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FLORISTIC COMPOSITION OF INDIGENOUS VEGETATION OF NAMAL VALLEY, MIANWALI - PUNJAB, PAKISTAN

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SUMMARY

The floristic survey of selected sites of Namal valley, Mianwali, Punjab, Pakistan began in 2016 until 2019 for documenting of wild species in the valley, which continues from the Salt Range. The research explored the unobserved vegetation of Namal valley, which has a unique biodiversity extended along its six ecological sites. Indigenous species totaled 188, distributed across discovered 152 genera and 54 families during the reporting period. The significant primary family based on species demonstration was Poaceae, having 25 genera and 39 species. Poaceae family has Asteraceae following it, having 17 genera and 18 species, and then by Fabaceae (10 genera, 15 species). The most dominating vegetation was of herbaceous type (79%). The study reported a total of 28 species of shrubs, with only 12 species of trees identified during this research from selected sites. Experimental results of five nominated plants (*Grewia tenax, Pentatropis spiralis, Pulicaria edmondsonii, Ruellia nudiflora, and Tephrosia purpurea*) showed that these plants differed considerably in terms of phytochemical concentration. Saponin concentration was minimal in all plants, except *Ruellia nudiflora* (1.7%). Tannins concentration was higher in *Tephrosia purpurea* (3.75%) and *Pulicaria edmondsonii* (3.11%) than in the other three plants. Quantitative results of free amino acids reflected that 11 amino acids were present in *Grewia tenax.* It was noticeable that proline was the highest amino acid (1.004 mg/ml) of the separated free amino acids, whereas isoleucine was the lowest (0.008 mg/ml) in the amino acid concentration. This checklist consists of updated systematic families and plant names that will provide a handy starting point for further ecological and bio-prospective research of the area under study.

Keywords: Checklist, salt range, Namal valley, ecological sites, families, Mianwali, Pakistan

Key Findings: This research provides information about the vegetation spectrum, respective families, habitats, and habits that with no earlier documentation. It revealed the phytochemical, mineral concentration, and amino acid information about unique plant species, thus, concluding the diverse vegetation of Namal valley.

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INTRODUCTION

The Salt Range is an approximately 300 km long belt in Punjab, extending among the Himalayan Mountains and Indus Plains. It begins in district Jehlum in the east and ends in Kalabagh along the Indus River in the west (Aziz *et al.,* 2021). The Salt Range name comes from the momentous salt reservoirs continually deposited at Khewra, Warcha, Mauza Bazar, Makarwal, and Kalabagh, Pakistan. The Salt Range comprises a prosperous vegetative assortment of low-lying subtropical forests, acknowledged as the geological museum of Pakistan (Ahmed *et al.,* 2016; Majeed *et al.,* 2021). There are multiple habitats for the expansion and growth of vegetation populations, with grasses specifically make governing expansion over a comprehensive range and demonstrating immense adaptability for plant existence underneath enormous different ecological conditions. The plant species of the Salt Range show drought and salt easiness with less rainfall. The reported average rainfall of the valley was 159.3 mm per year, and the average highest temperature was 42 °C during the last five years (Haq *et al.,* 2015; Shah *et al.,* 2018).

With its pulsating climate and arrangement of mountains and plains, Salt Range is amusing in biodiversity despite having terrestrial ecosystems (Aziz *et al.,* 2020). Observing the association between ecological attributes and vegetation in these ecosystems is imperative to be aware of terrestrial ecosystems. The chief constituents of terrestrial ecosystems are plant species and abiotic features. An essential characteristic of most global ecosystems is the soil dissimilarity in allotment of minerals and diverse particle structure. The provision of these nutrients to vegetation is irregular. Soil plays a significant role in controlling vegetation development. Plants show different adaptations to adjust them to various environmental conditions. On the foundation of resemblance in organization and purpose, grouping the vegetation of an ecosystem can be in diverse life forms and leaf size groups, which specify the adjustment of flora in varied environmental circumstances. Life forms also help observe and monitor dispersed vegetation communities (Shah *et al.,* 2020; Haq *et al.,* 2022).

Different researchers have worked on the biodiversity of the Salt Range explicitly in Soon valley; however, no specific work occurred on the mountains of the Salt Range near Namal valley in the District of Mianwali, Pakistan, with this valley still unexplored (Ghani *et al.,* 2014; Shah and Rahim, 2017).

District Mianwali situates in the North West of the Punjab province. It characterizes the plains and mountains of the western part of the Salt Range near the Soon valley (Ghani *et al.,* 2014). District Mianwali has an area of 5,840 sq km, geographically located between 32° 10′ and 33° 15′ N and 71° 08′ and 71° 57′ E. Most of the area is the extension of the Potohar Plateau and the Salt Range (Ahmed *et al.,* 2016; Shah *et al.,* 2018).

Namal valley is about 30 km from Mianwali city in the eastern direction, situating the east boundary of districts Chakwal and Khushab. This valley is well-known for Namal Lake. Namal Dam, constructed in 1913, uses Namal Lake water for irrigation. A road passing from this valley connects Mianwali to Talagang, Chakwal, and Rawalpindi. The lake has a surface area of 5.5 km². This valley is part of the Salt Range, with an area totaling about 300 km² (Shah *et al.,* 2018).

The regular slope of the valley is from the South to the North-East side. The irrigation depends mainly on rainfall, with the whole area deprived of any river or canal. The climate of this site is arid due to scanty rainfall, which is usually low in the valley. The mean valley rainfall is nearly 159.3 mm per year. This average rainfall calculation is from the annual data for 2016–2019. In 2016, yearly rainfall was the least, i.e., 95.6 mm, while the maximum rainfall was in 2019 (Ahmed *et al.,* 2019; Arshad *et al.,* 2020).

The vegetation of Namal valley remains unobserved and unnoticed. The flora of this valley depends mainly on rainfalls, nutrient availability, and particularly suitable temperature during summer. Anthropogenic disturbances like accidental fires by the herds' men and illegal honey hunters, agricultural activities, and harvesting of medicinal plants by uprooting have markedly disturbed the natural plant vegetation in this valley (Sarwat *et al.,* 2012; Shah *et al.,* 2018). The presented research proceeded to explore and document the unnoticed and undetected vegetation of Namal valley. The main objectives detail the indigenous vegetation of Namal valley to show the biological spectrum and phenology of all wild plant species for proper identification and future reference.

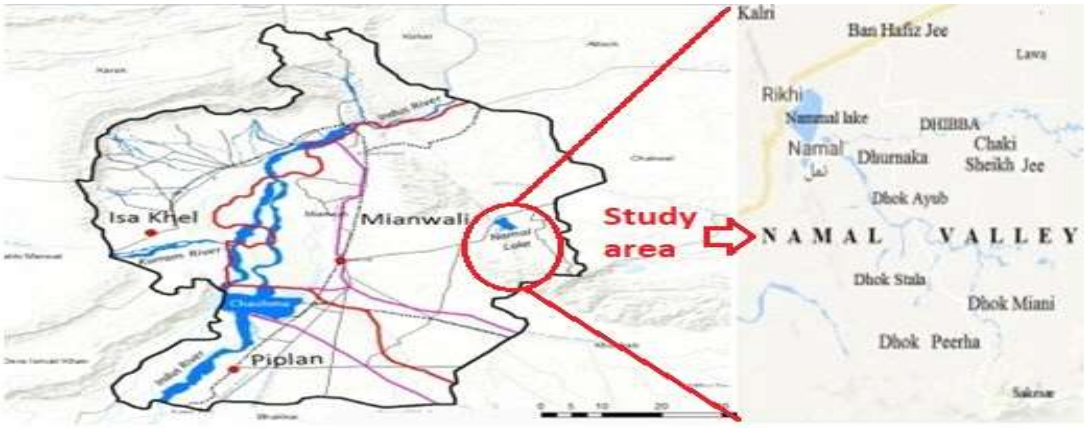

Figure 1. Map of study area of Namal valley, Mianwali, Pakistan.

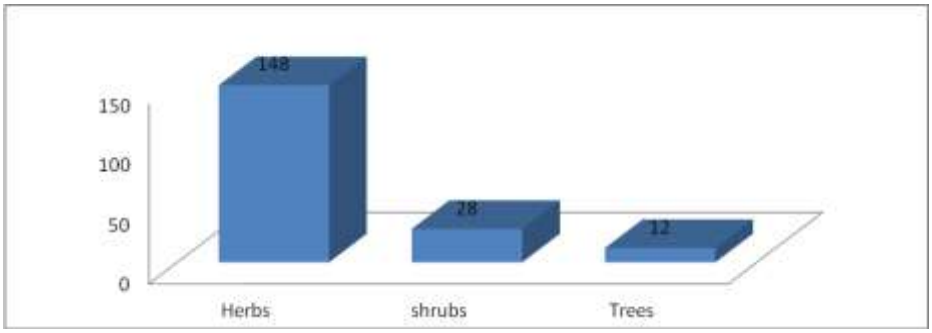

Figure 2. Summary of plant habits in Namal Valley, Mianwali, Pakistan.

MATERIAL AND METHODS

Study area

The study transpired in the Namal valley of Mianwali, Punjab, from 2016 to 2019. This valley is about 30 km from Mianwali city in the eastern direction. The climate of Namal valley is usually very hot in summer while freezing in the winter. Summer begins in May and extends to mid of September, and the day length ranges to 15 h. In June, the average least and highest temperature is 26 °C and 42 °C, respectively. Weather in December, January, and February are typically chilly and day length is nine hours. January is the coldest month each year, with the mean lowest temperature recorded at 1 °C. The mean rainfall in the valley is nearly 159.3 mm per year (Shah *et al.,* 2018). Vegetation sampling proceeded from six ecologically diverse study sites, namely, Dhok Peera, Dhok Satala, Dhok Lataka, Dhok Garori, Namal village, and Rikhi, chosen mainly based on different topographical characteristics (Figure 1).

Vegetation structure

Taking vegetation data of plant species used the quadrat method from all ecological sites throughout 2016–2019. Plots used measured 10 m × 10 m w for trees and shrubs and 1 m × 1 m quadrat for herbs and grasses. Data collection from 10 to 15 random quadrats ensued every season. Only data on woody vegetation (trees and shrubs) and grasses underwent documentation in this study (Figures 2 and 3). Plant identification employed the help of available literature, especially the flora of Pakistan. After data collection further experimentation and analysis proceeded on selected five plants species (*Grewia tenax, Pentatropis spiralis, Pulicaria edmondsonii, Ruellia nudiflora*, and *Tephrosia purpurea*) based on their individuality, as these species abound only in this valley and not found in other areas of Salt Range (Figure 4).

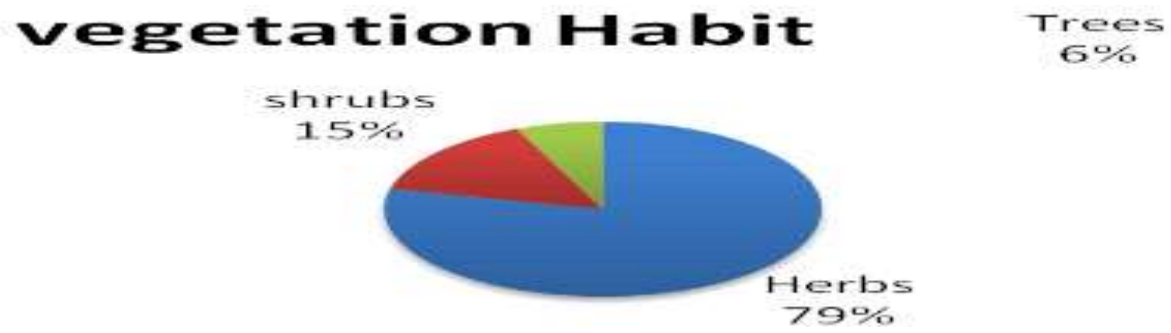

Figure 3. Percent share of various habit forms of vegetation of Namal valley, Mianwali, Pakistan.

Figure 4. The five selected plant species, *Grewia tenax*, *Pentatropis spiralis*, *Pulicaria edmondsonii*, *Ruellia nudiflora*, and *Tephrosia purpurea* for the evaluation of phytochemical levels, mineral concentration, and free amino acid concentration.

Estimation of mineral contents

The elemental analysis of a powdered sample taken from the selected five plants progressed with atomic absorption spectrophotometry instrument (model AA-670 1F, Shimadzu).

Phytochemical analysis

Achieving qualitative evaluation of different phytochemicals used Mayer`s reagent for alkaloids, foam test for saponins, Salkowski's test for steroids, stain test for oils, ferric chloride for phenols and tannins, and lead acetate test for flavonoids (AOAC, 1990).

Amino acid composition

Amino acids determination was according to the modified AOAC method (1990). A map already prepared using reference amino acids compared and identified separated amino acids on the chromatograms.

Statistical analysis

Statistical analysis employed the SPSS (Statistical Program for Social Sciences) version 16.0. All data underwent analysis of variance (ANOVA).

RESULTS AND DISCUSSION

The basis for selection of six ecologically diverse study sites of Namal valley, viz., Dhoke Pera, Dhoke Satala, Dhoke Lataka, Dhoke Garori, Namal, and Rikhi, primarily consisted of dissimilarities in elevation, aspect, slope, altitude, soil composition, topography, habitat, plant community, and type of vegetation life. The existing vegetation species at chosen sites were observed and enlisted.

Biodiversity is the key feature of the Salt Range, and as Namal valley continues from this range, it also contains indigenous wild medicinal plants. Differences in habitat ecology and vegetation structure are extraordinary everywhere in the Namal valley. Location-wise, all ecological sites shared a great variety in vegetation structure due to the variation in topographical and habitat differences. Plant species totaling 188 relate to 152 genera and 54 families collected from the six sites of Namal valley (Table 1). The mainly significant family in terms of species demonstration was Poaceae, having 25 genera and 39 species. Following it was Asteraceae, with 17 genera and 18 species, and then Fabaceae (10 genera, 15 species). These results follow those of Ruocco *et al.* (2014) and Ahmed *et al.* (2019), who documented similar families in abundance in the same type of habitats.

Summary of all the reported families is documented in Table 2. Floristic composition and biological spectrum detail like local name, habitat, flowering period, and flower color are in summary (Table 3).

Table 1. Various habit forms of vegetation in Namal valley, Mianwali, Pakistan.

Plant type	Total plant species	Dhoke Pera	Dhoke Satala	Dhoke Lataka	Dhoke Garori	Namal	Rikhi
Herbs	148	121	94	109	84	97	75
Shrubs	28	25	20	23	19	23	16
Trees	12	11	7	11	4	11	7
	188	157	121	143	105	131	98

Table 2. Summary of reported families from Namal valley, Mianwali, Pakistan.

No.	Family	Genera (#)	Species (#)	Family type	No.	Family	Genera (#)	Species (#)	Family type
1	Acanthaceae	4	4	Dicot	28	Meliaceae	1	1	Dicot
2	Aizoaceae	1	1	Dicot	29	Menispermaceae	1	1	Dicot
3	Amaranthaceae	6	8	Dicot	30	Moraceae	1	2	Dicot
4	Apocynaceae	7	7	Dicot	31	Moringaceae	1	1	Dicot
5	Arecaceae	1	1	Monocot	32	Myrtaceae	1	1	Dicot
6	Asphodelaceae	2	2	Monocot	33	Nelumbonaceae	1	1	Dicot
7	Asteraceae	17	18	Dicot	34	Nitrariaceae	1	1	Dicot
8	Bignoniaceae	1	1	Dicot	35	Nyctaginaceae	1	1	Dicot
9	Boraginaceae	2	2	Dicot	36	Oleaceae	1	1	Dicot
10	Brassicaceae	6	6	Dicot	37	Oxalidaceae	1	1	Dicot
11	Cactaceae	1	1	Dicot	38	Papaveraceae	2	2	Dicot
12	Campanulaceae	1	1	Dicot	39	Plantaginaceae	4	4	Dicot
13	Cannabaceae	1	1	Dicot	40	Poaceae	25	39	Monocot
14	Capparaceae	1	2	Dicot	41	Polygonaceae	4	5	Dicot
15	Caryophyllaceae	2	2	Dicot	42	Primulaceae	1	1	Dicot
16	Chenopodiaceae	1	2	Dicot	43	Ranunculaceae	2	2	Dicot
17	Convolvulaceae	4	5	Dicot	44	Rhamnaceae	1	2	Dicot
18	Cyperaceae	2	2	Monocot	45	Rubiaceae	2	2	Dicot
19	Euphorbiaceae	4	7	Dicot	46	Salvadoraceae	1	1	Dicot
20	Fabaceae	10	15	Dicot	47	Sapindaceae	1	1	Dicot
21	Gentianaceae	1	1	Dicot	48	Solanaceae	3	5	Dicot
22	Geraniaceae	1	1	Dicot	49	Tamaricaceae	1	2	Dicot
23	Juncaceae	1	1	Monocot	50	Tiliaceae	1	1	Dicot
24	Lamiaceae	6	7	Dicot	51	Typhaceae	1	1	Monocot
25	Linaceae	1	1	Dicot	52	Verbenaceae	2	2	Dicot
26	Lythraceae	1	1	Dicot	53	Violaceae	1	1	Dicot
27	Malvaceae	2	2	Dicot	54	Zygophyllaceae	2	2	Dicot

Table 3. Floristic composition, biological spectrum, and phenology of plant species recorded from Namal valley, Mianwali, Pakistan.

No.	Species Name	Local Name	Family	Seed Type	Habit	Habitat	Flower Season	Flower Color
1	*Achyranthes aspera*	Puthkanda	Amaranthaceae	Dicot	Herb	D	Jul- Sep	Yellowish- White
2	*Acrachne racemosa*	Kanghi Ghass	Poaceae	Monocot	Herb	W & D	Mar-Sep	Whitish Green or Brownish
3	*Aerva javanica*	Bui	Amaranthaceae	Dicot	Shrub	D	Jan-May	Pale whitish
4	*Ageratum conyzoides*	Bhakumar	Asteraceae	Dicot	Herb	D	Oct-Dec	White, Mauve
5	*Ajuga bracteosa*	Weedi	Lamiaceae	Dicot	Herb	D	Mar-Aug	Blue, Purple
6	*Albizia lebbeck*	Kala Sharin	Fabaceae	Dicot	Tree	D	Apr-Jun	Cream
7	*Albizia procera*	Sufaid shrin	Fabaceae	Dicot	Tree	D	Apr-Jun	Pale White
8	*Aloe barbadensis*	Kawar Gandal	Asphodelaceae	Monocot	Herb	D	Jul- Sep	Yellow
9	*Alternanthera pungens*	Khaki booti	Amaranthaceae	Dicot	Herb	D	Jul- Sep	Straw color
10	*Alternanthera sessilis*	Gudrisag	Amaranthaceae	Dicot	Herb	D	Jul- Sep	Pink, White
11	*Amaranthus graecizans*	Maririe	Amaranthaceae	Dicot	Herb	D	Apr- Sep	Reddish Pink
12	*Amaranthus viridis*	Barhu	Amaranthaceae	Dicot	Herb	D	Apr-Sep	Brown
13	*Anagallis arvensis*	Nili Boti	Primulaceae	Dicot	Herb	D &W	May-Sep	Blue, Pink
14	*Anisomeles indica*	Kutki podina	Lamiaceae	Dicot	Herb	D	May-Oct	Pink
15	*Aristida adscensionis*	Tela ghass	Poaceae	Monocot	Herb	D &W	Mar-Nov	Straw colour
16	*Arundo donax*	Narki	Poaceae	Monocot	Herb	D &W	Sep-Oct	Brown
17	*Asphodelus tenuifolius*	Pyazi	Asphodelaceae	Monocot	Herb	D	Jan-Mar	White
18	*Azadirachta indica*	Neem	Meliaceae	Dicot	Tree	D &W	May-Jun	White
19	*Bacopa monnieri*	Barhami Booti	Plantaginaceae	Dicot	Herb	D &W	Apr-May	Blue, Pale violet
20	*Barleria cristata*	Kala bansa	Acanthaceae	Dicot	Herb	D &W	Dec-Feb	Pink, White
21	*Boerhavia procumbens*	It sit	Nyctaginaceae	Dicot	Herb	D	Jun-Sep	Pink
22	*Bothriochloa bladhii*	Sitti buti	Poaceae	Monocot	Herb	D &W	May-Nov	Pinkish
23	*Brachiaria distachya*	Chit ghass	Poaceae	Monocot	Herb	D &W	Jul-Sep	Straw colour
24	*Brachiaria ramosa*	Koray	Poaceae	Monocot	Herb	D &W	Jul-Oct	Whitish
25	*Brachiaria reptans*	Para Ghas	Cannabaceae	Monocot	Herb	D	Jun-Nov	Whitish
26	*Calligonum comosum*	Khip	Polygonaceae	Dicot	Shrub	D	Mar-Apr	Silvery White
27	*Calotropis procera*	Akra	Apocynaceae	Dicot	Shrub	D	Apr-Sep	White Purple
28	*Cannabis sativa*	Bhang	Cannabaceae	Dicot	Herb	D	Jun-Aug	Off White
29	*Capparis decidua*	Karin	Capparaceae	Dicot	Shrub	D	Mar-Apr	Pink
30	*Capparis spinosa*	Kabarra	Capparaceae	Dicot	Shrub	D	May-Oct	White
31	*Capsella bursa- pastoris*	Ani Boti	Brassicaceae	Dicot	Herb	D	Jul-Sep	Reddish- Brown
32	*Caralluma tuberculata*	Chongan	Apocynaceae	Dicot	Herb	D	Aug-Oct	Yellow, Red
33	*Cardamine hirsuta*	Kori boti	Brassicaceae	Dicot	Herb	D	Mar-Apr	White
34	*Cardaria draba*	Makhi dal	Brassicaceae	Dicot	Herb	D &W	Feb-Apr	White
35	*Carthamus oxyacantha*	Pohli	Asteraceae	Dicot	Herb	D	Apr-Jun	Yellow
36	*Cenchrus echinatus*	Ludhi	Poaceae	Monocot	Herb	D	Apr-Jun	Yellow, Brown
37	*Cenchrus setigerus*	Dhama ghass	Poaceae	Monocot	Herb	D &W	Mar-Sep	Straw colour
38	*Centaurium pulchellum*	Luntak boti	Gentianaceae	Dicot	Herb	D	Mar-Oct	Purple
39	*Chenopodium album*	Bathu	Chenopodiaceae	Dicot	Herb	D	Jul-Oct	Green
40	*Chenopodium murale*	Jangli Batu	Chenopodiaceae	Dicot	Herb	D	Jul-Oct	Pale Brown

Table 3. (cont'd).

No.	*Species Name*	Local Name	Family	Seed Type	Habit	Habitat	Flower Season	Flower Color
41	*Chloris barbata*	Pankha ghas	Poaceae	Monocot	Herb	D &W	Mar-May	Purple
42	*Chloris digitata.*	Ungli ghass	Poaceae	Monocot	Herb	D &W	Nov-Dec	Greenish- Brown
43	*Chloris gayana*	Kagha ghass	Poaceae	Monocot	Herb	D &W	Aug-Oct	Greenish- Brown
44	*Chrozophora tinctoria*	Shadevi	Euphorbiaceae	Dicot	Herb	D	Apr-Jun	Yellow
45	*Chrysopogon aucheri*	Nela ghas	Poaceae	Monocot	Herb	D &W	Mar-Sep	Purple
46	*Chrysopogon serrulatus*	Lampa Ghass	Poaceae	Monocot	Herb	D &W	Apr-Sep	White, Purple
47	*Cichorium intybus*	Kasni	Asteraceae	Dicot	Herb	D	Agust-Sep	Blue
48	*Cirsium vulgare*	Laih	Asteraceae	Dicot	Herb	D	Mar-May	Purple
49	*Cistanche tubulosa*	Khar ghainr	Orobanchaceae	Dicot	Herb	D	Feb-Apr	Yellow
50	*Citrullus colocynthis*	Gharomba	Cucurbitaceae	Dicot	Herb	D	Mar-Jun	Yellow
51	*Clematis grata*	Charkhi	Ranunculaceae	Dicot	Shrub	D &W	Jul-Oct	Purple, White
52	*Clerodendrum phlomidis*	Arni	Lamiaceae	Dicot	Herb	D	Aug-Feb	Cream
53	*Clitoria ternatea*	Nela Matar	Fabaceae	Dicot	Herb	D &W	Aug-Nov	Blue
54	*Cocculus hirsutus*	Farid Buti	Menispermaceae	Dicot	shrub	D	May-Sep	Green
55	*Convolvulus arvensis*	Verri	Convolvulaceae	Dicot	Herb	D &W	Apr-Jul	White pink
56	*Convolvulus prostratus*	Lablab Bail	Convolvulaceae	Dicot	Herb	D	Apr-Sep	White
57	*Conyza bonariensis*	Flax grass	Asteraceae	Dicot	Herb	D &W	Apr-Sep	White
58	*Conyza canadensis*	Daryae Boti	Asteraceae	Dicot	Herb	D	Mar-Jun	White
59	*Corchorus depressus*	Boh Phali	Tiliaceae	Dicot	Herb	D	Mar-Jun	Yellow
60	*Croton bonplandianum*	Kala Bhangra	Euphorbiaceae	Dicot	Herb	D &W	Apr-Sep	White
61	*Cucumis melo*	Chibbar	Cucurbitaceae	Dicot	Herb	D	Mar-Sep	Yellow
62	*Cuscuta reflexa*	Aakash Bail	Convolvulaceae	Dicot	Herb	D &W	Jan-Mar	White
63	*Cymbopogon jwarancusa*	Rosha Grass	Poaceae	Monocot	Herb	D &W	Apr-Jul	Pale Brown
64	*Cynodon dactylon*	Talla	Poaceae	Monocot	Herb	D &W	Jul-Sep	Green
65	*Cyperus rotundus*	Koheri	Cyperaceae	Monocot	Herb	W	Mar-Jul	Brown
66	*Dactyloctenium aegyptium*	Pankha Khabal	Poaceae	Monocot	Herb	D &W	Apr-Jul	Brown
67	*Dactyloctinium scindicum*	Pankha Ghass	Poaceae	Monocot	Herb	D &W	Apr-Jul	Blue Green
68	*Dalbergia sissoo*	shesham	Fabaceae	Dicot	Tree	W&D	Mar-May	White
69	*Datura metel*	Datura	Solanaceae	Dicot	Herb	D	Apr-Sep	White
70	*Desmostachya bipinnata*	Dabb Ghass	Poaceae	Monocot	Herb	D &W	Apr-Sep	Straw color
71	*Dichanthium annulatum*	Jargu ghass	Poaceae	Monocot	Herb	D	May-Jul	Dark pink
72	*Dicanthim foveolatum*	sheda grass	Poaceae	Monocot	Herb	D &W	Mar-Sep	Brown
73	*Dicliptera bupleuroides*	Kuthhi	Acanthaceae	Dicot	Herb	D	Nov-Jun	Pink
74	*Digera muricata*	Leswa	Amaranthaceae	Dicot	Herb	D	Aug-Sep	Brown
75	*Digitaria sanguinales*	Takri ghass	Poaceae	Monocot	Herb	D &W	Jun-Sep	Brown, Yellow
76	*Digtaria nodosa*	Jawarani	Poaceae	Monocot	Herb	D &W	Mar-Sep	Brown, Green
77	*Dinebra retroflexa*	Kangar ghass	Poaceae	Monocot	Herb	D	Apr-Jul	Green, Pinkish
78	*Dodonaea viscosa*	Sanatha	Sapindaceae	Dicot	Shrub	D	Apr-Jul	Yellow
79	*Echinochloa crus-galli*	sanwak	Poaceae	Monocot	Herb	D	Jul-Sep	Green to Purple
80	*Echinops echinatus*	Oont Kateli	Asteraceae	Dicot	Herb	D	Nov-Jan	White

Table 3. (cont'd).

No.	*Species Name*	Local Name	Family	Seed Type	Habit	Habitat	Flower Season	Flower Color
81	*Eclipta prostrata*	Bhangra	Asteraceae	Dicot	Herb	D	Aug-Sep	White
82	*Ehretia obtusifolia*	Gohkru	Boraginaceae	Dicot	Shrub	D	Dec-Jan	White, Purple
83	*Eichhornia crassipes*	Gul e- Rana	Pontederiaceae	Monocot	Herb	W	Mar-Jul	Purple
84	*Enneapogon persicus*	Phumbar ghass	Poaceae	Monocot	Herb	D &W	Jun-Aug	Straw colour
85	*Epilobium hirsutum*	Kawo Boti	Onagraceae	Dicot	Herb	D	Jun-Sep	Pink
86	*Eragrostis cilianensis*	Parra Ghass	Poaceae	Monocot	Herb	D	Mar-Oct	Brown
87	*Eruca sativa*	Jamayon	Brassicaceae	Dicot	Herb	D	Jan-May	Yellow
88	*Eucalyptus camaldulensis*	Sufaida	Myrtaceae	Dicot	Tree	D	Apr-Sep	White
89	*Eulaliopsis binata*	Bhabhar	Poaceae	Monocot	Herb	D	Mar-Jul	Brown
90	*Euphorbia helioscopia*	Dhudya	Euphorbiaceae	Dicot	Herb	D	Apr-Jun	Yellow Green
91	*Euphorbia hitra*	Dhodhak	Euphorbiaceae	Dicot	Herb	D &W	Jul-Sep	Purple
92	*Euphorbia peplus*	Dhodhak	Euphorbiaceae	Dicot	Herb	D &W	Jul-Sep	Yellow Green
93	*Euphorbia prostrata*	Lal Dhodhak	Euphorbiaceae	Dicot	Herb	D &W	Aug-Sep	Blue Green
94	*Evolvulus alsinoides*	Sankhaholi	Convolvulaceae	Dicot	Herb	D	Jul-Sep	Purple
95	*Fagonia indica*	Dhamasa	Zygophyllaceae	Dicot	Shrub	D	May-Sep	Purple
96	*Ficus benghalensis*	Bohr	Moraceae	Dicot	tree	D	Apr-Oct	Yellow
97	*Ficus virgata*	Jangli Injeer	Moraceae	Dicot	Shrub	D	May-Nov	Violet
98	*Filago hurdwarica*	Bahi boti	Asteraceae	Dicot	Herb	D	May-Jun	Yellow
99	*Fumaria indica*	Papara	Papaveraceae	Dicot	Herb	D	Apr-May	Pale pink
100	*Galium aparine*	Kuri	Rubiaceae	Dicot	Herb	W	May-Jul	White
101	*Geranium mascatense*	Sasa Boti	Geraniaceae	Dicot	Herb	D	Apr-Aug	Purple
102	*Grewia tenax*	Ghungair	Malvaceae	Dicot	Shrub	D	Apr-Aug	Yellow
103	*Heliotropium crispum*	Hathi Sundi	Boraginaceae	Dicot	Herb	D	Apr-Jul	White
104	*Imperata cylendrica*	Dabba Ghass	Poaceae	Monocot	Herb	D &W	Mar-Nov	White
105	*Juncus elegans*	Dila	Juncaceae	Monocot	Herb	W	Apr-Jul	Straw color
106	*Justicia adhatoda*	Bhaikarr	Acanthaceae	Dicot	Shrub	D	Feb-Aug	Yellow
107	*Kickxia ramosissima*	Khunger Boti	Plantaginaceae	Dicot	Herb	D	Dec-Feb	Yellow
108	*Lactuca serriola*	tukhm-i-kahu	Asteraceae	Dicot	Herb	D	Jul-Sep	Yellow
109	*Lantana camara*	Panjphuli	Verbenaceae	Dicot	Shrub	D	Mar-Aug	Red, Pink, White
110	*Lathyrus aphaca*	Kasari	Fabaceae	Dicot	Herb	W	Jun-Aug	Yellow
111	*Launaea capitata*	Jangli ghobi	Asteraceae	Dicot	Herb	D	Mar-Aug	Yellow
112	*Leptadenia pyrotechnica*	Khip	Apocynaceae	Dicot	Shrub	D	Dec-Jan	Yellow
113	*Leucaena leucocephala*	Jumbay	Fabaceae	Dicot	Shrub	D	Apr-Aug	Tan, cream
114	*Lindenbergia indica*	Pili Boti	Scrophulariaceae	Dicot	Herb	D	Mar-May	Yellow
115	*Linum strictum*	Alsi	Linaceae	Dicot	Herb	D	Mar-May	Yellow
116	*Malvastrum coromandelianum*	Kharenti	Malvaceae	Dicot	Herb	D	Apr-Jul	Yellow
117	*Melilotus indicus*	Jangli Methi	Fabaceae	Dicot	Herb	D	Apr-Sep	Yellow
118	*Mentha longifolia*	Jangli Podina	Lamiaceae	Dicot	Herb	D &W	Aug-Sep	Mauve
119	*Merremia dissecta*	Bengal sage	Convolvulaceae	Dicot	Herb	D &W	Mar-May	White
120	*Minuartia hybrida*	Mallow Boti	Caryophyllaceae	Dicot	Herb	D &W	May-Jun	White

Table 3. (cont'd).

No.	*Species Name*	Local Name	Family	Seed Type	Habit	Habitat	Flower Season	Flower Color
121	*Misopates orontium*	Kuta Phool	Plantaginaceae	Dicot	Herb	D &W	Feb-Apr	Pink
122	*Moringa oleifera*	Sohajna	Moringaceae	Dicot	Tree	D	Jan-Mar	Yellow White
123	*Nerium oleander*	Kanair	Apocynaceae	Dicot	Shrub	D	Apr-Jul	Yellow, Pink, Red, White
124	*Ocimum americanum*	Kali tulsi	Lamiaceae	Dicot	Herb	D	Aug-Sep	White
125	*Ocimum basilicum*	Niazbo	Lamiaceae	Dicot	Herb	D	Aug-Sep	Pink, White
126	*Opuntia dillenii*	Thor	Cactaceae	Dicot	Herb	D	Mar-Jun	Yellow
127	*Oxalis corniculata*	Khathi Boti	Oxalidaceae	Dicot	Herb	W	May-Sep	Yellow
128	*Papaver dubium*	Jangli Afyun	Papaveraceae	Dicot	Herb	D	Feb-Jun	Red, Purple, White
129	*Parthenium hysterophorus*	Dhania Boti	Asteraceae	Dicot	Herb	D	Apr-Sep	White
130	*Peganum harmala*	Harmal	Nitrariaceae	Dicot	Herb	D	Apr-Sep	White
131	*Pennisetum Orientale*	Kohlu ghass	Poaceae	Monocot	Herb	D	Apr-Nov	Brown Purple
132	*Pentatropis spiralis*	Aakari Bail	Asclepiadaceae	Dicot	Herb	D	Sep-Dec	pale Yellow
133	*Periploca aphylla*	Barara	Apocynaceae	Dicot	Shrub	D	Jul-Sep	Purple
134	*Persicaria lapathifolia*	Manba	Polygonaceae	Dicot	Herb	D	Jul-Sep	White
135	*Persicaria maculosa*	Gulabi Boti	Polygonaceae	Dicot	Herb	D	Aug-Sep	Purple
136	*Phoenix sylvestris*	Khajoor	Arecaceae	Monocot	tree	W & D	Aug-Sep	Purple
137	*Phragmites australis*	Nari	Poaceae	Monocot	Herb	D &W	Aug-Oct	White
138	*Phragmites karka*	Doka Ghass	Poaceae	Monocot	Herb	W	Oct-Nov	Purple
139	*Phyla nodiflora*	Bhukkan	Verbenaceae	Dicot	Herb	D &W	Apr-Nov	White
140	*Physorrhynchus chamaerapistrum*	Cheel	Brassicaceae	Dicot	Herb	D	Feb-Jun	White
141	*Pluchea arabica*	Rasan Boti	Asteraceae	Dicot	Herb	D	Aug-Nov	Yellow
142	*Polygonum plebeium*	Gulabi sag	Polygonaceae	Dicot	Herb	W	Aug-Sep	Pink
143	*Portulaca oleracea*	Qulfa	Portulacaceae	Dicot	Herb	D	May-Jul	Yellow
144	*Prosopis cineraria*	Jandi	Fabaceae	Dicot	Tree	D	Feb-May	Yellow
145	*Prosopis glandulosa*	Angrezi Kikar	Fabaceae	Dicot	Shrub	D	Apr-Jun	Cream
146	*Prosopis juliflora*	Kikri	Fabaceae	Dicot	Shrub	D	Mar-Jul	Cream
147	*Pseudogaillonia hymenostephana*	Bubadar	Rubiaceae	Dicot	Herb	D	Apr-Jul	Pink
148	*Pulicaria edmondsonii*	Ghandphool	Asteraceae	Dicot	Herb	D	Aug-Oct	Yellow
149	*Punica granatum*	Jangli anar	Punicaceae	Dicot	Shrub	D	Mar-May	Red
150	*Pupalia lappacea*	GolPuthkanda	Amaranthaceae	Dicot	Herb	D	Jul-Sep	White
151	*Ranunculus hispidus*	Shim	Ranunculaceae	Dicot	Herb	W	Apr-Jun	Yellow
152	*Rhazya stricta*	Weirran	Apocynaceae	Dicot	Shrub	D	Apr-Sep	White
153	*Ricinus communis*	Harnoli	Euphorbiaceae	Dicot	Shrub	D	Jul-Sep	Yellow
154	*Rosa acicularis*	Jangli Ghulab	Rosaceae	Dicot	Shrub	D	Mar-Sep	Pink
155	*Ruellia nudiflora*	Patakhi	Acanthaceae	Dicot	Herb	D	Mar-Sep	Violet, Pink, White
156	*Rumex dentatus*	Jangli Palak	Polygonaceae	Dicot	Herb	W	May-Jun	White
157	*Saccharum spontaneum*	Kahn	Poaceae	Monocot	Herb	D	Jul-Sep	White
158	*Salvadora persica*	Jall	Salvadoraceae	Dicot	Shrub	D	Mar-Jul	Yellow
159	*Salvia moorcroftiana*	Sarda	Lamiaceae	Dicot	Herb	D &W	May-Jun	Purple
160	*Schweinfurthia papilionacea*	Sanni	Plantaginaceae	Dicot	Herb	W	May-Jul	White

Table 3. (cont'd).

No.	*Species Name*	Local Name	Family	Seed Type	Habit	Habitat	Flower Season	Flower Color
161	*Senegalia modesta*	Phulai	Fabaceae	Dicot	Tree	D	Mar-May	Pale White, pale yellow
162	*Sisymbrium irio*	Khoob Kalan	Brassicaceae	Dicot	Herb	W	Mar-Apr	Yellow
163	*Solanum nigrum*	Mako	Solanaceae	Dicot	Herb	D	Oct-Jan	White
164	*Solanum surattense*	Makora Poda	Solanaceae	Dicot	Herb	W	May-Oct	White violet
165	*Sonchus asper*	Dhodhak	Asteraceae	Dicot	Herb	W	May-Aug	Yellow
166	*Stellaria media*	Banbator	Caryophyllaceae	Dicot	Herb	D	Feb-Oct	White
167	*Tamarix aphylla*	Khagul	Tamaricaceae	Dicot	Tree	D	Aug-Sep	White, Pink
168	*Tamarix dioica*	Khaguli	Tamaricaceae	Dicot	Shrub	W	Aug-Sep	Pink, White
169	*Taraxacum officinale*	Duddal	Asteraceae	Dicot	Herb	W	Jan-Apr	Yellow
170	*Taverniera glabra*	Jethmad	Fabaceae	Dicot	Herb	D	Mar-May	Yellow
171	*Taverniera spartea*	Pahari Boti	Fabaceae	Dicot	Herb	D	Apr-Sep	Pink
172	*Tecomella undulata*	Rohera	Bignoniaceae	Dicot	Shrub	D	Dec-Feb	Yellow, orange, Red
173	*Tephrosea purprea*	Dalili	Fabaceae	Dicot	Herb	D	Oct-Jan	Purple
174	*Tragus roxburghii*	Burr grass	Poaceae	Monocot	Herb	D	May-Oct	Yellow
175	*Trianthema portulacastrum*	It sit	Aizoaceae	Dicot	Herb	D &W	Apr-Sep	Purple
176	*Tribulus terrestris*	Bhakra	Zygophyllaceae	Dicot	Herb	D	Apr-Sep	Pale Yellow
177	*Tripidium bengalense*	Kana	Poaceae	Monocot	Herb	D	Oct-Jan	White
178	*Tripidium revennae*	Sarkanda	Poaceae	Monocot	Herb	D	Aug-Nov	White
179	*Typha latifolia*	Konder	Typhaceae	Monocot	Herb	W	Aug-Sep	Brown
180	*Urtica dioica*	Bicho boti	Urticaceae	Dicot	Herb	D &W	Jun -Oct	Yellow
181	*Vachellia nilotica*	Kikar	Fabaceae	Dicot	Tree	D	Mar-Sep	Yellow
182	*Vernonia arabica*	Kalgira	Asteraceae	Dicot	Herb	D	Apr-Sep	Purple
183	*Viola cinerea*	Mohri Boti	Violaceae	Dicot	Herb	D	Mar-Oct	White, purple
184	*Withania coagulans*	Khamjera	Solanaceae	Dicot	Herb	D	Jan-Apr	Yellow
185	*Withania somnifera*	Rashbhari	Solanaceae	Dicot	Herb	D	Jul-Nov	Yellow
186	*Xanthium strumarium*	Chota Dhatora	Asteraceae	Dicot	Herb	D	Jul-Sep	Yellow Green
187	*Ziziphus mauritiana*	Beri	Rhamnaceae	Dicot	Tree	D	Feb-May	White
188	*Ziziphus nummularia*	Karkina	Rhamnaceae	Dicot	Shrub	D	Mar-Jun	White

Dhoke Pera showed the maximum species richness, with 157 plant species reported from this site during four seasons. Different taxa were noted at the Dhoke Pera site, viz., *Senegalia modesta*, *Dalbergia sisso*, *Moringa oleifera,* and *Phoenix sylvestris,* with many large shrubs like *Grewia tenax*, *Tecomella undulata, Ziziphus nummularia*, and *Ziziphus mauritiana.* Many small shrubs like *Aerva javanica*, *Alhagi maurorum, Capparis decidua, Capparis spinosa, Clematis grata, Justicia adhatoda, Nerium oleander, Periploca aphylla, Prosopis glandulosa, Rhazya stricta,* and *Tamarix aphylla* were also habitant to this site. A similar type of result came out earlier, and researchers also reported the occurrence of the same species during a study in similar habitats (Rahman *et al.,* 2016: Sharma *et al.,* 2019).

The Dhoke Satala site reported 121 species during the study. Vegetation at this site had high domination of shrubby vegetation, with tall shrubs like *Capparis decidua*, *Grewia tenax*, *Prosopis cineraria, Ricinus communis*, *Salvadora persica, Tamarix dioica,* and *Ziziphus mauritiana,* as well as, some small shrubs like *Aerva javanica*, *Alhagi maurorum, Calotropis procera, Capparis decidua, Capparis spinosa, Prosopis juliflora,* and *Rhazya stricta* also dominating the site. Few trees like *Vachellia nilotica, Senegalia modesta, Dalbergia sisso*, and *Salvadora persica* were present in scattered places. These species can bear a variety of ecological pressure and spring over diverse habitat types (Gul *et al.,* 2014; Amjad *et al.,* 2016).

Dhoke Lataka showed the second-highest species richness and diversity, following Dhoke Pera, with a total of 143 plant species reported from this site. Among the trees, *Vachellia nilotica* and *Moringa oleifera* showed a relationship with the highest number of species. Only *Ziziphus mauritiana* and *Prosopis juliflora* were the large shrubby vegetation that had a positive relationship with *Rhazya stricta* and *Prosopis cineraria* (Adnan *et al.,* 2015).

At the Dhoke Garori site, recorded species richness and diversity were comparatively less than earlier-mentioned sites, with 105 species noted from this site, dominated by shrubs like *Grewia tenax*, *Nerium oleander,* and *Periploca aphylla* and herbaceous vegetation, such as, *Tephrosia purpurea*. Namal site showed a very definite type of vegetation, totaling 131 species obtained from this site. Tree vegetation flourishes in lonely patches, and merely *Grewia tenax* and *Salvadora persica* represented a quantity of association with shrubs like *Senegalia modesta* and *Tecomella undulata*. *Tephrosia purpurea*, though, is the chief governing annual herb of the site, found associated with many plant species during all four seasons. This plant species is adjustable to various habitat types and tolerant to different environmental factors (Khan *et al.,* 2017; Asif *et al.,* 2021).

Species richness and vegetation diversity were the least at Rikhi because of all the observed ecological sites. A total of 98 species emerged from this site. Consequently, the presence of additional species, may have shown a strapping positive relationship for most species at this location (Baydoun *et al.,* 2015; Amjad *et al.,* 2016). Multiple ecological attributes control species organization and vegetation arrangement in arid climates. The parameters affecting vegetation structure and species association in the studied area were linked to the site, such as, total elevation, aspect, and canopy cover of the quadrat, and fertility, such as, soil mineral content (Jan *et al.,* 2016; Shah *et al.,* 2020). The relations among land moisture content and ground vegetation increase, as intense land vegetation can influence land humidity content (Khan *et al.,* 2021; Zhang *et al.,* 2022). Vegetation diversity everywhere in the Namal valley was fairly extraordinary, and the structure and composition of the vegetation depended upon the climate of the area, altitude, slope, and aspect of the mountains. Elevation plays a key role in the distribution of vegetation in rocky regions (Qureshi *et al.,* 2014; Aziz *et al.,* 2020; Haq *et al.,* 2022).

The results of the phytochemical analysis of five selected plants are available in Table 4. Important medicinal phytochemicals, such as, saponin, alkaloids, flavonoids, phenolic acids, and volatile oils, were present in the samples. The phytochemical analysis result shows that the five plants are rich in flavonoids. *Grewia tenax and Tephrosia purpurea* indicated a high concentration of flavonoids (311 mg/g and 304 mg/g, respectively), and *Pulicaria edmondsonii and Ruellia nudiflora* revealed a slightly high concentration of phenolic acids (228 mg/g and 239 mg/g, respectively). Saponin concentration reports to be very low in all plants except *Ruellia nudiflora,* which showed a high concentration (1.7%). Tannins concentration was higher in *Tephrosia purpurea* (3.75%) and *Pulicaria edmondsonii* (3.11%) than in the other three plants. *Ruellia nudiflora* showed the minimum concentration

Table 4. Phytochemical evaluation in five selected plants of Namal valley, Mianwali, Pakistan.

Plant	Saponins (%)	Tanins (%)	Alkaloids (%)	Flavonoids (mg/g)	Phenolic acids (mg/g)	Volatile oils (%)
Grewia tenax	0.6±0.19	3.75±0.51	3.54±0.32	311±0.11	200±0.38	4.11±0.15
Pentatropis spiralis	1.23±0.15	1.42±0.14	4.72±0.04	265±0.25	160±0.81	3.12±0.32
Pulicaria edmondsonii	0.9±0.58	3.11±0.22	2.21±0.22	185±0.33	228±0.11	5.51±0.41
Ruellia nudiflora	1.7±0.09	2.22±0.81	1.16±0.39	198±0.38	239±0.44	4.66±0.25
Tephrosia purpurea	1.3±0.11	2.95±0.11	2.31±0.01	304±0.19	189±0.61	4.31±0.85

Table 5. Mineral concentration (mg/100g) of selected plants of Namal valley, Mianwali, Pakistan.

No.	Plant name	Cu	Ni	Zn	Co	Cr	Cd	Fe	Mn	Pb	Ca	Mg	K	Na
1	*Grewia tenax*	0.153 ±0.02	0.149 ±0.04	0.143 ±0.02	0.294 ±0.06	0.154 ±0.01	0.148 ±0.00	0.249 ±0.02	0.419 ±0.11	0.129 ±0.04	191± 0.01	542± 0.01	789± 0.04	78±0 .04
2	*Tephrosia purpurea*	0.132 ±0.03	0.142 ±0.05	0.139 ±0.02	0.232 ±0.06	0.142 ±0.03	0.124 ±0.08	0.342 ±0.02	0.542 ±0.32	0.212 ±0.22	209± 0.38	242± 0.38	832± 0.66	63±0 .66
3	*Pulicaria edmondsonii*	0.162 ±0.21	0.152 ±0.03	0.142 ±0.44	0.228 ±0.63	0.132 ±0.22	0.161 ±0.73	0.252 ±0.07	0.312 ±0.01	0.242 ±0.04	142± 0.11	212± 0.11	642± 0.08	72±0 .08
4	*Pentatropis spiralis*	0.146 ±0.01	0.160 ±0.43	0.156 ±0.32	0.170 ±0.45	0.160 ±0.33	0.135 ±0.7	0.260 ±0.4	0.360 ±0.22	0.160 ±0.32	41±0 .16	160± 0.16	760± 0.42	80±0 .42
5	*Ruellia nudiflora*	0.148 ±0.14	0.132 ±0.48	0.09 ±0.11	0.70 ±0.18	0.210 ±0.84	0.111 ±0.55	0.110 ±0.58	0.240 ±0.14	0.090 ±0.66	111± 0.36	154± 0.36	540± 0.49	59±0 .58

of alkaloids (1.16%), with all other plants reported almost the same proportion of alkaloids. The concentration ratio of phytochemicals in these five plants is comparatively lower than what other scientists reported in similar studies on these plants (Senhaji *et al.,* 2017; Zaman *et al.,* 2021). This comparatively squat concentration could be due to the dry condition of the area and little precipitation.

The results of mineral contents appear in Table 5. Among the macro-elements determined, potassium showed higher content than calcium. Potassium content was superior in *Tephrosia purpurea* (832 mg/100 g), followed by *Grewia tenax* (789 mg/100 g) and *Pentatropis spiralis* (760 mg/100 g). Potassium content was lowest in *Ruellia nudiflora* (540 mg/100 g). The high concentration of macronutrients was from the reports of various researchers who performed similar studies on these plants in different regions (Jan *et al.,* 2016; Senhaji *et al.,* 2017). Copper content was maximum in *Pulicaria edmondsonii* (0.163 mg/100g) and lowest in *Tephrosia purpurea* (0.132 mg/100g). Nickle concentration varied in all plants and was high (0.160 mg/100g) in *P. spiralis* and least in *Tephrosia purpurea* (0.142 mg/100g). Zinc concentration ranged from 0.139 to 0.156mg/100g. The variation in concentration agreed with previous studies (Haq *et al.,* 2015; Sharma *et al.,* 2019; Xu *et al.,* 2021). Zn emerged highest in *Pentatropis spiralis* and lowest in *Tephrosia purpurea*. Cobalt concentration was least in *Pentatropis spiralis* (0.170 mg/100g) and maximum in *Grewia tenax* (0.294 mg/100g).

Chromium concentration showed minimal in *Pulicaria edmondsonii* (0.132 mg/100 g) and maximum in *Pentatropis spiralis* (0.160 mg/100 g). Cadmium concentration in *Grewia tenax, Tephrosia purpurea, Pulicaria edmondsonii*, and *Pentatropis spiralis* was 0.148 mg/100 g, 0.124 mg/100g, 0.161 mg/100g, and 0.135 mg/100g, respectively. Iron revealed a maximum concentration in *Tephrosia purpurea* (0.342 mg/100g) and minimal in *Grewia tenax* (0.252 mg/100g). *Tephrosia purpurea* also showed the highest concentration of manganese (0.542 mg/100g). Lead concentration was leading in *Pulicaria edmondsonii* (0.242 mg/100g), followed by *T. purpurea* (0.212 mg/100g), but lowest concentration of Pb appeared in *Grewia tenax* (0.129 mg/100g). Observed magnesium concentration was different in all plants and was highest (542 mg/100 g) in *Grewia tenax* and least in *Pentatropis spiralis* (160 mg/100 g). Sodium concentration in *Grewia tenax, Tephrosia purpurea, Pulicaria edmondsonii*, and *Pentatropis spiralis* was 78 mg/100 g, 63 mg/100g, 72 mg/100g, and 80 mg/100g, respectively. The findings on mineral concentrations align with the previous studies (Khan *et al.,* 2017; Asif *et al.,* 2021).

Table 6. Free amino acid concentration in selected plants of Namal valley, Mianwali, Pakistan (mg/ml).

No.	Name of Amino Acid and Amides	*Grewia tenax*	*Pentatropis spiralis*	*Pulicaria edmondsonii*	*Ruellia nudiflora*	*Tephrosia purpurea*
1	Isoleucine	0.076	1.006	0.471	0.008	0.895
2	Phenylalanine	0.914	0.995	1.241	0.958	0.071
3	Tyrosine	0.104	-	-	0.884	0.854
4	Proline	1.004	0.665	1.001	-	0.152
5	Alanine	0.041	-	-	0.098	0.451
6	Glutamic acid	0.051	0.251	1.076	0.854	0.685
7	Threonine	0.056	0.251	0.417	-	-
8	Arginine	0.017	0.358	0.554	0.525	0.141
9	Aspartic acid	0.141	0.441	0.995	0.362	0.085
10	Serine	0.049	0.142	-	-	0.541
11	Glycine	0.874	0.254	0.036	-	0.365

Table 6 details the concentration of free amino acids in the samples. The results showed that 11 free amino acids occurred in different quantities in plant tissues. Quantitative results of free amino acids reflected that 11 amino acids were present in *Grewia tenax.* Notably, proline was the highest amino acid of the separated free amino acids in concentration (1.004 mg/ml). Inversely, Isoleucine was the lowest amino acid concentration (0.008 mg/ml). Amino acids totaling of 11 resulted in *Tephrosia purpurea*. Eight types of amino acids came from *Pentatropis spiralis* and *Pulicaria edmondsonii.* A total of six free amino acids appeared in *Ruellia nudiflora*. Previous studies also reported similar results (Alias *et al.,* 2015; Bose *et al.,* 2018; Majeed *et al.,* 2021; Waheed *et al.,* 2022).

CONCLUSIONS

This study concludes that the ecological slope of the Namal valley, Mianwali, Pakistan, has a fundamental position in forming different plant associations of the valley. Individual plant species and associations among species show distortion with modifying edaphic, topographic, and climatic factors. Observations also revealed that selected plant species have a limited supply of different mineral and chemical concentrations due to the harsh climate and less rainfall, causing poor mineral drive in the soil. Plant researchers have agreed that plant species depict an inconsistency above a wide range of specific parameters in an ecosystem.

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