Traditional medicine in the treatment of gastrointestinal diseases in northern part of Kashmir Himalayas

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Databases and Inventories

Abstract

Background: Treatment of gastrointestinal diseases with medicinal plants from the northern portion of the Kashmir Himalayas is widespread, because of effectiveness, ease of availability, lack of modern healthcare alternatives, cultural preferences, and century-old affinity with the plants. Thus this vast supply of traditional knowledge must be documented as soon as feasible if sustainable healthcare systems are to be developed.

Methods: This survey was conducted from June 2020 to September 2021 to document the indigenous knowledge on plant resources of the tribal communities of the administrative district Kupwara, Kashmir Himalayas. The data was gathered through open-ended semi-structured interviews and group discussions. Various statistical indices (UV & ICF) were used to further examine quantitative data.

Results: A total of 67 plant species representing 31 families are reported to treat different gastrointestinal diseases, with herbs being the most dominant used plants (93%). Leaves (36%) are most frequently used in the study area followed by roots (33%) with preparation being dominated by infusion. Present study revealed that abdominal pain (23.88%) is the dominant disease which is treated using quoted medicinal herbs followed by constipation (17.91%), stomachache (16.42%). The reported ICF is very high I.e. (0.91- 0.96) indicating that the traditional knowledge about medicinal plants used to cure gastrointestinal diseases in district Kupwara is very extensive. Highest UV has been reported for *Aconitum heterophyllum* (0.96) and the lowest UV is recorded for *Verbena officinales* (0.17).

Conclusion: The goal of this study was to highlight the potential for medicinal plants to be used to treat a variety of gastrointestinal ailments. Ten medicinal plants for the treatment of gastrointestinal issues were discovered for the first time in this part of Himalaya. The phytochemical content and pharmacological effects of these should be explored and there is a need for more research for conservation strategies.

Key Words: Gastrointestinal, Traditional Knowledge, Ethnomedicine, Kupwara, Medicinal plants.

Background

In humans, the gastrointestinal tract is considered as the most sensitive organ vulnerable to diverse diseases such as bloating, constipation, diarrhea, gastroenteritis and reflux, parasitic and other infectious ailments (Kasper *et al.* 1762; Mir *et al.* 2021d). The diet-dependent gastrointestinal diseases are mainly due to disordered eating patterns.

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These patterns describe irregular eating behaviors like skipping meals, restricted food types, fasting and binge eating (Grilo 2006). From primitive to modern times, herbal medicines occupy a unique position in primary system of medication for the people residing in remote places of sub-urban or rural areas (Jan *et al.* 2021a, Mir *et al.* 2021a, b).

Medicinal plants are best sources for primary healthcare because they are much compatible with nature of human body and are reported to have little or no side effects (Rafieian-Kopaei 2012). Modernization in rural cultures has put the centuries-old traditional knowledge in jeopardy. In India, a lot of tribal people from various ethnic origins live and follow their own traditional medical system for basic healthcare. According to report (Gogtay *et al.* 2002), 80% of Indians consume non-allopathic (Ayurveda, Siddha, Unani, and Homeopathy) medications for their health, and herbs are a key component of these alternative medical systems. In India, major health hazards include widespread communicable diseases, inadequate sewage infrastructure, and a lack of safe drinking water (Jeelani *et al.* 2018; Mir *et al.* 2021c; Hassan *et al.* 2021).According to Porcelli *et al.* (2004) diarrhea as an infectious disease occurs in about 19-83 people out of every 100 people annually depending on regions.

Due to the numerous adverse effects associated with the use of synthetic medicines for a variety of ailments, medicinal plants are increasingly being regarded as a primary source of novel pharmaceuticals, and significant research is conducted in quest of strong plant-based treatments (Savikin *et al.* 2013; Holst *et al.* 2008). However, sometimes the higher doses may cause serious implications or even death. This is why one needs to be more sensitive when using herbs at home.

The present study is the first in its kind to document use of flora to treat gastrointestinal disorders in administrative district Kupwara of Jammu and Kashmir. The aim of the study was to document medicinal plants used in treatment of gastrointestinal disorders. So we wanted to know the answers to the following questions about medicinal plants used to treat gastrointestinal diseases in this study: (A) which species are used in the treatment of gastrointestinal diseases. (B) What type of gastrointestinal diseases does a particular plant treat? (C) Which portion of the plant is used for medicine purpose? (D) What is the mode of administration? Furthermore, the data was examined using ethnomedicinal indices to identify most popular plants in the study area. This could be than subjected to further pharmacological and phytochemical investigation.

Materials and Methods

Study area and site description

Kupwara is an administrative district in the Union territory of Kashmir. GPS coordinates include 34°45 and 75° 20 east longitudes (Fig.1). The district has a total geographical area of 2,379sq Km comprising 368 villages. As per 2011 census the region has a population of 870,354 persons with population density of 366 persons per sq Km (Aadil*et al.* 2021b). The luxuriant biodiversity of the area is characterized by Himalayan dry temperate to alpine (Haq *et al.* 2020; Haq et al 2022), with an elevation range of 1500- 3200m and by a severe winter season (almost 4 to 5 months), followed by summer and monsoon seasons. The temperature ranges between -4˚ C minimum in winter and up to 32˚C maximum in summers (Aadil*et al.* 2021a). The month of March and April receives the highest rainfall. The local vegetation is composed of Himalayan dry temperate, subalpine and alpine species. The present study was carried out in Budnamal, Inchas, Rashanpora Dutt, and Bungus Valley. The dominant tree species in the study area are *Abies pindrow, Cedrus deodara* and *Pinus wallichiana* while as in case of shrubs the dominant species are *Viburnum grandiflorum, Parrotiopsis jacquemontiana* and *Berberis lyceum*; in case of herbs species like *Senecio chrysanthemoides, Poa spp, Fragaria nubicola, Artemisia absinthium, Ranunculus laetus* and *Sambucus wightiana* are dominant (Haq *et al.* 2020). The elevation range of the study sites recorded were:- Budnamal - 2500m; Inchas - 2800m; Rashanpora Dutt - 3100m and Bungus valley - 3000m. Study sites were dominated by three ethnic groups Gujjars, Bakarwals and Kashmiri. Budnamal has a population of 3039 as per census 2011, while as the remaining three study sites i.e. Rashanpora Dutt, Inchas and Bungus valley are inhibited during summers to autumn by Bakarwals and Gujjars communities which mainly fed their livestock in the pastures and forests regions of the said area.

Field survey and data collection

An extensive survey was conducted in the study area from June 2020 to September 2021 to collect plants with important medicinal values and their association with indigenous knowledge. Information was gathered through semi-structured personal interviews and group discussions (Haq *et al.* 2021; Hassan *et al.* 2021a).

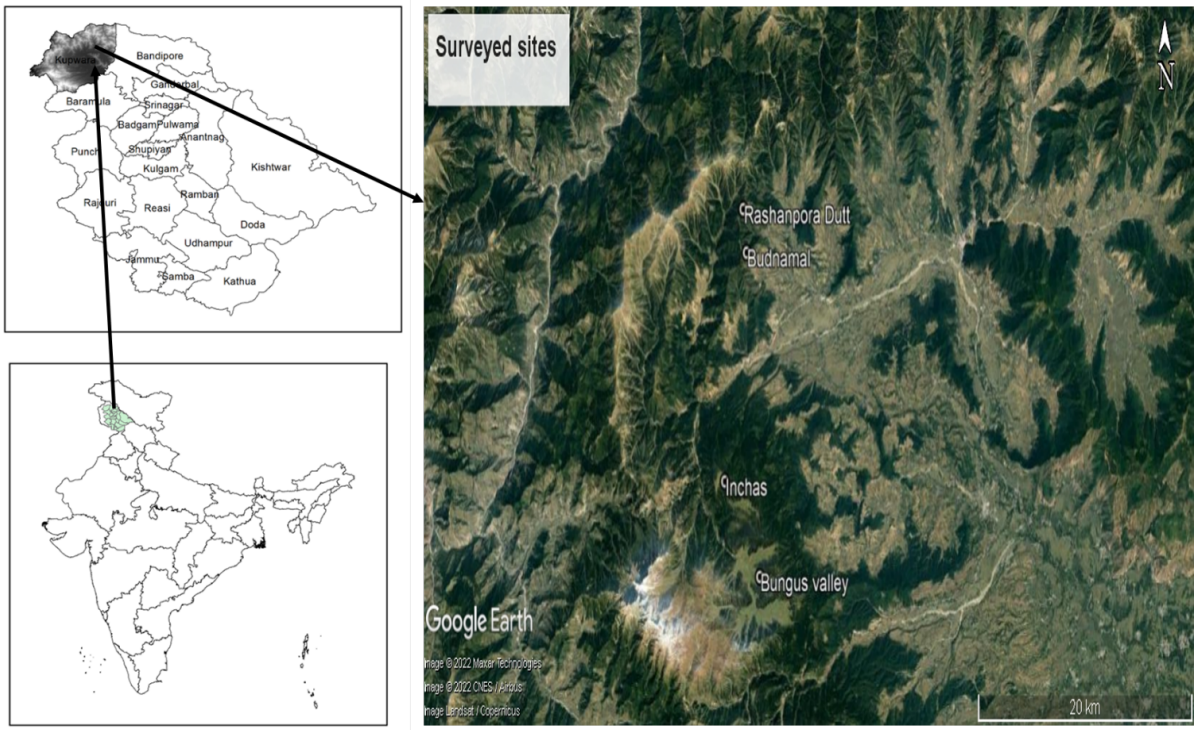

Figure 1. Map of Kupwara, Jammu and Kashmir, India showing surveyed villages.

The main basis for selecting informants was their popularity in traditional knowledge of treating gastrointestinal illnesses. Prior to each interview, verbal consent was obtained from the participants and the Code of Ethics adopted by the international Society of Ethnobiology was followed (International Society of Ethnobiology. Code of Ethics. (2006) (https://www.ethnobiology.net).The interviews were carried in the local language with the assistance of a hired translator and local field guide, all recorded data was subsequently translated into English. The data collected includes the local name, part used, ethnomedicinal use, life form, preparation and administration methods.

Preservation and identification of collected plants:

The specimens collected were dried, pressed and mounted on herbarium sheets and good quality voucher specimens were made according to standard techniques (Jain and Rao 1997). For identification, plant specimens and usable pieces were also collected. Flora of Jammu and Kashmir (Singh *et al.* 2002), Flowers of the Himalayas (Polunin and Stainton 1984), and Flora of the Pir Panjal range of the north-west Himalaya were used to identify the plant species (Singh and Kachroo 1994). Additional identification was carried out by matching voucher specimens with previously identified specimens deposited in KASH Herbarium of the Department of Botany, University of Kashmir, and Srinagar. Herbarium specimens and plant parts collected during this study have been deposited in the mentioned herbarium for future references. The botanical names of the plant species were updated according to the Plant List (www.theplantlist.org). Through the literature review on this subject, a comparative evaluation was made to determine the new findings of plants with ethical significance.

Demography of informants:

A total of 48 informants comprising 34 (70.83%) men and 14 (29.17%) women were interviewed to document the extent of traditional knowledge on the indigenous use of the medicinal plant species to treat gastrointestinal ailments. The uneven ratio of men and women was because women are restricted mainly to their homes and do not have access to distant areas (Haq et al. 2021a; Mir *et al.* 2021a; Asif et al. 2021). Most of the selected informants were illiterate; Gujjri, Pahari, and Kashmiri are the three main languages of communication. The most important traditional knowledge holders are older people (40%) followed by middle (35%) and young (25%) (Table.1).

Data analysis:

The data collected was statistically analyzed using indices like, Use value (UV), Informant Consensus factor (ICF). Sorensen's distance similarity coefficient was used to clusters the plant species based on the usage as traditional medicines against various diseases (Hassan *et al.* 2021b.) Principal Component Analysis (PCA) was employed Haq

et al. (2021) and Asif *et al.* (2021) to visualize the provisioning service and plant parts associations between plants using the Paste softwear.ver.3

Table 1. Demography of informants from the study area.

Informants	**Number**	**Percentage**
Total	48	100
Men	34	70.83
Women	14	29.17
Age groups		
Young 25-40 years	12	25
Middle aged 41-55 years	17	35
Old aged 56-75 years	19	40
Occupation		
Shepherds	17	35
Farmers	10	21
Local healers	13	27
Housewives	8	17
Villages		
Budnamal	10	21
Rashanpora Dutt	19	39
Bungus valley	15	32
Inchas	4	8

Use value (UV)

UV was used to determine the relative importance of a particular species with respect to other species as per (Phillips *et al.* 1994) and is given as

$$UV=\Sigma U/N$$

Where, U=number of use reports for a given species; N=total number of informant

A high value of UV indicates that the plant is very important and low value approaching zero suggests relatively less importance with respect to other species (Musa *et al.* 2011).

Informant consensus factor (ICF)

ICF determines the level of homogeneity of knowledge among informants. The ICF value varies from 0 to 1. A high value (1.0 or close to 1) indicates that a large proportion of the informants use a relatively small number of plant species (Heinrich *et al.* 1998). The index is calculated as the number of citations used in each disease category minus the number of species used, divided by the number of citations used in each category minus one:

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

Where, Nur = number of use-reports; Nt = number of taxa used.

Results and Discussion

Diversity of ethnomedicinal flora

During the present study a total of 67 medicinally important plant species belonging to 31 families were reported, used to treat gastrointestinal diseases (Table 2).

Table 2. List of medicinal plant species used by the locals in district Kupwara of Jammu and Kashmir against gastrointestinal ailments.

Family name	Scientific Name	Common Name	Part used	Life form	Preparation	Administration	Disease treated	Total reports	Use Value
Acoraceae	*Acorus calamus* L. 4225-KASH	Vai	Roots	Herb	Dried roots are crushed into powder and mixed with water and sugar to make infusion	Infusion taken orally in early morning	Constipation	25	0.52
Amaranthaceae	*Amaranthus caudatus* L. * KB-1008	Ganhar	Leaves	Herb	Leaves are sun dried & crushed into powder & mixed with water to make infusion	The mixture taken orally in the morning	Stomachache	23	0.48
Amaranthaceae	*Amaranthus dudis* Mart. ex Thell. KB-1013	Kreykul	Leaves	Herb	Dried leaves are made into infusion	The mixture is taken orally twice a day	Acidity	12	0.25
Amaranthaceae	*Amaranthus spinosus* L. KB-1009	Liss	Leaves	Herb	Leaves are boiled into water to make decoction	The mixture is taken orally for 2-4 days	Constipation	17	0.35
Apiaceae	*Angelica glauca* Edgew. 4110-KASH	Chour	Roots	Herb	Dried roots are crushed into powder and the said powder is boiled in water	The mixture is taken orally for 2 days	Abdominal pain	16	0.33
Apiaceae	*Selenium vaginatum* C.B.Clarke. 3811-KASH	Buddjeath	Roots	Herb	Roots are dried and crushed into powder made into infusion	The mixture is taken orally twice a day	Abdominal pain	32	0.66
Araceae	*Arisaema jacquemontii* Blume. KB-1018	Hapat gogaj	Bulb	Herb	Dried bulb is crushed into powder & mixed with sugar	The mixture is taken orally at bedtime	Helminthic infestation	17	0.35
Asteraceae	*Artemisia absinthium* L. 4224-KASH	Tethwan	Leaves	Herb	Roots are sun dried and later crushed into powder and mixed with water to make infusion	The mixture is taken orally early in the morning	Constipation & Helminthic infestation	27	0.56
Asteraceae	Artemisia annua L. KB-1012	Tethwan	Roots	Herb	Roots are sundried & mixed with water and sugar	The mixture is taken orally once a day	Abdominal pain	28	0.58

Asteraceae	*Artemisia moorcroftiana* Wall. ex DC. KB-1006	Tethwan	Leaves	Herb	Dried leaves are boiled in the water to make decoction	The mixture is taken orally early in the morning for 1-3 days	Acidity	15	0.31
Asteraceae	*Artemisia stelleriana* Besser. KB-1007	Jungle tethwan	Leaves	Herb	Leaves are grinded into powder and mixed with water to make infusion	The mixture is taken orally early in the morning	Helminthic infestation	27	0.56
Asteraceae	*Cirsium wallichii* L. * KB-1026	Kund	Roots	Herb	Root are sun dried	Roots are eaten raw twice a day	Abdominal pain	11	0.23
Asteraceae	*Conyza bonariensis* (L.) Cronquist KB-1016	Shalut	Leaves	Herb	Leaves are soaked into water overnight	The mixture is taken orally thrice a day	Dysentery	17	0.35
Asteraceae	*Conyza Canadensis* L. 4116-KASH	Shasherda	Leaves	Herb	Leaves are soaked into water overnight	The mixture is taken orally twice a day	Dysentery	19	0.40
Asteraceae	*Inula racemosa* Hook. f. KB-1036	Poshkar	Roots	Herb	Dried roots are crushed into powder	Dried Root is taken with water orally	Abdominal pain	22	0.46
Asteraceae	*Ligularia jacquemontiana* Decne* 4214-KASH	Hapat kout	Roots	Herb	Dried roots along and sugar are taken empty stomach	The mixture is taken orally with water early in the morning	Helminthic infestation	31	0.65
Asteraceae	*Senecio chrysanthemoides* DC. 4101-KASH	Boug	Leaves	Herb	Infusion is made from leaves	The mixture is taken orally for 2-3 days	Abdominal pain	21	0.44
Asteraceae	*Senecio graciliflorus* (Wall.) DC. KB-1053	Mongol	Leaves	Herb	Infusion is made from leaves	Taken orally	Diarrhoea	12	0.25
Asteraceae	*Sonchus oleraceus* L. KB-1047	Dudij	Whole plant	Herb	Decoction is made from whole plant	Taken orally for 2-3 days	Indigestion	16	0.33
Asteraceae	*Taraxicum officinale* (L.) Weber ex F.H. Wigg KB-1059	Heand	Whole plant	Herb	Whole plant especially leaves are cooked as vegetable	The vegetable is taken orally along with rice	Stomach cramps	30	0.62
Asteraceae	*Tussilago farfara* L. 4103-KASH	Watt pan	Leaves	Herb	Leaves are dried and crushed into powder & taken along with sugar	The mixture is taken orally	Stomachache	16	0.33

Asteraceae	*Xanthium spinosum* L. KB-1062	Cheur	Tuber	Herb	Roots are sundried and grinded into powder	Taken orally in small amount	Abdominal pain	11	0.23
Berberidaceae	*Podophyllum hexandrum* (Royle) T.S Ying. 4218-KASH	Wanwagun	Roots	Herb	Roots are sundried and crushed into powder & taken with water	Taken orally early in the morning	Diarrhoea	25	0.52
Boraginaceae	*Arnebia benthamii* Wall. ex G. Don 4096-KASH	Khazaban	Leaves	Herb	Leaves are boiled in the water to make infusion	The mixture is taken orally	Constipation	18	0.37
Brassicaceae	*Nasturtium officinale* W.T. Aiton 4226-KASH	Kul nunnery	Whole plant	Herb	Whole plant is boiled in the water to make infusion	The mixture is taken orally	Abdominal pain	10	0.21
Caryophyllaceae	*Silene vulgaris* (Moench) Garcke. KB-1049	Wat kram	Leaves	Herb	Leaves are cooked as vegetable	Taken orally	Indigestion	9	0.19
Colchicaceae	*Colchicum luteum* Baker KB-1021	Virkumpoash	Roots	Herb	Dried roots are crushed into powder. Water is added to the obtained powder.	Mixture is taken orally early in the morning	Constipation	22	0.46
Convolvulaceae	*Convolvulus arvensis* L. KB-1020	Haroli	Leaves	Herb	Leaves are soaked in water overnight to make infusion	The mixture is taken orally	Constipation	12	0.25
Equisetaceae	*Equisetum diffusum* D. Don 4233-KASH	Gandamgud	Whole plant	Herb	Whole plant is made into decoction	Taken orally early in the morning	Stomachache	19	0.40
Gentianaceae	*Gentiana carinata* (D. Don) Griseb * KB-1035	Pangri	Whole plant	Herb	Whole plant is boiled in the water to make infusion	The mixture is taken orally early in the morning	Abdominal pain	23	0.48
Gentianaceae	*Swertia petiolata* Royle. ex D. Don KB-1060	Moomrum	Roots	Herb	Roots are taken raw	Dried roots are taken orally	Abdominal pain	23	0.48
Geraniaceae	*Geranium pratense* L. 4098-KASH	Ratanjog	Whole plant	Herb	Whole plants are crushed into powder & boiled in the water which upon cooling is taken as infusion.	The mixture is taken orally early in the morning	Constipation	14	0.29

Geraniaceae	*Geranium wallichianum* Oliv. 4112-KASH	Ratanjog	Whole plant	Herb	Roots are crushed into powder made into infusion	Taken orally	Constipation	19	0.40
Hypericaceae	*Hypericum perforatum* L. 4089-KASH	Chai kul	Roots	Herb	Roots are crushed into powder	Taken orally early in the morning with water	Diarrhea	13	0.27
Lamiaceae	*Ajuga integrifolia* Buch.-Ham. ex D. Don * 4234-KASH	Jainadam	Whole plant	Herb	The roots are made into decoction	The mixture is taken orally for 2-5 days	Diarrhea	20	0.42
Lamiaceae	*Ajuga parviflora* Benth* 4095-KASH	Jainadam	Whole plant	Herb	Whole plant is made into decoction	Taken orally early in the morning	Stomachache	25	0.52
Lamiaceae	*Isodon rugosus* (Wall. ex Bentha). KB-3033	Suliye pan	Leaves	Shrub	Leaves are crushed and made into infusion	The mixture is taken orally twice a day	Diarrhea	19	0.40
Lamiaceae	*Mentha aquatica* L. 4235-KASH	Kul pudine	Leaves	Herb	Green leaves are crushed into paste, added with salt	The mixture is taken orally along with rice	Abdominal pain	19	0.40
Lamiaceae	*Mentha arvensis* L. 4234-KASH	Pudine	Leaves	Herb	Green leaves are crushed into paste, added with salt	The mixture is taken orally along with rice	Dysentery	16	0.33
Lamiaceae	*Nepeta raphanorhiza* Beath KB-1044	Vangogaj	Roots	Herb	Roots are sundried powdered and added with sugar and water to obtain decoction	The mixture is taken orally	Digestive problems	9	0.19
Lamiaceae	*Prunella vulgaris* L. 4254-KASH	Kal yuth	Whole plant	Herb	Whole plant is shade dried& boiled in the water along with salt	The mixture is taken orally	Diarrhoea	21	0.44
Lamiaceae	*Thymus linearis* Benth. 4107-KASH	Jaind	Leaves	Herb	Leaves are dried and boiled in water to make tea	Taken orally	Stomach cramps	29	0.60
Lamiaceae	*Thymus serpyllum* L. KB-1061	Jungle jaind	Leaves	Herb	Leaves are dried and boiled in water to make tea	Taken orally	Abdominal pain	27	0.56
Liliaceae	*Fritillaria roylei* Hook. KB-1027	Sheetkhar	Bulb	Herb	Dried bulb is crushed into powder and mixed with water	The mixture is taken orally twice a day	Abdominal pain	29	0.60

Liliaceae	*Lilium polyphyllum* D. Don KB-1038	Pland	Bulb	Herb	Dried bulb is crushed into powder	The mixture is taken orally with water early in the morning	Abdominal bloating	18	0.37
Malvaceae	*Malva neglecta* Wallr. 4114-KASH	Souchal	Leaves	Herb	Leaves are boiled in the water to make decoction	The mixture is taken orally	Lower abdominal pain	28	0.58
Melanthiaceae	*Trillium govanianum* Wall. ex D. Don KB-1065	Tripatri	Tuber	Herb	Tubers are dried in shade & crushed into powder and mixed with water	The mixture is taken orally	Helminthic infestation	15	0.31
Morinaceae	*Morina longifolia* Wall. 4251-KASH	Moriee	Roots	Herb	Green roots are crushed into paste and boiled in water	The mixture is taken orally twice a day	Helminthic infestation	13	0.27
Oxalidaceae	*Oxalis corniculata* L. 4113-KASH	Chockchrey	Whole plant	Herb	Whole plant is sundried and are used to make tea	Taken orally twice a day	Diarrhea	18	0.37
Papaveraceae	*Papaver somniferum* L. KB-1046	Kashkash	Whole plant	Herb	Whole plant is crushed into powder and is taken along with salt and water	Taken orally for 2 days	Diarrhea	11	0.23
Plantaginaceae	*Picrorhiza kurroa* Royle ex Benth. KB-1050	Kour	Roots	Herb	Dried roots are grinded into powder & boiled in water to make infusion	The mixture is taken orally	Abdominal pain	19	0.40
Plantaginaceae	*Plantago major* L. 4118-KASH	Bead gull	Roots	Herb	Dried roots are crushed into powder	Taken orally	Abdominal bloating	18	0.37
Polygonaceae	*Bistorta amplexicaulis* (D. Don) Greene 4108-KASH	Manchri	Roots	Herb	Dried roots are boiled in the water to make tea	The mixture is taken orally twice a day	Stomachache	16	0.33
Polygonaceae	*Bistorta amplexicaulis* var. *alba* Munsh& Javeid. * 4109-KASH	Manchri chai	Roots	Herb	Dried roots are boiled in the water to make tea	The mixture is taken orally	Stomach pain	15	0.31
Primulaceae	*Androsace rotundifolia* Hardw. * 4240-KASH	Uzmpoash	Leaves	Herb	Leaves are soaked in water for at least 12 hrs	The mixture is taken orally twice a day	Stomachache	11	0.23
Ranunculaceae	*Aconitum chasmanthum* Stapf ex Holmes KB-1003	Mohand	Roots	Herb	Dried roots are grinded into powder & mixed with water to make infusion	Infusion is taken orally in the evening	Helminthic infestation	16	0.33

Ranunculaceae	*Aconitum heterophyllum* Wall. ex Royle. 4094-KASH	Patrees	Roots	Herb	Dried Roots are crushed into powder and mixed with water to make infusion	The infusion is taken empty stomach for 2-4 days orally	Abdominal pain	33	0.69
Ranunculaceae	*Aconitum laeve* Royle * KB-1008	Mori	Roots	Herb	Dried roots are crushed along with sugar into powder	Mixture is taken orally early in the morning in little concentration	Abdominal pain	10	0.21
Ranunculaceae	*Aconitum violaceum* Jacquem. ex Stapf KB-1010	Pekuya	Roots	Herb	Roots are crushed into powder and mixed with water and sugar to make it less bitter and is used as infusion	Infusion is taken orally early in the morning	Constipation	19	0.40
Ranunculaceae	*Caltha alba* Jacquem ex Cambess KB-1025	Baringu	Roots	Herb	Roots are crushed into paste & mixed with sugar	The mixture is taken orally	Abdominal pain	14	0.29
Rosaceae	*Cyndonia oblonga* Mill KB-1022	Bomb choat	Fruit	Tree	Fruit is taken raw	Fruits are taken orally mostly in winters	Constipation	18	0.37
Rosaceae	*Geum elatum* Wall. ex G. Don * KB-1023	Shah buti	Whole plant	Herb	Whole plant is grinded and made into decoction	The mixture is taken orally for 2-3 days	Constipation Helminthic infestation	16	0.33
Rosaceae	*Rubus ulmifolius* Schott. KB-1048	Gounch	Leaves	Shrub	Green leaves are soaked into water to make infusion	The mixture is taken orally	Digestive problems	10	0.21
Rubiaceae	*Rubia cordifolia* L. KB-1052	N.A	Whole plant	Herb	Decoction is made from whole plant	Taken orally	Stomachache	15	0.31
Rutaceae	*Skimmia anquetillia* N.P. Taylor & Airy Shaw 4223-KASH	Nair pan	Leaves	Shrub	Dried leaves are boiled in water to make decoction	The mixture is taken orally	Digestive problems	20	0.42
Salicaceae	*Salix alba* L. KB-1048	Veer	Twigs	Tree	Fresh twigs are used	Chewed	Stomachache	25	0.52
Verbenaceae	*Verbena officinalis* L. 4117-KASH	Hatmool	Leaves	Herb	Green Leaves are soaked in water to make infusion	The mixture is taken orally	Indigestion	8	0.17

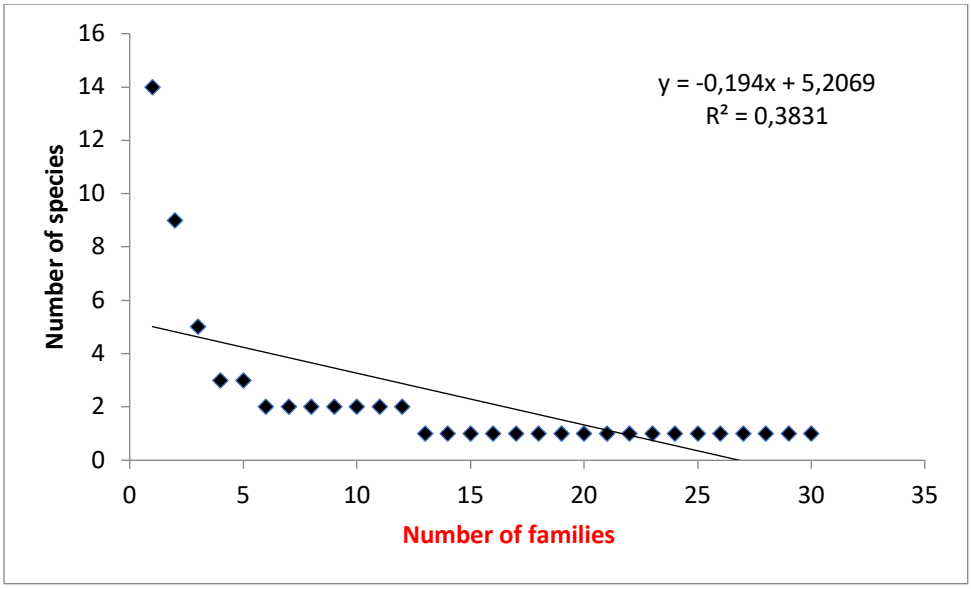

Figure 2.Contribution of various families to ethnomedicinal flora in the study area..

Life form of medicinal flora

In the current study, herb life forms were most cited (93%) for treating various gastrointestinal ailments followed by shrubs (4%) and trees (3%) (Table 2). The reason behind the use of herbs might be due to the presence of high content of bio-active compounds in them (Giday *et al.* 2009). Herbs also grow mostly along roadsides and in home gardens, so are easily available in nature to collect (Shrestha & Dhillion 2003; Singh *et al* 2020; Kayani *et al.* 2014).

Plant part used

Leaves (36%) were found the most common plant part used followed by roots (33%), whole plant (21%), tuber (4%), twig (3%) bulb (2%) and fruits (1%). (Fig.3). the reason behind the frequent use of leaves is easy collection and preparation of medicinal remedies rather than other parts of the plant. This is corroborated by principal components analysis (PCA) investigations, which revealed three separate groups based on differences in plant part preference levels. PC1 and PC2 described the biplot's similarity of plant parts (Fig.4). The leaves and the entire plant were clearly separated from one another, while the other parts formed their own group (Fig.5). Jan *et al.* (2021a) and Asif *et al.* (2021) from the other parts of Kashmir Himalayas reported similar findings.

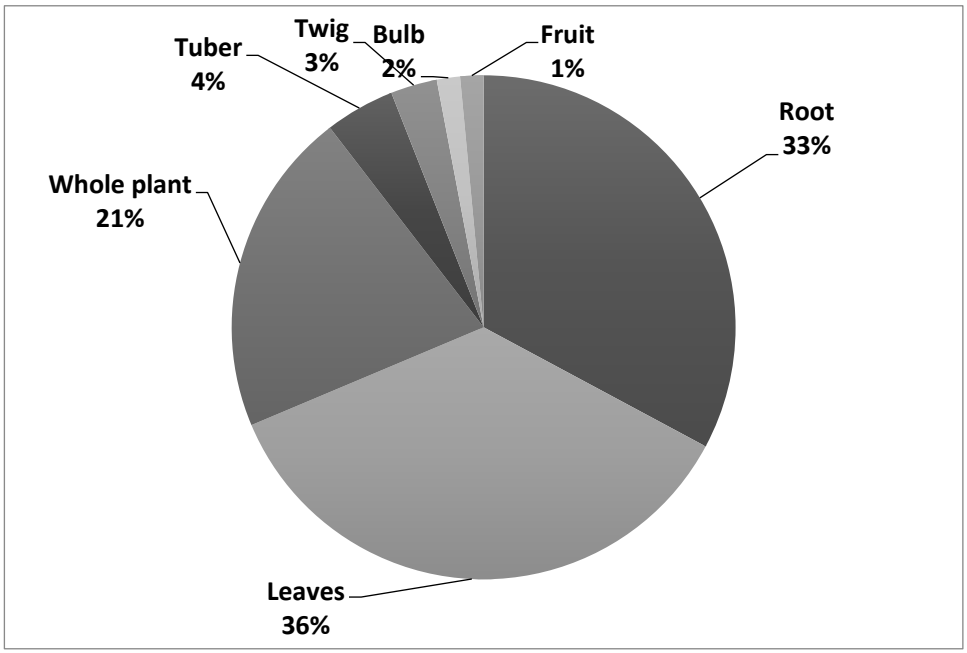

Figure 3. Contribution of plant parts in the traditional medicinal therapies.

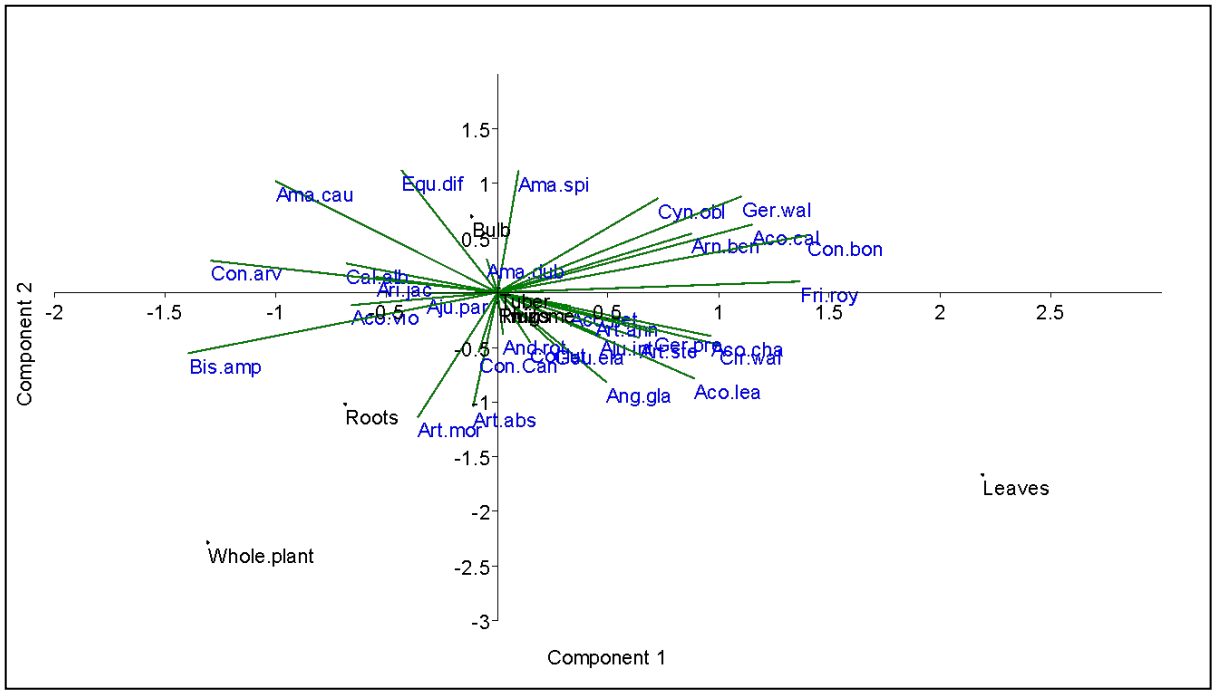

Figure 4. Principal Component Analyses (PCA) biplot of different plant parts usage in the study area. (It is a PCA drawn by using Paste softwear.ver.3. The same has been used in early regional studies, i.e., Asif et al., 2021; Haq et al. 2021)

Disease categories

On the basis of information from the respondents, we categorized the different diseases by following the international classification of primary care with certain modification

Based on the emic reports we categorized the aliments into 11 diseases among which abdominal pain (23.88%) was the dominant disease treated by using quoted medicinal herbs followed by constipation (17.91%), stomachache (16.42%), anthelminthic (11.94%), diarrhea (10.45%), indigestion (4.48%) (Fig5; Table.2). It is important to note that sometimes higher doses from the medicinal herbs can cause serious effects. This is why one needs to be careful while using these medicinal herbs at home. The dendrogram generated five distinctly separate clusters based on the usage of plants as traditional medicines against various diseases (Fig.6). The clusters that are grouped in one limb are more similar in plant usage to cure these diseases. Moreover, the similarity in usage decreased with increasing distance between groups (cluster). Cluster one included abdominal problems and obesity; cluster two comprised kidney problems, asthma, healing and cancer. In cluster three fevers, cold & cough was included. The stomach problems, bone and joints disease formed 4th and 5th cluster of the dendrogram respectively. Similar clustering ordination was used by Haq and Singh, (2020), Haq *et al.* (2021), Hassan *et al.* 2021 and Asif *et al.* (2021) from the different regions of Himalayas.

Informant consensus factor (ICF)

The purpose of using ICF in this study is to determine the informants consent for the types of disease cured. This value explains the cultural consistency for the use of a group of therapeutic plants to treat a group of particular ailment (Umair *et al.* 2017). In the current study, all the ailments were categorized into 11 different ailments to calculate the value of ICF. In present study, lower abdominal pain was having highest ICF value (0.96) while as lowest ICF value was for Abdominal bloating (0.91) (Table 3). *Aconitum heterophyllum, Aconitum leave, Angelica glauca, Fritillaria roylei, Inula racemosa, Senecio chrysanthemoides, Selinum vaginatum, Swertia petiolata* and *Thymus serphyllum* were mostly reported species to be useful for the treatment of abdominal pain.A high ICF value indicates that there is consensus between the informants to treat various diseases by the particular plant species. Further, this indicates the possibility of presence of biologically active components in these plants (Cakilcioglu *et al.* 2011). It has been suggested that high ICF values are related to high plant use values for one disease category (Madikizela *et al.* 2012). *A. heterophyllum* is an important medicinal plant employed for the treatment of ailments related to the nervous system, rheumatism and digestive system (Amjad *et al.* 2020). The presence of diterpene alkaloids and flavonoids in the roots of *A. heterophyllum* makes it effective in treating various gastrointestinal

diseases, such as diseases of the liver (Wink 2015). The extract of roots of *A. heterophyllum* is effective in the treatment of gastric ulcers caused due to cold stress (Paramanick *et al.* 2017).

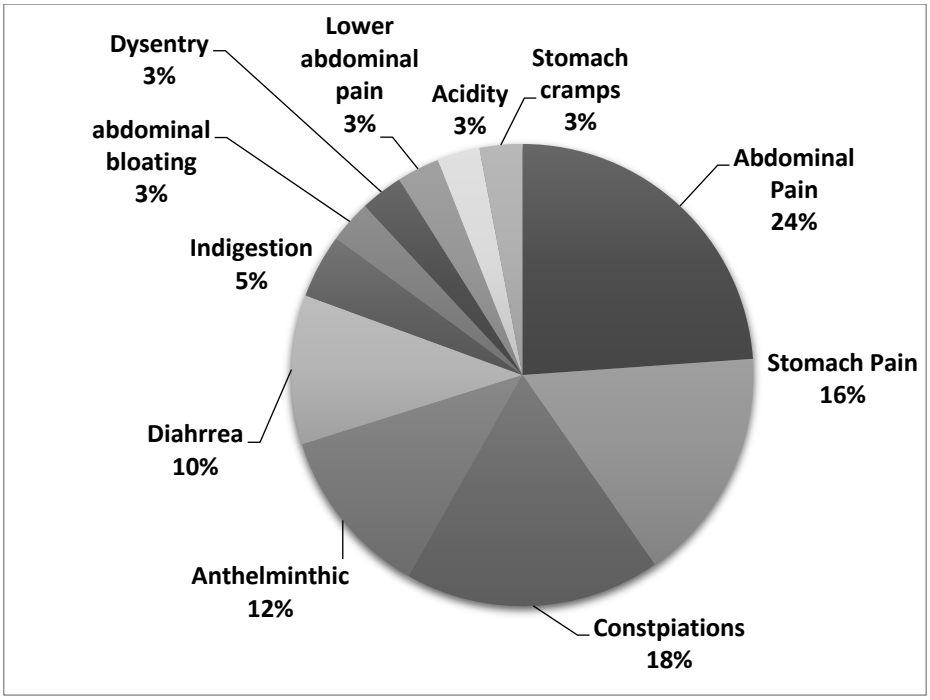

Figure 5.Percentage of disease treated by the documented flora in the study area.

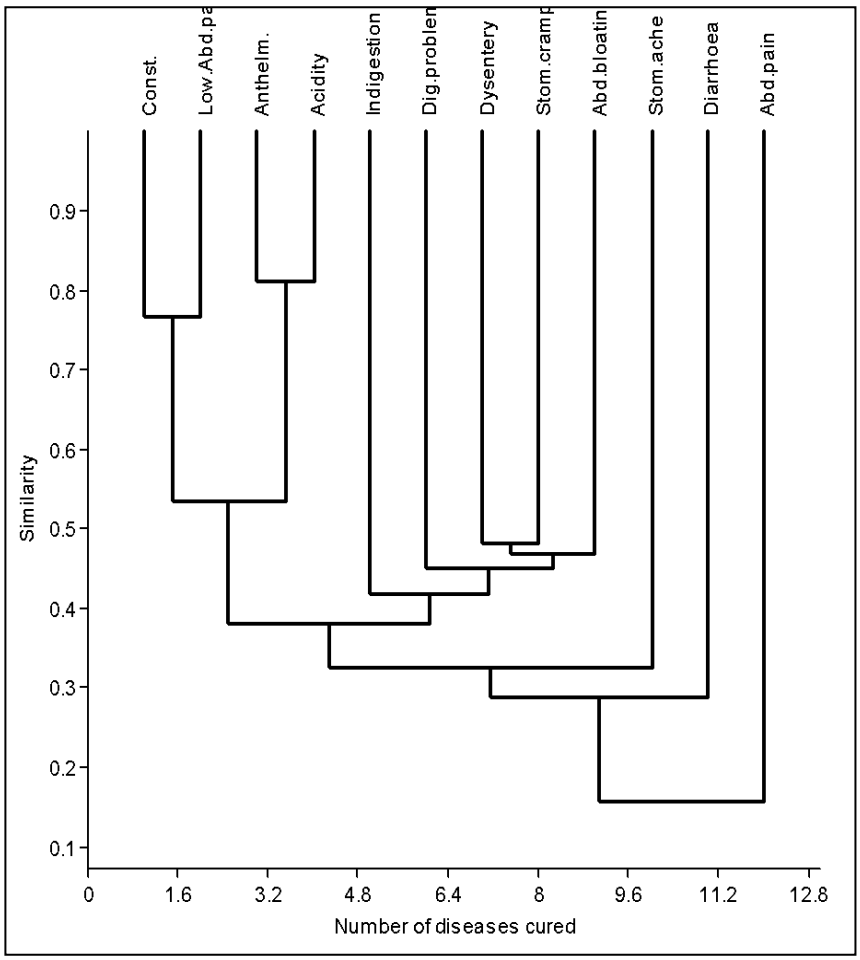

Figure 6. Cluster Analysis based on Sorenson's similarity index of plant species and diseases cured.

Table 3. Value of informant consensus factor (ICF) for each disease category.

Disease categories	Nur	Nt	ICF
Abdominal pain	293	16	0.94
Constipation	187	11	0.94
Stomachache	149	8	0.95
Anthelmintic	134	7	0.95
Diarrhoea	149	8	0.95
Indigestion	25	2	0.92
Digestive problems	44	3	0.93
Acidity	27	2	0.93
Abdominal bloating	36	2	0.91
Dysentery	52	3	0.94
Lower abdominal pain	46	2	0.96
Stomach cramps	42	2	0.95

Use value UV

The use value UV is used to determine the relative importance of medicinal plants. The value ranges between 0-1. Medicinal plants with maximum use reports have highest use value while as medicinal plants with minimum use reports have lowest use value. In the present study the highest UV of 0.69 was calculated for *Aconitum heterophyllum* and the lowest UV of 0.17 for *Verbena officinalis* (Table 2). Locally *Aconitum heterophyllum* is commonly present in the higher altitudes; it has different kinds of medicinal properties, so it's commonly used. Meanwhile, the medicinal plants with low use values (UV) indicate that the knowledge of these medicinal plants is at risk or availability of the particular medicinal plant is less (Chaudhary *et al.* 2006; Mahmood *et al.* 2013). The high UV of medicinal plants in the study region is attributed to their common distribution in the area and the local people are well familiar with their medicinal uses (Aadil *et al.* 2021c).

Conclusion

Present study was carried out to highlight the potential medicinal plants used against various gastrointestinal diseases in district Kupwara of Jammu and Kashmir. The study found that the study area is having a potential green wealth (flora) to be used as the alternative and prime source of healthcare. The indigenous people are using this flora for centuries and hence possess the potential traditional knowledge accumulated with time and inherited from generations, however with the rapid urbanization this traditional knowledge is at verge. This is clearly observed by the elderly people who have a wealth of indigenous knowledge as compared to the young. The traditional knowledge of medicinal plants disappears at an alarming rate in the region; hence it is necessary and need of hour to document the eroding traditional knowledge before it vanishes from the area.

Declarations:

Ethics approval and consent to participate: All the participants provided prior informed consent before the interviews.

Consent for publication: Not applicable-no personal data is included in this manuscript.

Availability of data and materials:

The data used to support the findings of this study are available from the corresponding author upon request.

Competing interests: The authors declare that they have no competing interests.

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