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Ethnobotanical plants used for gastrointestinal ailments by the inhabitants of Kishtwar plateau in Northwestern Himalaya, India

Sajan Thakur[1], Nawang Tashi[1], Bishander Singh[2], Harish Chander Dutt[1]* & Bikarma Singh*[,3,+]

[1]Department of Botany, University of Jammu, Jammu 180 006, Jammu and Kashmir, India

[2]Department of Botany, Veer Kunwar Singh University, Ara 802 301, Bihar, India

[3]Plant Sciences (Biodiversity and Applied Botany Division), CSIR-Indian Institute of Integrative Medicine, Jammu 180 001, Jammu and Kashmir, India

E-mail: [+]drbikarma@iiim.ac.in, hcdutt@rediffmail.com

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Gastrointestinal (GI) tract in human body is the most important and vulnerable organ for the diverse type of diseases such as diarrhea, reflux, constipation and parasitic infections. To treat such ailments, inhabitants of Kishtwar plateau in Jammu and Kashmir (India) use the wild medicinal herbs growing in the valleys and on the hill-top of their region. Most of these medicinal plants are common in occurrence but not reported earlier for the GI disorders. The aim of this communication is to narrow down the list of the medicinal plant species on the basis of oral traditional knowledge (OTK) for treating GI disorders at Kishtwar plateau. This documentation and quantitative analysis will help the natural plant chemists to get the pure and efficacious molecules for the treatment of GI ailments. For this a semi-structured questionnaire study was used to document the OTK on use of different medicinal plants to treat GI ailments by the local people of Kishtwar plateau in Northwestern Himalaya. The information gathered during the questionnaire study has been quantified by calculating use value, family use value, factor informant consensus (F_{ic}) and fidelity level. A total of 40 plant species representing 27 families are reported to treat various GI ailments, where in *Mentha longifolia* has shown the maximum use value *(UV)*=0.87 and *Carpesium abrotanoides* has shown the minimum *UV*=0.03. Maximum F_{ic} (0.88) has been calculated for worm infection and constipations category, however, minimum F_{ic}=0.75 is calculated for dyspepsia. Maximum family use value has been calculated for Plantaginaceae (*FUV*=0.75) and minimum for Geraniaceae and Juglandaceae (*FUV*=0.08). *Artemisia maritima* (*FL*=20.25%) and *Elwendia persica* (*FL*=18.18%) accounts the maximum fidelity level, therefore, considered important for the treatment of diarrhea and stomachache. From calculated use value, it has been concluded that the use of *M. longifolia* for treating GI ailments is relatively higher than other investigated species. Further analysis revealed that uniformity in OTK homogeneity is prevailing in the area, which indicates that OTK has not been diluted over the period of time.

Keywords: Gastritis, Gastrointestinal (GI) tract, Kishtwar, Medicinal plants, Northwestern Himalaya, OTK

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Approximately 70–80% of global population of human depends on plants for medicine in prime healthcare[1]. Herbal medicines or botanicals are considered as the most effective candidate to cure various human and animal diseases including gastrointestinal ailments[2-7]. In human being, the gastrointestinal (GI) tract is considered as the most important organ vulnerable to diverse diseases such as bloating, constipation, diarrhea, gastroenteritis, reflux and parasitic and other infectious ailments[8]. Diet dependent GI ailments are mainly due to disordered eating patterns in individual's body. These patterns describe irregular eating behaviors like skipping meals, restricted food types, fasting and binge eating[9]. These ailments slowly and steadily lead to mortality, particularly in developing countries where proper sanitation facilities are deficient[4,10-11]. According to reported studies, diarrhea as infectious disease occurs in about 19-83 people out of every 100 people annually depending on regions[12]. These GI disorders are significant ailments[13], which lead to adoption of effective medication practices. Today's herbal botanicals are of high demand and consumers are exploring new drugs through them because of minimum side effects. Wild medicinal plants are best sources for this because they are much compatible

*Corresponding author

with nature of human body and are reported to have little or no side effects[14-15]. Use of plant species as medicine is primary system of medication for the people residing in remote places of sub-urban or rural areas[16]. Various wild plant species are being used worldwide as medicine to treat stomach troubles and related hemorrhagic troubles. Therefore, wild plants are considered as an effective phytomedicine presently being used in different traditional health-care of the world.

During the current research, ethnobotanical investigations on plant species used by the mountainous people of Kishtwar plateau in J&K were conducted and information was analysed statistically. The immense store of ethnobotanical knowledge of indigenous people of the study area has not been documented earlier. In present study, various traditional phytomedicinal remedies out of the common plant species prepared by these people against GI ailments have been documented. The remedies for stomach troubles like blood-dysentery, diarrhea, jaundice, dyspepsia, intestinal worms (anthelminthic), as carminative and stomachic have been documented. Maximum informants were from Below Poverty Line (BPL) and are mostly reliant on wild resources for their day to day needs, therefore, possess rich oral traditional knowledge on medicinal plant species. The current study was carried out to document all the medicinal plant species used by the local people in treatment of gastrointestinal ailments of Kishtwar plateau which can be presented to natural product chemists as target plants to develop future drugs and medicine formulations.

Methodology

Study area

The data for the current investigation were collected from the local inhabitants of Kishtwar plateau in Jammu and Kashmir, India (Fig. 1) situated between the geographical co-ordinates (GPS points: site 1. 33°17′15.45″N, 75°45′50.19″E; site 2. 33°22′49.41″N, 75°46′10.25″E; site 3. 33°20′05.70″N, 75°43′57.88″E; site 4. 33°19′36.84″N, 75°46′36.03″E). The study area is positioned at a mean elevation of 1500 masl on the bank of Chenab river. This mountainous area is characterized by temperate vegetation dominated by *Pinus wallichiana* AB Jacks. (Pinaceae) at low and *Cedrus deodara* (Roxb. ex D.Don) G.Don (Pineaceae) at high elevations. Agricultural system is mostly dependent on seasonal rains and therefore only rain-fed crops such as maize, wheat, barley, oats and mustard are cultivated by local inhabitants on the plateau. Among fruit trees apple, apricot, pear, quince and walnut are the

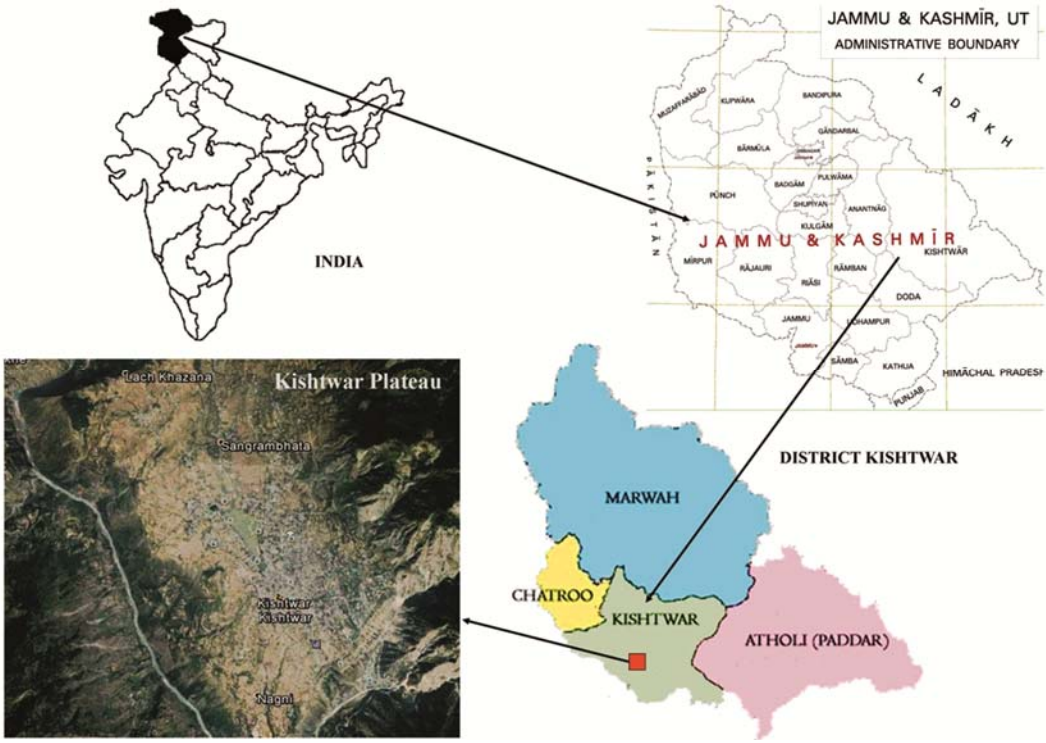

Fig. 1 — Study area and geographical location of Kishtwar plateau in J&K

main horticultural crops. The region is also known for cultivation of saffron (*Crocus sativus* L.), and is considered as the second largest region of saffron production after Pampore in Jammu and Kashmir, India.

Surveys and data collection

During the extensive surveys conducted during March 2016 to September 2018, 62 people were interviewed for information on wild medicinal plants used to cure GI ailments through semi-structured questionnaire study. Personal interviews were conducted only with elderly persons, local heads and common medicine men (traditional healers), aged between 20-70 years (Table 1), to know the exact quantum of plants used and practices to cure GI ailments in the study area. The informants were selected mainly on the basis of their popularity among locals with respect to traditional knowledge about medicinal plants and were divided into three main age groups (Group I-20 to 35 years, Group II-36 to 50 years and Group III-51 to above). The ethical approvals were taken from the informants in the form of declaration along with questionnaire. The interviews and questionnaire studies were repeated several times among and between the informants to verify and confirm the authenticity of their plant-based knowledge. Each of the plant materials were investigated and identified to botanical name, local name, families of the plants, parts used, usage and mode of usage for particular disease. Plant specimens were authenticated by using keys and floras[17-18]. For proper certification, Janaki Ammal Herbarium of CSIR-Indian Institute of Integrative Medicine (IIIM) Jammu and Herbarium of University of Jammu were consulted; web based taxonomic database 'The Plant List' (www.theplantlist.org) and Kew Botanical Garden (www.mpns.kew.org) were also referred for proper and correct identification and updated nomenclature. All the plant specimens were accessioned and available at Herbarium, Department of Botany (HBJU), University of Jammu, Jammu.

Table 1 — Demography of informants in the study.

Informants	Number			
Male	40 (64.51%)			
Female	22 (35.48%)			
Children	Nil			
Total	62			
Age group (years)	Male	Female	Total	Type of Ration Card
Group I (20-35)	16 (40%)	5 (22.72%)	21 (33.87%)	BPL (100%)
Group II (36-50)	15 (37.5%)	9 (40.9%)	24 (38.7%)	BPL (100%)
Group III (51-above)	9 (22.5%)	8 (36.36%)	17 (27.41%)	BPL (100%)

Certificate of BPL (Below Poverty Line) as issued by Government of Jammu and Kashmir

Data analysis

The data collected from 62 informants was statistically analysed as below[19].

Use value (UV)

UV used to determine the relative importance of a particular species with respect to other species as per Phillips *et al*.[20] and is given as

$UV=\Sigma U/N$

where,

U=number of use reports for a given species

N=total number of informant

High value of UV indicates that the plant is very important and low value approaching zero suggest relatively less importance with respect to other species[21].

Family use value (FUV)

FUV determines relative importance of a particular family of plants with respect to other families and was obtained according to Phillips & Gentry[22], using formula given below:

$FUV=\Sigma UVs/n_s$

where,

ΣUV=sum of the use values for all the species within a given family

n_s=total number of species within a given family

High FUV represent high use of the species of that particular family and low values approaching towards zero implies less use of the species of a particular family. This index provides us the relative importance of a particular family.

Factor informant consensus (F_{ic})

F_{ic} determine the level of homogeneity of knowledge among informants as per Heinrich *et al*.[4]:

$F_{ic}= Nur - Nt/(Nur - 1)$

where,
n_{ur}=number of use-reports
nt = number of taxa used

F_{ic} ranges from 0 to 1, where F_{ic} nearing zero indicates less or no exchange of knowledge and approaching values towards 1 represent high exchange of knowledge regarding the use of plant species for a particular ailment[23-25].

Fidelity level (FL)

FL determines preferred species used in curing a particular ailment as Friedman *et al*.[26].

$$FL\ (\%)=(Np\ /N)\times 100$$

where,
Np=use-reports of species for a particular use category
N=total use-reports cited of that species

High value of *FL* (near 100%) represents the use of a particular species for all the use categories in the same way whereas low value of *FL* represents the use of plants for many different purposes.

Results

Demography of informants

Total 62 local individuals, 40 (64.51%) males and 22 (35.48%) females were interviewed to document the extent of OTK on the traditional use of the plant species to treat various GI ailments. Among the informants, 16 (40%) males and 5 (22.72%) females belong to group I, 15 (37.5%) males and 9 (40.90%) females belong to group II and 9 (22.5%) males and 8 (36.35%) females belong to group III (Table 1).

Medicinal plants for GI disorders

Total 40 medicinal plants representing 27 families are documented to be used by the people of Kishtwar district for curing various GI ailments. The rationale behind the use of these medicinal plants by the local people is their long time tested practice and medicinal efficacy to treat GI disorders. Of these investigated plants used by the elderly people, local healers and village heads, 35 species are collected from wild habitat and 5 species people cultivate in their garden and lawn for their application in GI disorders. Leaves recorded as the most used parts of plants collected by the local people for treating GI ailments, which is a sustainable approach in term of conservation. Among the medicinal plants used, Asteraceae is the dominant family (12.5%) used as GI medicine, followed by Lamiaceae and Rosaceae (each 10%) plant species. Further, it is documented that maximum families comprised of only 01 species utilized to treat GI disorders. Leaves of 21 (52.5%) species; whole plant, inflorescence/ flower and seeds of 05 (12.5%) species each; bark of 03 (7.5%) species; fruits of 02 (5%) species and rhizome/ galls of 01 (2.5%) species each are either pounded, made to infusion, decoction or eaten directly for the medication purpose (GI disorders) (Table 2 & Fig. 2).

Table 2 — Plant species used by the locals of Kishtwarplateau for treating Gastrointestinalailments along with *UV*

S.No	Scientific Name (Accession no.)	Family	Local names	Common english name	Plant Part(s) Used	Ethnomedicinal knowledge (Use reports)	Total Use reports	Use value (UV)
1.	*Acalypha brachystachya* Hornem. (4408)	Euphorbiaceae	Badidoodli	Copper leaves	Leaves	Infusion of leaves is taken daily to cure stomach ache (11).	11	0.17
2.	*Acorus calamus* L. (12166)	Acoraceae	Braiya, Bach, Bareen	Sweet flag or Calamus	Leaves and rhizomes	Leaves and rhizomes are used as vegetables to cure stomach ache (6) and also to kill intestinal worms (7).	13	0.20
3.	*Artemisia maritima* L. (11495)	Asteraceae	Kirmala/ Mooi	Sea wormwood	Leaves	Leaves are crushed to make pills which are taken orally to treat intestinal worms (21), indigestion (13), diarrhea (10), and vomiting (7).	51	0.82
4.	*Athanasia linifolia* Burm.f. (12160)	Asteraceae	Ban chai	Long Leaved Tansy	Roots	Roots are used to make tea which is used to cure stomach ache (3) and bloat (6).	9	0.14
5.	*Atropa acuminata* Royle ex Lindl. (6134)	Solanaceae	Bellodoma	Deadly Nightshade	Leaves	Leaves are eaten as vegetable to cure intestinal colic and peptic ulcers (14).	14	0.22

(*Contd*.)

Table 2 — Plant species used by the locals of Kishtwarplateau for treating Gastrointestinalailments along with *UV* (*Contd*.)

S.No	Scientific Name (Accession no.)	Family	Local names	Common english name	Plant Part(s) Used	Ethnomedicinal knowledge (Use reports)	Total Use reports	Use value (UV)
6.	*Bupleurum falcatum* L. (8255)	Apiaceae	Pipllu, Jardjeeri	Sickle-leaved hare's-ear	Roots and leaves	Decoction of leaves and roots is taken to cure indigestion (7), diarrhea (6) and constipation (7).	20	0.32
7.	*Capsella bursa-pastoris* (L.) Medik. (8289)	Brassicaceae	Gual battua, Chidihalaiya	Shepherd's-purse	Leaves and fruits	Decoction made of leaves and fruit is taken to cure stomach and abdominal ulcers (6).	6	0.09
8.	*Cardamine impatiens* L. (8496)	Brassicaceae	Buti	Narrowleaf bittercress	Bark and leaves	Decoction of bark and leaves is taken to cure indigestion (13).	13	0.20
9.	*Carpesium abrotanoides* L. (2116)	Asteraceae	Ban sario	Pig's Head	Roots , leaves and seeds	Infusion of leaves, roots and seeds is used to kill intestinal worms (2).	2	0.03
10.	*Cichorium intybus* L. (5446)	Asteraceae	Litchken, Handiposh	Chicory	Roots	Decoction of root is helpful to treat stomachache (3), vomiting (2) and diarrhea (2).	7	0.11
11.	*Commelina benghalensis* L. (8300)	Comelinaceae	Kaanchatta, Churra	Wandering Jew	Whole plant	Infusion of whole plant is helpful to treat intestinal ulcers (7).	7	0.11
12.	*Corydalis govaniana* Wall. (8381)	Papaveraceae	Bhootkesi, Indrajata	Govan's Corydalis	Roots	Roots are crushed to make pills and used as appetizer, vermifuge (5), febrifuge and stomachic (10).	15	0.24
13.	*Cyperus cyperoides* (L.) Kuntze (15740)	Cyperaceae	Ghaa	Tall sedge	Above-ground	Whole above-ground part of plant is boiled to make decoction which is used as vermifuge (5).	5	0.08
14.	*Desmodium elegans* DC. (8083)	Fabaceae	Samber, Chamgath	Elegant Desmodium	Roots and bark	Root and bark decoction is used as carminative and to treat bilious complaints and peptic ulcers (8).	8	0.13
15.	*Dioscorea deltoidea* Wall. eh Griseb. (11672)	Dioscoreaceae	Kreensh, Kinas	Yam	Leaves	Leaves are crushed to make pills and eaten to cure intestinal worms (7) and constipation (11).	18	0.29
16.	*Elwendia persica* (Bioss.) Pimenov & Kljuykov (15728)	Apiaceae	Kala Zira	Great pignut/ Black cumin	Seeds	Seeds are used as spice in food and are helpful in diarrhea (14), dyspepsia (10), flatulence and stomach ache (8).	32	0.51
17.	*Erodium cicutarium* (L.) L'Hér. (0696)	Geraniaceae	Jillo	Red stem Stork's bill	Whole plant	Whole plant extract is used to treat intestinal ulcers (5).	5	0.08
18.	*Ficus palmata* Forssk. (11774)	Moraceae	Feru, Fog	Wild fig	Hypantho dium	Fresh fruits are eaten raw to cure diarrhea (7) and constipation (7).	14	0.22
19.	*Fragaria vesca* L. (8381)	Rosaceae	Ban achoo	Woodland strawberry	Leaves	Leaves are used to make tea which is helpful for digestion and bowl movement (12).	12	0.19
20.	*Fumaria indica* (Hausskn.) Pugsley (10094)	Papaveraceae	Pitpapda, Chatra	Fumewort	Leaves	Leaves are crushed to make pills or powder and taken orally to cure bile disorders and indigestion (6).	6	0.09
21.	*Geum urbanum* L. (1433)	Rosaceae	Goglimool, Barfatributti	Royle's Avens	Roots and leaves	Roots and leaf decoction is used as stomachic and febrifuge (15).	15	0.24
22.	*Hydrocotyle javanica* Thunb. (HCST001)	Araliaceae	Brami	Java pennywort	Leaves and leaf stalk	Leaves are boiled to make infusion which is used to treat indigestion (3) and dysentery (2).	5	0.08

(*Contd*.)

Table 2 — Plant species used by the locals of Kishtwarplateau for treating Gastrointestinalailments along with *UV* (*Contd*.)

S.No	Scientific Name (Accession no.)	Family	Local names	Common english name	Plant Part(s) Used	Ethnomedicinal knowledge (Use reports)	Total Use reports	Use value (UV)
23.	*Hypericum perforatum* L. (0496)	Hypericaceae	Bankehri, Basant	Perforate St. John's-wort	Leaves and flowers	Leaves and flower are boiled and used as infusion to treat stomach ulcers (8) and acute dysentery (7).	15	0.24
24.	*Juglans regia* L. (11742)	Juglandaceae	Akhroot, Khorh	English walnut	Kernel	Dry fruits are eaten raw or its oil is used in food preparations and also useful in indigestion (5).	5	0.08
25.	*Mentha longifolia* (L.) L. (8320)	Lamiaceae	Jhangliputna, Venni	Horse Mint	Leaves	Leaves are crushed to make sauce which is taken with food and is used as carminative, stimulant and recommended in dysentery (24) and diarrhea (30).	54	0.87
26.	*Micromeria biflora* (Buch.-Ham. ex D.Don) Benth. (8321)	Lamiaceae	Jar-joan, Marua	Lemon scented thyme	Leaves	Leaves are used as spice in food and are helpful as Colic remedy and for gastric ulcers (12).	12	0.19
27.	*Mollugo pentaphylla* L. (6215)	Molluginaceae	Milli	Five Leaved Carpetweed	Whole plant	Decoction made from whole plant is used as stomachic (14).	14	0.22
28.	*Nepeta elliptica* Royle ex Benth. (3705)	Lamiaceae	Shingli	Elliptic-leaved catmint	flowers and seeds	Flowers and seeds are boiled to make infusion which is used as carminative and helpful in gastric ulcers (7).	7	0.11
29.	*Oxalis corniculata* L. (11039)	Oxalidaceae	Khatta-meetha, Khatti butti	Creeping wood sorrel	Leaves and roots	Paste of leaves and roots is taken orally to cure stomach ache (4), intestinal worms (5) and dysentery (9).	18	0.29
30.	*Phytolacca acinosa* Roxb. (11644)	Phytolaccaceae	Saraal, Lubarsaag, Jingal	Indian Poke	Roots	Root decoction is helpful in treating dysentery (4) and stomach cramps (4).	8	0.13
31.	*Pistacia chinensis* subsp. *integerrima* (J.L. Stewart ex Brandis) Rech.f. (8537)	Anacardaceae	Kangad, Kakdai, Kadhek	East Indian Mastiche	Galls	Decoction of galls is useful in dysentery (6) and dyspepsia (4).	10	0.16
32.	*Plantago lanceolata* L. (8358)	Plantaginaceae	Goba, Challa, Gulla, Bhumnugha	Narrow leaf plantain	Seed husk	Infusion is prepared by boiling seed husk in water which is taken orally against diarrhea (4), dysentery (17), stomach cramps (16) and intestinal worms (10).	47	0.75
33.	*Punica granatum* L. (8250)	Lythraceae	Annardana, Danoi, Darooni	Pomegranate	Seeds	Extract of seeds (sauce) is taken with food which is helpful against diarrhea (3) and indigestion (17).	20	0.32
34.	*Rubia cordifolia* L. (8394)	Rosaceae	Majith, Suru, Kaangi	Indian madder	Up-ground parts	Decoction of up ground part of plant is taken orally which is used against diarrhea (3), stomach problems and amoebic dysentery (14).	17	0.27
35.	*Rubus niveus* Thunb. (8388)	Rosaceae	Keryarri	Ceylon raspberry	Fruits	Fresh fruits are taken raw to cure dysentery (10).	10	0.16

(*Contd*.)

Table 2 — Plant species used by the locals of Kishtwarplateau for treating Gastrointestinalailments along with *UV* (*Contd*.)

S.No	Scientific Name (Accession no.)	Family	Local names	Common english name	Plant Part(s) Used	Ethnomedicinal knowledge (Use reports)	Total Use reports	Use value (UV)
36.	*Tagetes minuta* L. (8273)	Asteraceae	Van- gutti, Itlimorat	Wild marigold	Leaves and flowers	Leaves and flowers are boiled to prepare infusion which is helpful in curing dyspepsia (2), stomach ache (2), gas (4) and diarrhea (4).	12	0.19
37.	*Thymus mongolicus* (Ronniger) Ronniger (8323)	Lamiaceae	Banajwain	Breckland thyme	Leaves	Leaf decoction is useful to cure diarrhea (3), stomach ache (1), dysentery (5), bloat (2) and indigestion (4).	15	0.24
38.	*Trillium govanianum* Wall. Ex D.Don. (8340)	Melanthiaceae	Satwa	Wood Lily & Wake Robin	Roots	Root infusion is helpful to treat diarrhea (5) and dysentery (9).	14	0.22
39.	*Verbascum thapsus* L. (8409)	Scrophulariaceae	Dandachha, Gidar tambhaku	Cow's lungwort, Common mullein	Leaves	Leaf pills are consumed with juice/water to cure constipation (10) and allied stomach pains (2).	12	0.19
40.	*Ziziphus jujuba* Mill. (8245)	Rhamnaceae	Beri, Bairi	Red date or Indian date	Bark	Bark powder is eaten with water to cure gastric ulcer (15), hemorrhoid and diarrhea (6).	21	0.33

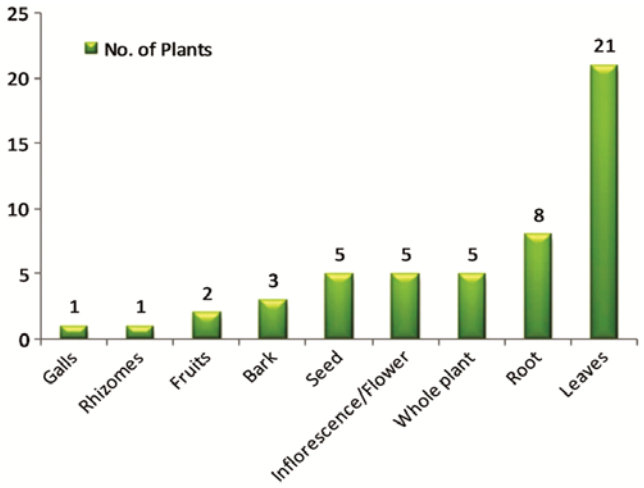

Fig.2 — Plant parts investigated to be used in treatment of GI disorders

Use value (UV)

In terms of use value *(UV), M. longifolia* (L.) L. (*UV*= 0.87) is relatively more important species followed by *A. maritima* L. (*UV*=0.82), *P. lanceolata* L. (*UV*= 0.75) and *E. persica* (Bioss.) Pimenov & Kljuykov (*UV*=0.51) with respect to the treatment of different GI disorders in the region. *C. abrotanoides* L. possessed least *UV* equal to 0.03 (Table 2). Therefore, analysed use value indicated that *M. longifolia* and *A. maritima* are relatively important species as compared to other species growing in the Kishtwar plateau to treat GI disorders.

Family use value (FUV)

Plantaginaceae has shown the higher family use value (0.75), followed by Apiaceae (0.42), Lamiaceae (0.35), Rhamnaceae (0.33) and Lythraceae (0.32). The family use value of other less commonly used families is recorded for Dioscoreaceae and Oxalidaceae (0.29), Asteraceae (0.25), Hypericaceae (0.24), Molluginaceae, Moraceae, Solanaceae and Melanthiaceae (0.22), Rosaceae (0.21), Acoraceae (0.20), Scrophulariaceae (0.19), Euphorbiaceae (0.17), Anacardiaceae and Papaveraceae (0.16), Brassicaceae (0.14), Fabaceae and Phytolaccaceae (0.13), Commelinaceae (0.11), Cyperaceae (0.09) and Araliaceae, Geraniaceae and Juglandaceae (0.08) (Table 3). The data obtained indicates that Plantaginaceae is relatively more important family than other plant families with respect to treatment of various GI disorders.

Factor informant consensus (F_{ic})

A total 498 actual use records categorized to 10 different ailments have been registered through interviews conducted with 62 local individuals. People of the region use the maximum 13 plant species to treat diarrhea and for which maximum use report is also obtained (n=97), however factor informant consensus reveals that the homogeneity of knowledge is more for treating constipation, cramps and removal of intestinal worms using the medicinal plants of the region. Each of the ailment accounts F_{ic}=0.88. The maximum heterogeneity

Table 3 — Informant consensus factor (F_{ic}) by various Gastrointestinal ailments.

S.No.	Category	No. of Taxa used (N_t)	No. of total Use reports (N_{ur})	F_{ic}
1.	Intestinal worms	8	62	0.89
2.	Constipation and cramps	6	55	0.91
3.	Diarrhea	13	97	0.88
4.	Vomiting	2	9	0.88
5.	Stomach bloat (Gas)	3	12	0.82
6.	Stomach pain	12	77	0.86
7.	Indigestion	9	80	0.90
8.	Ulcers	9	82	0.90
9.	Dysentery	11	107	0.91
10.	Dyspepsia	3	16	0.87

in the opinion among the informants is seen in the treatment of Dyspepsia (F_{ic}=0.75) (Table 3 & Table 4).

Fidelity level (FL %)

The analysed value of FL indicate *A. maritima* accounts for maximum fidelity level (FL=20.25%) in the treatment of diarrhea, whereas, *E. persica* accounts for maximum fidelity level (FL= 18.18%) in curing stomach pains (Table 5). The value obtained indicates diarrhea is the most significant ailment treated using of *A. maritima* in the study area.

Discussion

GI tract is the most vulnerable system with respect to number of human disorders. Such ailments affect people of all ages, race and sex. There is a pressing need to support research regarding treatment of GI ailments which cause a wide range of discomforts to the patients. However, research regarding GI disorders remains always severely underfunded. In this regard, numbers of explorations and research studies are conducted to understand the extent of traditional knowledge among tribal people. Such explorations have resulted in a long enumeration of medicinal plant species for the treatment of different GI disorders. This investigation also coincides with a list of 32 plant species reported from Wayanad district of Kerala, India; 36 medicinal plants from Northern Thailand and 33 plants from Izmir province of Turkey[19,27,28]. Similarly, current findings on 40 plant species from Kishtwar plateau (J&K, India) indicate that the Himalayan regions are rich niche of unique medicinal plants. In addition to ethnobotanical enumeration on medicinal plants, there is a published report on 28 plant extracts that were tested against Charcoal-gum Acacia induced hyper peristalsis in cats wherein two species *Artemisia. absinthium* L. and *A. ludoviciana* Nutt. have shown (57±2.1% and 31±3%) inhibition of stomach churning sensation in the modal[29]. There is also a report where ethnobotanists have grouped the medicinal plants on the basis of plant parts used to treat

Table 4 — Fidelity level (%) of the most important species for treatment of different Gastrointestinal ailment categories

Category	Botanical name	Citations	Fl(%)
Intestinal Worms	*Cyperus cyperoides* (L.) Kuntze	5	100
	Carpesium abrotanoides L	2	100
	Acorus calamus L.	7	53.8
Stomach Pain	*Acalypha brachystachya* Hornem.	11	100
	Geum urbanum L.	15	100
	Mollugo pentaphylla L.	14	100
Diarrhea	*Mentha longifolia* (L.) L.	30	55.6
	Ficus palmata Forssk.	7	50
Constipation and Cramps	*Verbascum thapsus* L.	10	83.3
	Dioscorea deltoidea Wall. ex Griseb.	11	61.1
	Ficus palmata Forssk.	7	50
	Phytolacca acinosa Roxb.	4	50
Ulcers	*Atropa acuminata* Royle ex Lindl.	14	100
	Capsella bursa-pastoris (L.) Medik.	6	100
	Commelina benghalensis L.	7	100
	Desmodium elegans DC.	8	100
	Erodium cicutarium (L.) L'Hér.	5	100
	Micromeria biflora (Buch.-Ham. ex D.Don) Benth.	12	100
	Nepeta elliptica Royle ex Benth.	7	100
Vomiting	*Cichorium intybus* L.	2	28.6
	Artemisia maritima L.	7	13.7
Indigestion	*Cardamine impatiens* L.	13	100
	Fragaria vesca L.	12	100
	Fumaria indica (Hausskn.) Pugsley	6	100
	Juglans regia L.	5	100
Stomach bloat (Gas)	*Athanasia linifolia* Burm. f.	6	66.7
	Tagetes minuta L.	4	33.3
Dysentry	*Rubus niveus* Thunb.	10	100
	Rubia cordifolia L.	14	82.4
	Pistacia chinensis subsp. *integerrima* (J.L. Stewart ex Brandis) Rech.f.	6	60
Dyspepsia	*Pistacia chinensis* subsp. *integerrima*(J.L. Stewart ex Brandis) Rech.f.	4	40
	Elwendia persica (Bioss.) Pimenov & Kljuykov	10	31.3

Table 5 — Family use value of the species used to treat gastrointestinal disorders

S.No.	Family	Number of species	Family Use Value
1.	Acoraceae	1	0.20
2.	Anacardaceae	1	0.16
3.	Apiaceae	3	0.30
4.	Araliaceae	1	0.08
5.	Asteraceae	5	0.25
6.	Brassicaceae	2	0.14
7.	Commelinaceae	1	0.11
8.	Cyperaceae	1	0.08
9.	Dioscoraceae	1	0.29
10.	Euphorbiaceae	1	0.17
11.	Fabaceae	1	0.13
12.	Geraniaceae	1	0.08
13.	Hypericaceae	1	0.24
14.	Juglandaceae	1	0.08
15.	Lamiaceae	4	0.35
16.	Lythraceae	1	0.32
17.	Melanthiaceae	1	0.22
18.	Molluginaceae	1	0.22
19.	Moraceae	1	0.22
20.	Oxalidaceae	1	0.29
21.	Papaveraceae	1	0.09
22.	Phytolaccaceae	1	0.13
23.	Plantaginaceae	1	0.75
24.	Rhamnaceae	1	0.33
25.	Rosaceae	4	0.21
26.	Scrophulariaceae	1	0.19
27.	Solanaceae	1	0.22

GI disorders e.g., bark of 17 plant species formed a major group of the plants to treat GI disorders by Raji tribe of Nepal[30]. Lots of ethnobotanical explorations works were conducted from J&K during the last few decades[24,25,31], but it has been observed that the exclusive reports on GI ailments are very few and no GI investigation is carried out from Kishtwar plateau. Data collected on Gujjar and Bakarwal tribes of Rajouri in Jammu and Kashmir has enumerated 28 plant species for treatment of various GI ailments; however the quantitative analysis of the data is not published[32].

Current research investigations on useful plants in GI disorders indicate Kishtwar mountain is rich repository of medicinal plants. Using leaves, 52.5% of documented species are used for treating GI disorders and frequent collection of leaves is done very scientifically so that conservation concept is maintained. *M. longifolia* (UV=0.87) is evaluated as relatively important species for the treatment of various GI disorders in the study area. However, *C. abrotanoides* (UV=0.03) is relatively not so important in the treatment of GI disorders. Therefore, *M. longifolia* is considered as important species to treat GI ailments in Kishtwar plateau. Further, Plantaginaceae (*FUV*=0.75) is documented as relatively more important plant family in the treatment of GI disorders, whereas, Araliaceae, Geraniaceae and Juglandaceae (*FUV*=0.08 each) represented minimum importance in treatment of GI disorders. The homogeneity of traditional knowledge among informants regarding a particular plant species to be used for a particular GI disorder revealed that traditional knowledge is homogeneous for the treatment of intestinal worms (F_{ic}=0.88). The calculated values more than 0.75 for each category also indicate that the homogeneity of knowledge is maintained among the informants. Fidelity level *(FL)* indicates the preference of a plant against a particular ailment used by the local inhabitants. Generally *A. maritima* has maximum percentage of fidelity level (*FL*=91.42%) for vomiting and is also a preferred plant for intestinal worms, indigestion and diarrhea. Second most preferred plant is *E. persica* (*FL*=58.04%) for dyspepsia and is also used to cure stomach pain and flatulence.

Conclusion

The investigated 40 plant species used by the local informants to treat various GI disorders are recorded to be growing in the high altitude regions of Himalaya in Kishtwar and adjoining areas. Majority of the plants included in this study occur in the wild habitat of Himalaya, while few of them are cultivated or planted (*M. longifolia, J. regia* and *T. minuta)* in home-gardens for daily use and for economic-benefits. The local people use some of these plants judiciously by way of sun drying and use them by preparing decoctions or infusions as per need throughout the year. From this research, it can be concluded *M. longifolia*, *E. persica, P. lanceolata, A. maritima, B. fulcatum, Z. jujuba* and *D. deltoidea* recorded to posses high Use Values and Fidelity levels and thus are more important plants as per curing various GI disorders. The family Plantaginaceae is of great importance for GI ailments, whereas Geraniaceae and Juglandaceae have little importance. There is more need of research data to authenticate homogeneity of traditional knowledge regarding the use of particular plant species to treat a particular GI ailment. Leaves and fruits are always the most

important parts along with bark and roots for preparation of drugs. The F_{ic} values were high for intestinal worms and constipation and minimum for dyspepsia, and the data obtained are reliable. Few medicinal plants reported to possess greater values of UV and FL require more pharmacological research on biological activities and discovery of new compounds. This research will help a lot in discovering new molecules that could be helpful in future for getting leads for new drugs in time to come. Further, conservation of such useful medicinal plants not only help in species conservation, but also aid in preservation of ethnobotanical knowledge associated with these plants in Kishtwar plateau and elsewhere in the globe.

Conflict of Interest

All the authors are equal contributors of the work and declare no conflict of interest.

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