasing (Table 2).

Quantitative Ethnobotanical Indices

Frequency of citation (FC)

Frequency of citation was examined, and the highest frequency citation value was resulted for *Morus alba* L. with (150), *Verbesina encelioides* (Cav.) Benth. & Hook.f. ex A.Gray (105), *Conyza bonariensis* (L.) Cronquist and *Quercus baloot* Griff. (102) each, *Solanum incanum* L. (101), *Dodonaea viscosa* (L.) Jacq. and *Withania coagulans* (Stocks) Dunal (98) each, *Isodon coetsa* (Buch.-Ham. ex D.Don) Kudô (96), *Chrozophora tinctoria* (L.) A. Juss. (95) *Phlomoides spectabilis* (Falc. ex Benth.) Kamelin & Makhm. (94), *Grewia optiva* J.R.Drumm. ex Burret (92), *Viburnum cotinifolium* D. Don (91). However in approche the lowest FC was shown by *Ficus palmata* Forssk. (33), *Physalis divaricata* D. Don (32), *Acacia nilotica* (L.) Delile (30), *Calotropis procera* (Aiton) Dryand. (28), and the lowest value indicated by *Malvastrum coromandelianum* (L.) Garcke (25) the represented is mentioned in (Table 2).

Relative frequency citation (RFC)

In analysis the highest relative frequency citation values were resulted for *Morus alba* L. (0.50), *Verbesina encelioides* (Cav.) Benth. and Hook.f. ex A.Gray (0.35), *Quercus baloot* Griff*., Solanum incanum* L., *Conyza bonariensis* (L.) Cronquist*,* and *Withania somnifera* (L.) Dunal (0.34) each, *Dodonaea viscosa* (L.) Jacq., and *Withania coagulans* (Stocks) Dunal (0.33) each, *Isodon coetsa* (Buch.-Ham. ex D.Don) Kudô, and *Chrozophora tinctoria* (L.) A. Juss. (0.32) each, *Grewia optiva* J.R.Drumm. ex Burret*, Origanum vulgare* L., *Phlomoides spectabilis* (Falc. ex Benth.) Kamelin & Makhm. (0.31) each While the lowest values were resulted for *Melia azedarach* L. (0.12), *Ficus palmata* Forssk., and *Adiantum capillus-veneris* L. (0.11) each, *Acacia nilotica* (L.) Delile (10), *Calotropis procera* (Aiton) Dryand. (0.09), *Malvastrum coromandelianum* (L.) Garcke (0.08) (Table 2).

Relative popularity level (RPL)

The RPL value ranged from 1.62 to 0.1 which classify the taxa based on popularity and unpopularity. The top leading parameter were indexed for *Dodonaea viscosa* (L.) Jacq. (1.62) while the second was resulted for *Quercus baloot* Griff. (1.61), and third top ranked parameter for *Justicia adhatoda* L. (1.52). The rest of taxa *Rydingia limbata* (Benth.) Scheen and V.A.Albert (1.47), *Achyranthes Aspera* L. (1.43), *Solanum nigrum* L. (1.41), *Olea ferruginea* Wall. ex Aitch. (1.39), *Solanum surattense* Burm. f. (1.36), *Berberis lyceum* Royle (1.32), *Acacia modesta Wall* (1.30). In the RPL the lowest parameters were resulted for *Oenothera speciosa* Nutt. (0.16), *Dalbergia sissoo* DC. (0.15), *Cajanus platycarpus* (Benth.) Maesen (0.14), *Myosotis alpestris* F.W.Schmidt (0.11), *Malvastrum coromandelianum* (L.) Garcke (0.1) (Table 2).

Use value (UV)

Use values were calculated to examine the significance of a single species. In the present investigation, the highest (0.98) use value (Uv) was recorded for *Cyperus esculentus* L., *Caralluma adscendens* var. *fimbriata* (Wall.) Gravely & Mayur., and *Justicia adhatoda* L. had the value (0.98), *Teucrium massiliense* L. (0.95), *Arisaema utile* Hook.f. ex-Schott and *Parthenium hysterophorus* L. (0.91), *Rosa moschata* Herrm. (0.90), *Physalis divaricata* D. Don (0.88), *Adiantum capillus-veneris* L. (0.87), *Abutilon indicum* (L.) Sweet (0.85), *Cyperus rotundus* L. (0.84), *Geranium ocellatum* Jacquem. ex Cambess. (0.83), *Eleusine indica* (L.) Gaertn. and *Ziziphus oxyphylla* Edgew. (0.82). However the lowest values were resulted for *Myosotis alpestris* F.W.Schmidt (0.24), *Cajanus platycarpus* (Benth.) Maesen, *Withania coagulans* (Stocks) Dunal, and *Ziziphus nummularia* (Burm.f.) Wight & Arn. (0.26) each, *Conyza bonariesnsis* (L.) Cronquist (0.31), *Sonchus asper* (L.) Hill (0.33), and *Euphorbia hirta* L. (0.34) (Table 2).

Fidelity level (FL %)

The outcomes of FL values were indicated in percent which range from 88.37% to 98.88%. The change in the fidelity value of a species was caused by the use of a species for more than one disease. The plant includes *Amaranthus viridis L.*, *Rumex hastatus* D. Don, *Eucalyptus camaldulensis* Dehnh., *Justicia adhatoda* L., and *Ajuga bracteosa* Wall. ex Benth. had the highest FL with 100% against specific diseases, the *Acacia modesta Wall* and *Olea ferruginea* Wall. ex Aitch., *Ziziphus oxyphylla* Edgew*., Morus nigra* L. and *Dysphania botrys* (L.) Mosyakin & Clemants were having more than 80 percent FL (Table 3). The plants species with higher FL 100% have the greatest therapeutic value, so these are recommended for phytochemical analysis and pharmacological activities to get the greatest advantages from them. The low FL plants have also been treated with immense significance as they may be endangered species or may not be effective against a disease.

Table 3. Fidelity level of the flora of Sellay Pattay valley, district Malakand, Pakistan.

Plant name	Disease Treated	NP	N	FL
Acacia modesta Wall.	Cough	89	90	98.88%
Amaranthus viridis L.	Asthma	84	87	96.55%
Rumex hastatus D. Don	Wound curative	74	82	90%
Olea ferruginea Wall. ex Aitch.	liver disorders	68	70	91.14%
Ziziphus oxyphylla Edgrew	Diabetes	62	65	95.38%
Eucalyptus camaldulensis Dehnh.	Tonic	80	85	94.11%
Morus nigra L.	Laxative	55	60	91.66%
Justicia adhatoda L.	Jaundice	76	88	88.37%
Dysphania botrys (L.) Mosyakin & Clemants	Hepatic diseases	65	75	86.66%
Ajuga bracteosa Wall. ex Benth.	Diarrhea	92	96	95.83%

Informant consensus factor (ICF)

ICF is the value concerning the occurrence of ailments in the study area. The current study compiles the categories of diseases based on the reports of informants. in the categorization of diseases, the most dominant disease was diabetes recorded with (0.91) followed by the second category anticancer with a value of (0.89) recorded while the third dominant diseases were muscular and sexual diseases with a value of (0.88) each. The rest of the categories shown in (Table 4).

Table 4. Informant consensus factor (ICF) of the medicinal flora of Sellay Pattay valley, district Malakand, Khyber Pakhtunkhwa, Pakistan.

Disease Category	Nt	Nur	ICF
Respiratory diseases	150	340	0.55
Ear Nose Throat diseases	70	550	0.87
Cardiovascular	110	612	0.82
Gastrointestinal tract Disorders	82	590	0.86
Urinary Disorders	36	204	0.82
Sexual Diseases	11	98	0.88
Muscular (joint pain, rheumatic, toothache	60	500	0.88
Nervous disorder	102	721	0.85
Infectious diseases	35	356	0.9
Anti-cancer	10	99	0.89
Liver disorder	30	150	0.8
Antidote	9	98	0.9
Dermatological problems	90	620	0.85
Diabetes	15	186	0.91
Fever	92	409	0.77

Discussion

In the current study, a total of 111 species belonged to 58 families were documented from Sellay Pattay valley, district Malakand, Khyber Pakhtunkhwa, Pakistan. Habit wise, amongst them 21 were tress, 61 were herbs, and 29 were shrubs. Herbs were dominantly used, as these findings were supported by the previous work of (Irfan *et al.* 2018c; Jan *et al.* 2022) which proved that herbs are a well adopted habit, used dominantly in the field of ethnomedicine.

The leading family was Lamiaceae with 12 species (10.81%), followed by Solanaceae with 7 species (6.3%), Amaranthaceae with 6 species (5.4%). The current assessment of the family dominancy was supported by the work of (Irfan *et al.* 2018d) as they indicated the family Lamiacaea, Solanacae, and Amarantahaceae is well known for the active chemical ingredients.

The current study revealed that, for curing disorders specific plant parts used dominantly the leaves of 66 species with (59.4%), and secondly the roots were used of 35 species with (31.5%), whole plant and fruits were used of 30 species with

(27.02%), similar results were previously documented by (Irfan *et al.* 2018e) indicated that the leaves has the active compound with quick healing potential.

According to (Sandhya and Rajamohan, 2008) the traditional protocols for the curing of human beings have been accepted through social later primordial earliest time unpaid to the absence of advanced current therapeutic technologies and facilitation. For effective work, the recipes were also documented with diverse method of preparation. The decoctions were the leading method with 66 (59.45%) species, and second leading recipes was extract with 30 species (27.02%) followed by infusion with 15 species (13.51%), paste and powder utilized of 6 species (5.40%). Numerous approaches were determined through interviews concerning the cured diseases that made the taxa enriched with potential for treating ailments (Zahoor *et al.* 2017).

According to (Irfan *et al.* 2018f; khan *et al*. 2023) the demand of medicinal plant increasing in market which cause the shortage of these taxa, but in current study also pointed the unwanted use of these of medicinal taxa, however most of the taxa facing to overgrazing a deforestation. The rural population of Pakistan frequently depends on plants for the cure of their ailments. Plant's diverse part having active ingredients are used to care for the many ailments in both animals as well as humans (Shinwari *et al.* 2000; Jan *et al.* 2020).

In the present investigation, the highest (0.98) use value (Uv) was recorded in *Justicia adhatoda* L., and the lowest (0.25) value was recorded in *Myosotis alpestris* F.W.Schmidt based upon the utilization record through an informant in maximum and minimum numbers in the study area in this research. Biological significance has improved of plants that are used a lot and report by many author effort era to time having latent treatments of diverse diseases (Ayantunde *et al*. 2009; Irfan *et al.* 2018g).
The outcomes regarding fidelity level were between 20 to 100%. The changes in the level of fidelity plant in the research region were due to the changes of a specimen of diverse ailments in the region. The plant includes *Amaranthus viridis, Rumex hastatus* D. Don*., Eucalyptus camaldulensis* Dehnh*., Justicia adhatoda,* and *Ajuga bracteosa* Wall. ex Benth. was maximum FL with 100% again precise ailments, *Acacia modesta Wall, Olea ferruginea* Wall. ex Aitch*., Ziziphus oxyphylla* Edgew*., Morus nigra* L. and *Dysphania botrys* (L.) Mosyakin & Clemants were having more than 80 percent FL in the present result. In this work, the greatest predominant disease in the study area was Diabetes with an ICF Value of (0.9)1 followed by muscular and sexual diseases with (0.88) ICF which had the similarity in dominancy with (Irfan *et al.* 2021).

Conclusion

Sellay Pattay valley has a huge diversity of medicinal flora, as compared with the younger generation, elder people have greater knowledge because the younger people are interested in allopathic medicines and use them for the treatment of different diseases. Native communities utilized these plants for the curing of different disorders such as respiratory, jaundice, malaria, hepatitis, diabetes and gastrointestinal. Generally herbs were mostly used as decoctions against different ailments. Certain plant species were at high risk of extinction due to anthropogenic factors such as overgrazing, overharvesting and random collection.

Declarations

Ethics statement: Prior to the survey, we obtained oral informed consent from each participant.
Consent for publications: Not applicable.
Funding: Authors have not received any funding during this research.
Conflicts of Interest: The authors declare that there are no conflicts of interest in this article.
Data Availability statement: The figures and tables supporting the results of this study are included in the article, and the original data sets are available from the first author upon request.
Author's contribution: MA wrote the original draft of the manuscript, GMS supervised the study, MI revised and edited the article, FU did the statistical analysis, and AU provided the technical assistance. All the authors approved the final draft of manuscript after revision.

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