

MEDICINAL FLORA OF THE KASHMIR HIMALAYA: A TAXONOMIC OVERVIEW

G. H. Dar^{*}, A. A. Khuroo, Z. S. Khan and A. R. Dar

Centre of Plant Taxonomy, Department of Botany, University of Kashmir, Srinagar-190 006, India

*E-mail: ghdar@kashmiruniversity.net

ABSTRACT

The resurgence of interest in the herbal cure all around the world has brought the medicinal plants under sharp focus both in public and scientific discourse. The Kashmir Himalaya in our country harbours a rich repository of medicinal flora. Despite a number of studies, mostly on the ethnobotany, an updated and reliable taxonomic assessment of the medicinal flora in this region is still not available. The present paper attempts a broad taxonomic overview of the medicinal flora from this phytogeographic region. At the present state of investigation, 450 medicinal plant species, distributed among 276 genera and 101 families represent the medicinal flora of the Kashmir Himalaya. This constitutes about 17% to the total flora of this region.

Key words: Biodiversity; medicinal flora; taxonomy; Kashmir Himalaya.

INTRODUCTION

Plants are vital component of the world's biodiversity and an essential natural resource for human well-being (Gadgil, 1996). Besides sustenance, the plants have been used as therapeutic aid for alleviating various human ailments from very earlier times (Sullivan & Shealy, 1997). Such plants, commonly referred to as medicinal plants, have been one of the valuable tools in the traditional system of medicine and also provide active ingredients to formulate new medicines by the pharmaceutical industry. In fact, the WHO has listed over 21,000 plant species to be of medicinal use around the world. More than 60% of the world's human population relies on

plant medicine for primary health-care needs (Singh, 2002).

During the first half of 20th century, strides made in the manufacturing of synthetic drugs led to a rapid decline of plant-based medicines. At the turn of the century, however, there has been a renewal of interest in the use of plant-based drugs throughout the world due to the sweeping green-wave. Besides the harmful side-effects associated with the indiscriminate and prolonged use of synthetic drugs, they are expensive and, therefore, inaccessible to the majority of the world's population (Dobson, 1995). One out of every 125 plant species studied has produced a major drug, whilst for the synthetics the same has been one in 1000 chemical compounds tested (Harvey, 2000).

Worldwide, extensive bioprospecting programmes are being carried out to identify plant-based biochemical compounds that may provide effective treatments for various human diseases (Pushpangadan & Nair, 2001). The increasing demand on raw medicinal plants by various processing industries (pharmaceutical, food, cosmetics, perfumery, etc.) has resulted in the market expansion. During the year 1999, the world market for herbal remedies was US \$ 19.4 billion with an annual growth rate of 10 %. India is a major exporter of raw medicinal plants and processed plant-based drugs (Singh *et al.*, 2002). Exports of the medicinal plants and their products were valued at US\$ 67 million during the year 2000 (Kumar, 2004). The traditional healthcare systems- Ayurveda,

Unani, Sidda and Homeopathy (AYUSH) - operate alongside modern healthcare system. About 2,500 plant species in India are used by traditional healers (Utkarsh *et al.*, 1999).

In our country, the Himalayas represent the richest storehouse of medicinal plants. Kashmir Himalaya, one of the biotic provinces of the Himalayas, supports a rich and unique floristic diversity, including a fairly good representation of medicinal plants (Dar *et al.*, 2001). Various studies dealing with the medicinal flora of Kashmir Himalaya have been carried out (Chopra *et al.*, 1956; Kapur & Sarin, 1977; Kak, 1983; Dar *et al.*, 1984; Kachroo & Nahvi, 1987; Kaul *et al.*, 1990; Navchoo & Buth, 1990; Kapur, 1991; Ara & Naqshi, 1992; Naqshi *et al.*, 1992; Dhar & Siddique, 1993; Navchoo & Buth, 1994; Kaul, 1997; Khan *et al.*, 2004, 2006). Most of them dealt with the ethnobotany, agrotechniques, cultivation and phytochemistry of medicinal plants. Very uneven, and that too scattered, information is available on the taxonomic composition of the medicinal flora of the region. This is the main reason why it is often impossible to give a reliable estimate of the medicinal flora of Kashmir Himalaya. Hence, the present study is the first step towards an updated and authentic taxonomic overview of the medicinal flora of the Kashmir Himalaya.

STUDY AREA

Kashmir Himalaya, being located at the bio-geographically pivotal position, represents a unique biotic province in the northwestern extreme of the Himalayan range (Fig. 1). The region lies between coordinates $32^{\circ} 17'$ to $37^{\circ} 20'$ North latitude and $73^{\circ} 25'$ to $80^{\circ} 30'$ East longitude spreading over an area of about 2, 22, 235 km² (Hussain, 2002). Comprised of rugged terrain mostly, except for small plains of Jammu and Vale of Kashmir, broadly four categories of biogeographic Biomes are recognized: Tundra, Alpine, Temperate and

Subtropical (Rodgers & Panwar, 1988). Owing to the vast variety of edapho-climatic and physiographic factors, flora of the Kashmir Himalaya encompasses divergences of continental scale (Kant, 1989). Vegetation mainly constitutes of subtropical elements in the lower reaches, temperate in the middle valleys and dry temperate to alpine in the cold desert region (Singh *et al.*, 1998).

Geologically, the region is a recent formation richly endowed with almost all the time scale systems (de Terra, 1934). Soils are mostly loamy with little clay content. Diverse terrain zonations due to orography, altitude, relief and moisture patterns result into varied climatic regimes from subtropical to subarctic. Whereas Jammu province receives annual precipitation up to 1700 mm through the south-west monsoon, the Vale of Kashmir receives about 1050 mm, mostly in the form of winter snow. The formidable walls of Trans-Himalayan ranges completely prevent rain clouds into the interior valleys of Ladakh causing Holarctic climate with bare minimum precipitation of 100 mm per annum. The Indus and its tributaries, including the Jehlum and the Chenab drain the region. Glaciers and lakes also represent drainage system conspicuously; lakes such as the Tso Morari and Wular are on the Ram Sar list.

MATERIAL AND METHODS

In the present study, the plant species used in the traditional as well as modern medicine have been recognized as medicinal plant species (MPS). The study includes the MPS belonging to the vascular plants from the Kashmir Himalaya. Data base on the MPS has been generated on the basis of perusal of relevant literature published during the last half century, supplemented with our field observations while working on the flora of the Kashmir Himalaya during the last three decades. Information on the MPS has been

authenticated and augmented, wherever needed, by the herbarium studies in the Kashmir University Herbarium (KASH). Families have been ranked on the basis of number of species; however in case of equal number of species, the family with comparatively greater number of genera has been assigned higher rank.

The following indices were used for data analysis among the first ten larger families.

- (1) **KashProp** (Kashmir proportional representation) = number of species in the family in the region divided by the total number of species in the region. The total number of species in the Kashmir Himalaya has been taken as 2715 species (Dar *et al.*, unpublished).
- (2) **MedProp** (proportional representation in medicinal flora) = number of MPS in the family from the region divided by the total number of MPS from the region.
- (3) **MedRat** (medicinal plant species ratio) = number of MPS in the family from the

region divided by the number of species in the family from the region.

RESULTS AND DISCUSSION

At present stage of enquiry, our studies on the flora of the Kashmir Himalaya indicate that nearly 450 plant species find their use as medicinals. These medicinal plant species (MPS) are distributed within 276 genera and 101 families. With regard to the representation by different taxonomic groups, the dicotyledons constitute 400 MPS belonging to 239 genera under 79 families; while as the monocotyledons, gymnosperms and pteridophytes are represented by 37, 7 and 6 MPS belonging to 28, 4 and 5 genera under 13, 4 and 5 families, respectively (Table 1). In terms of percentage, the dicotyledons represent 89% of the total medicinal flora; while as other taxonomic groups of monocotyledons, gymnosperms and pteridophytes have a share of 8%, 1.5% and 1.5%, respectively. The overall ratios of family: species, family: genus and genus: species are 1: 4.45, 1: 2.73 and 1:1.61, respectively.

Table 1: A numerical summary of taxa in medicinal flora of the Kashmir Himalaya

Plant groups	Families	Genera	Species
Dicotyledons	79	239	400
Monocotyledons	13	28	37
Gymnosperms	4	4	7
Pteridophytes	5	5	6
Total	101	276	450

In terms of number of the MPS, the family Asteraceae contributes 55 MPS to the total medicinal flora. It is followed by Ranunculaceae and Lamiaceae with a share of 33 and 31 MPS, respectively (Table 2). The representation of the MPS within the families

is highly skewed, with just ten larger families contributing more than half (50.9%), while the remaining 49.1% is contributed by the other 91 families (Table 3). On the basis of the MedProp, the percentage of first ten large families in the medicinal flora is as follows:

Table 2: Number of genera (G) and species (S) per family in medicinal flora of the Kashmir Himalaya

Family	G	S	Family	G	S	Family	G	S
Dicotyledons			Malvaceae	3	3	Thymeliaceae	1	1
Amaranthaceae	1	3	Moraceae	2	3	Ulmaceae	2	2
Anacardiaceae	1	1	Morinaceae	1	1	Urticaceae	1	3
Apiaceae	14	19	Myrsinaceae	1	1	Valerianaceae	1	3
Araliaceae	1	1	Nymphaeaceae	2	2	Verbenaceae	2	2
Asclepiadaceae	1	3	Oleaceae	2	3	Violaceae	1	1
Asteraceae	28	55	Onagraceae	2	2	Vitaceae	1	1
Berberidaceae	1	5	Orobanchaceae	1	1	Zygophyllaceae	1	1
Betulaceae	1	1	Oxalidaceae	1	2	Monocotyledons		
Boraginaceae	6	8	Papaveraceae	3	3	Alismataceae	1	1
Brassicaceae	13	16	Papilionaceae	11	16	Alliaceae	1	5
Caesalpinaceae	1	1	Parnassiaceae	1	2	Amaryllidaceae	1	1
Campanulaceae	3	3	Phytolaccaceae	1	1	Araceae	3	3
Capparidaceae	1	1	Plantaginaceae	1	6	Cyperaceae	1	1
Caprifoliaceae	2	4	Platanaceae	1	1	Dioscoraceae	1	1
Caryophyllaceae	5	8	Plumbaginaceae	1	1	Hydrocharitaceae	1	1
Chenopodiaceae	3	4	Podophyllaceae	1	1	Iridaceae	1	5
Convolvulaceae	2	2	Polemoniaceae	1	1	Juncaceae	1	1
Crassulaceae	2	6	Polygonaceae	5	15	Liliaceae	5	6
Cucurbitaceae	1	2	Portulacaceae	1	1	Menyanthaceae	1	1
Cuscutaceae	1	1	Primulaceae	3	6	Orchidaceae	4	4
Datisacaceae	1	1	Punicaceae	1	1	Poaceae	7	7
Dipsacaceae	2	2	Pyrolaceae	1	1	Gymnosperms		
Elaeagnaceae	2	3	Ranunculaceae	16	33	Cupressaceae	1	3
Ericaceae	1	1	Rhamnaceae	2	2	Ephedraceae	1	2
Euphorbiaceae	3	8	Rosaceae	9	16	Pinaceae	1	1
Fumariaceae	3	5	Rubiaceae	2	5	Taxaceae	1	1
Gentianaceae	4	11	Rutaceae	1	1	Pteridophytes		
Geraniaceae	2	5	Salicaceae	2	2	Aspediaceae	1	2
Grossulariaceae	1	1	Santalaceae	1	1	Equistaceae	1	1
Hippocastanaceae	1	1	Sapindaceae	1	1	Ophioglossaceae	1	1
Hypericaceae	1	1	Saxifragaceae	2	6	Polypodiaceae	1	1
Juglandaceae	1	1	Scrophulariaceae	9	17	Pteridaceae	1	1
Lamiaceae	17	31	Simaroubaceae	1	2			
Lentibulariaceae	1	1	Solanaceae	5	7			
Linaceae	1	1	Tamaricaceae	1	1			

Asteraceae (12.2) > Ranunculaceae (7.3) > Lamiaceae (6.9) > Apiaceae (4.2) > Scrophulariaceae (3.8) > Brassicaceae (3.6) > Papilionaceae (3.6) > Rosaceae (3.6) > Polygonaceae (3.3) > Gentianaceae (2.4) (see Table 4). Families such as Poaceae,

Cyperaceae, Boraginaceae, Caryophyllaceae and Solanaceae, which figure among the top ten speciose families of Kashmir Himalaya, do not show the same pattern in the medicinal flora and represent relatively lesser number of taxa.

Table 3: The first ten large families in medicinal flora of the Kashmir Himalaya

S.No	Family	Genera	MPS
1.	Asteraceae	28	55
2.	Ranunculaceae	16	33
3.	Lamiaceae	17	31
4.	Apiaceae	14	19
5.	Scrophulariaceae	9	17
6.	Brassicaceae	13	16
7.	Papilionaceae	11	16
8.	Rosaceae	9	16
9.	Polygonaceae	5	15
10.	Gentianaceae	4	11

However, on computing the MedRat, the family Ranunculaceae with a value of 0.47 is the largest, followed by Lamiaceae (0.35) and Polygonaceae (0.29). In other words, nearly half of the species in the family Ranunculaceae from Kashmir Himalaya are MPS. Therefore, on ranking the families on the basis of MedRat, the sequence of first ten large families change as follows:

Ranunculaceae (0.47) > Lamiaceae (0.35) > Polygonaceae (0.29) > Apiaceae (0.28) > Scrophulariaceae (0.23) > Gentianaceae (0.22) > Asteraceae (0.21) > Papilionaceae (0.19) > Rosaceae (0.16) > Brassicaceae (0.14). The family Asteraceae, which tops on the basis of

absolute number of MPS, comes down to the 7th position in the relative terms (Table 4).

The families Boraginaceae, Caryophyllaceae and Euphorbiaceae are represented by eight MPS each; Poaceae and Solanaceae by seven species each; Crassulaceae, Liliaceae, Plantaginaceae, Primulaceae and Saxifragaceae by six species each; Alliaceae, Berberidaceae, Fumariaceae, Geraniaceae, Iridaceae and Rubiaceae by five species each; Caprifoliaceae, Chenopodiaceae and Orchidaceae by four species each; while Urticaceae, Valerianaceae, Amaranthaceae, Araceae, Asclepiadaceae, Campanulaceae, Cupressaceae, Elaeagnaceae, Malvaceae, Moraceae, Oleaceae and Papaveraceae are represented by three species each.

Table 4: KashProp., MedProp. and MedRat. computed for the ten large families in medicinal flora of the Kashmir Himalaya

Family	MedProp (n=450)		KashProp (n=2715)		MedRat
	No.	%age	No.	%age	
Asteraceae	55	12.2	260	9.6	0.21
Ranunculaceae	33	7.3	70	2.6	0.47
Lamiaceae	31	6.9	88	3.2	0.35
Apiaceae	19	4.2	68	2.5	0.28
Scrophulariaceae	17	3.8	77	2.8	0.23
Brassicaceae	16	3.6	115	4.3	0.14
Papilionaceae	16	3.6	84	3.1	0.19
Rosaceae	16	3.6	98	3.6	0.16
Polygonaceae	15	3.3	52	1.9	0.29
Gentianaceae	11	2.4	50	1.8	0.22

The families Convolvulaceae, Dipsacaceae, Nymphaeaceae, Oxalidaceae, Rhamnaceae, Simaroubaceae and Verbenaceae are represented by two species each, while Alismataceae, Anacardiaceae, Caesalpinaceae, Cuscutaceae, Dioscoreaceae, Grossulariaceae, Hydrocharitaceae, Juglandaceae, Lentibulariaceae, Menyanthaceae, Myrsinaceae, Orobanchaceae, Platanaceae, Podophyllaceae, Polypodiaceae, Punicaceae, Santalaceae, Thymeliaceae, Aspidiaceae, Cucurbitaceae, Ephedraceae, Onagraceae, Parnassiaceae, Salicaceae, Ulmaceae, Amaryllidaceae, Araliaceae, Betulaceae, Capparidaceae, Datisceae, Ericaceae, Hippocastanaceae, Hypericaceae, Juncaceae, Linaceae, Morinaceae, Ophioglossaceae, Phytolaccaceae, Pinaceae, Plumbaginaceae, Polemoniaceae, Portulacaceae, Pteridaceae, Pyrolaceae, Rutaceae, Tamaricaceae, Vitaceae and

Zygophyllaceae are represented by single species each (see Table 2.).

CONCLUSIONS

The taxonomic information being the foundation-stone for advanced studies in every discipline of biological science (Khushoo, 1995), the present study provides broad taxonomic overview on medicinal flora of the Kashmir Himalaya. From our study, it can be concluded that about 17% of the flora of the Kashmir Himalaya has known or potential medicinal value. Most of the MPS belong to the dicotyledones; the Asteraceae having the highest number of MPS in absolute terms, while as the Ranunculaceae represent the highest number of MPS in relative terms. Such type of studies can provide vital insights in the formulation of policies for the assessment, monitoring and conservation of medicinal plant resources of the region (Moerman *et al.*, 1999; Dhar *et al.*, 2000).

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