



Ethnobotanical Exploration of Polypetalous Riparian Flora along Beas River in Himachal Pradesh Utilized by Traditional Practitioners in the Management of Hypertension

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Abstract: Polypetalous plants of Riparian vegetation along the Beas River of Himachal Pradesh were utilized to treat various diseases. Extensive fieldwork was carried out to document the traditional use of ethnomedicinal plants, and a survey was conducted from March 2024 to June 2024 to assess the significance of these plants in healthcare practices. A total of 143 informants, including 65 men and 78 women, were randomly chosen for interviews via semi-structured questionnaires. The study computed several quantitative indices: frequency citation, Jaccard index, family importance value, and relative frequency of citation. Thirty polypetalous plant species distributed among 15 different families were identified for their use in treating hypertension in Himachal Pradesh. The predominant life form documented in the study was herbs (17 species). The most typical preparation mode was powder (11 species), and plant parts were root (8 species). Among the families, Fabaceae showed the highest family importance value of 20.97, and the relative frequency of citation varied between 0.10 and 0.41 across the reported plant species. This research bridges the conventional knowledge of polypetalous plants offering a promising avenue for developing novel therapeutics for hypertension.

Keywords: Ethnobotany, Hypertension, Traditional Medicine, Polypetalous, Jaccard index

Cardiovascular conditions are significantly high in human populations, making their avoidance and management a top priority in numerous countries (Aumeeruddy and Mahomoodally 2020). In current years, the practice of therapeutic herbs for treating diseases has seen a substantial increase. High blood pressure can harm the blood vessels that supply blood to the heart, eyes, brain, and kidneys (Malik et al 2018). It plays a significant role in the growth of cardiovascular incidents, heart disease, and stroke. The mortality rate from hypertension is double as high as that of the common populace. It raises the risk of rapid death in patients with cardiovascular disease. Hypertension, described by high BP levels, is a significant risk issue for circulatory diseases, stroke, and renal complications, contributing significantly to global morbidity and mortality (Baharvand-Ahmadi and Asadi-Samani 2017). The high BP affects around 1.27 billion adults aged 29-80 worldwide (Meresa et al 2017). This condition is most prevalent in low- and middle-income countries, where two-thirds of the affected populace resides. Approximately 10 million people die each year from hypertension-related causes, making it more lethal than all infectious diseases combined (Baharvand-Ahmadi et al 2015). Efforts to manage hypertension focus on lifestyle changes such as adopting a healthier diet, decreasing salt intake, boosting physical activity, giving up smoking, and limiting alcohol consumption. For many, medication is also essential to attain optimal blood

pressure control (Diallo et al 2019). The alternative method to cure and manage hypertension is through the use of herbal remedies. These polypetalous plants are effective in treating high blood pressure and addressing various other health conditions (Ajayi et al 2019). Medicinal plants have been used for centuries in folk medicine to cure numerous ailments (Ozturk et al 2018). This ancient therapeutic medicine offers a practical and thorough approach to using herbal plants, and adhering to its principles can be advantageous in tackling public health challenges. Ethno-botanical surveys studies aimed at documenting therapeutic information and the usage of herbal plants. In modern times, pharmacology has made remarkable advances and herbal drugs are utilized alongside conventional pharmaceuticals to address a wide array of health conditions (Panmei et al 2019). Reports indicate that over 30% of modern medicines have their origins traced back to medicinal plants. Numerous herbal plants have been thoroughly researched for their medicinal properties thus far. Despite advances in conventional pharmacotherapy, many individuals worldwide rely on traditional medicinal practices, including the usage of plant-based medications, for the management of high BP (Hassaine et al 2019, Nunes et al 2015). The ethnobotanical knowledge embedded within traditional healing systems offers a rich repository of potential therapeutic agents that warrant systematic investigation and validation. Due to the widespread occurrence of hypertension globally, particularly in Himachal Pradesh, and

the pressing demand for the exploration of potent herbal remedies, this research aimed to compile information on polypetalous plants endorsed by local people in the riparian region of Beas River of Himachal Pradesh for managing hypertension.

MATERIAL AND METHODS

Research area: The research was carried out in the riparian area of the Beas River in Himachal Pradesh, India. The Beas basin originates in the Shivalik Hills of Himachal Pradesh and extends over 460 km. This area covers 12,130 square kilometers, situated between latitudes 31°41' N to 32°46' N and longitudes 75°84' E to 77°88' E.

Methodology

Ethnobotanical survey: Direct interviews with traditional healers were carried out from March 2024 to June 2024 using a semi-structured questionnaire. The structured questionnaire was administered to traditional healers across diverse geographical regions known for their rich biodiversity. Information regarding the plants' identity, preparation methods, dosage, and perceived efficacy was documented.

Collection of plants and identification: Plant specimens cited by traditional healers were collected, identified, and authenticated by botanists and taxonomists from the Himalayan Forest Research Institute (HFRI), Shimla. Voucher specimens were deposited in the herbaria of Himachal Pradesh University, Shimla.

Quantitative Analysis

Relative frequency of citation (RFC): It is determined to assess the extent of indigenous information about the usage of therapeutic herbs in the studied regions (Nadaf et al 2019):

$$REF = \frac{Fc}{N}$$

Where "Fc" represents the number of participants who mentioned using the species, whereas "N" represents the overall number of participants.

Family importance value (FIV): These values indicate the respondents' information on the plant families used. The FIV values of the therapeutic herb were measured (Nadaf et al 2019):

$$FIV = \frac{\text{No. of families cited by authors}}{\text{Total no. of authors}} \times 100$$

A high value indicates that there is extensive information and several respondents are well-known, whereas a low value suggests limited awareness about the usage of that plant family (Nadaf et al 2019).

Jaccard similarity index (JI): It is computed by assessing previous research publications across national, international, and worldwide scopes. This calculation involves determining the proportions of the mentioned plant species and their

therapeutic usage (Faruque et al 2018, Kayani et al 2015):

$$JI = \frac{c}{a+b+c}$$

In this formula, "a" symbolizes the count of plants in Area 1, "b" symbolizes the count of plants in Area 2, and "c" symbolizes the count of floras common to both Areas 1 and 2.

Statistical analysis: The Excel 2016 spreadsheet was utilized for basic calculations and to ascertain plant frequencies.

RESULTS AND DISCUSSION

Diversity of polypetalous plants: The riparian vegetation of the Beas River used 30 taxa from 15 families and 27 genera (Table 2, Fig. 3). The most participants were between the ages of 39 and 79 (Table 1). The majority of informants who are interested in traditional therapeutic information are from the older age group (Ahmed et al 2015; Kayani et al 2015; Malik et al 2018). The Fabaceae family, with 8 plants, followed by Ranunculaceae, was the most prevalent among medicinal plants (Fig. 4). Out of approximately 350,000 identified species of flowering plants, nearly 9% are part of the Fabaceae family, which can be observed in almost every type of environment across various regions (Gbekley et al 2018). However, in the research site, more Ranunculaceae and Apiaceae species were employed, as previously reported. Informants identify a variety of herbal species within the same family, each with unique medical capabilities. Another possible explanation for the high citation of Fabaceae and Ranunculaceae is their higher occurrence in high-altitude regions, as observed in previous research.

The herbs were the preferred choice among therapeutic herb species due to their high natural richness in these regions and easy accessibility to local communities. Herbs are readily available and possess potent healing capabilities, producing secondary metabolites with therapeutic properties effective

Table 1. Demographic characteristics of the respondents

Characteristics	Groups	Informants	Percentages
Gender	Male	65	45.45
	Female	78	54.54
Age	30-50	31	21.67
	51-65	46	32.16
	66-79	57	39.86
Ethnic group	Gaddi	72	50.34
	Gujjar	69	48.25
Education	Illiterate	41	28.67
	Matric	59	41.25
	Secondary school	52	36.36

Table 2. Ethnomedicinal uses of polypetalous plants

Botanical name	Local name	Family name	Habit	Parts used	Mode of preparation	Ethnobotanical uses	FC	RFC	Jaccard Index (JI)	FIV
<i>Acacia nilotica</i> (L.)	Kikar	Fabaceae/Leguminosae	Tree	Root	Infusion	One glass of root infusion is drunk after a meal to reduce high blood pressure.	26	0.18	0.53	20.97
<i>Argemone mexicana</i> L.	Kanduri, Bharbhand	Papaveraceae	Herb	Seed and Root	Powder, Infusion	1-2 grams of the dried seed powder is given with mildly heated water to reduce hypertension.	18	0.12	0.60	6.99
<i>Bauhinia variegata</i> L.	Karali	Fabaceae	Tree	Flower and Bud	Powder	The root infusion is drunk during the night to reduce high blood pressure. One teaspoon of powder of dried flowers and buds is taken with water to reduce hypertension.	33	0.23	0.57	20.97
<i>Berberis lycium</i> Royle	Kashmal	Berberidaceae	Shrub	Root	Infusion	4-5 ml of root infusion is drunk early in the morning to decrease high blood pressure.	39	0.27	0.58	6.99
<i>Berberis aristata</i> DC.	Kashmal	Berberidaceae	Shrub	Leaf and fruit	Cooked	Leaves and fruits are cooked to make an infusion and 2-3 ml is drunk two times a day to reduce high blood pressure.	22	0.15	0.55	6.99
<i>Capsella bursa pastoris</i> (L.) Medik.	Jangli sarson	Brassicaceae	Herb	Shoot	Extract	1-2 ml extract of the shoot is drunk once a day to decrease hypertension.	15	0.10	0.69	6.99
<i>Cassia fistula</i> L.	Amaltas/ Aliah	Fabaceae/Leguminosae	Tree	Bark	Powder	1-2 grams of the dried bark powder is given with water to treat hypertension.	28	0.19	0.76	20.97
<i>Cassia occidentalis</i> Linn.	Bara elwan	Caesalpiniaaceae/Leguminosae	Shrub	Seed	Infusion	2ml of the seed infusion seed is drunk after a meal to reduce hypertension.	31	0.21	0.77	6.99
<i>Cassia tora</i> L.	Reli	Caesalpiniaaceae/Leguminosae	Shrub	Seed	Powder	1-2 grams of dried seed powder is drunk with warm water to reduce high Bp.	29	0.20	0.70	6.99
<i>Centella asiatica</i> (L.) Urban	Brahmi	Apiaceae/Umbelliferae	Herb	Whole plant	Decoction	The decoction of the entire plant is drunk early in the morning to reduce high blood pressure.	24	0.16	0.63	6.99
<i>Clematis grata</i> Wall.	Dhand	Ranunculaceae	Climber	Flower	Powder	1 gram powder of the dried flower is given with mildly heated water to treat hypertension.	17	0.11	0.57	10.48
<i>Fragaria nubicola</i> Lindl.	Kida-bhumla/ Lal aakhe	Rosaceae	Herb	Fruit	Fresh	Fresh fruits are consumed to lower hypertension.	32	0.22	0.50	6.99
<i>Fumaria indica</i> (Haussk) Pugstey.	Pitpapra	Papaveraceae	Herb	Whole plant	Decoction	The decoction of the entire plant is drunk after a meal to cure high blood pressure.	21	0.14	0.64	6.99
<i>Geranium wallichianum</i> Oliv.	Laljari	Geraniaceae	Herb	Root	Decoction	3-4 ml of root decoction is utilized for the treatment of hypertension.	27	0.18	0.52	3.49
<i>Impatiens balsamina</i> L.	Tiur	Balsaminaceae	Herb	Leaf and Root	Decoction and Powder	The leaf decoction is given after a meal to cure High Blood pressure. The dried root powder is given with mildly heated water to treat hypertension.	29	0.20	0.60	3.49

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Table 2. Ethnomedicinal uses of polypetalous plants

Botanical name	Local name	Family name	Habit	Parts used	Mode of preparation	Ethnobotanical uses	FC	RFC	Jaccard Index (JI)	FIV
<i>Indigofera hamiltonii</i> Graham	Kathi	Fabaceae	Shrub	Root	Decoction	5 ml of the decoction of the root is drunk two times a week to reduce hypertension.	39	0.27	0.58	20.97
<i>Mangifera indica</i> L.	Aam	Anacardiaceae	Tree	Stem, Bark	Decoction	25–30 mL of decoctions of stem and bark are drunk twice daily to cure high blood pressure.	51	0.35	0.67	3.49
<i>Mellilotus alba</i> Medik.	Kutaik	Fabaceae	Herb	Leaf	Infusion	The infusion of the leaves is given daily to reduce high blood pressure.	30	0.20	0.57	20.97
<i>Medicago polymorpha</i> L.	Khokhani	Fabaceae	Herb	Whole plant	Powder	The powder of the entire plant is given with warm water to lower hypertension.	42	0.29	0.54	20.97
<i>Murraya koenigii</i> (L.) Spreng.	Kadipata	Rutaceae	Shrub	Leaf	Powder	Dried leaf powder is taken with lukewarm water to cure hypertension.	20	0.13	0.50	3.49
<i>Nasturtium officinale</i> W.T.Aiton	Chuch, Nadd	Brassicaceae	Herb	Shoot	Decoction	Shoots are cooked to make a decoction and taken early in the morning to decrease hypertension.	44	0.30	0.61	6.99
<i>Nigella sativa</i> L.	Kalajeera, kalonji	Ranunculaceae	Herb	Seed	Extract	3–4 ml extract of seed is utilized to reduce high blood pressure.	22	0.15	0.48	10.48
<i>Oxalis corniculata</i> L.	Malori	Oxalidaceae	Herb	Aerial part	Extract	The extract of the aerial part is utilized to reduce hypertension.	54	0.37	0.72	3.49
<i>Pimpinella acuminata</i> (Edgew.) C.B. Clarke	Tarpakhi	Apiaceae	Herb	Root	Powder	2–3 g powder of the dried root is drunk with mildly heated water to reduce hypertension.	17	0.11	0.41	6.99
<i>Ranunculus muricatus</i> L.	Jaldhar/bimbi	Ranunculaceae	Herb	Stem and Leaf	Infusion	The infusion of stem and leaves is drunk daily to decrease high blood pressure.	48	0.33	0.48	10.48
<i>Rosa brunonii</i> Lindl.	Kuje	Rosaceae	Shrub	Root	Decoction	5–6 ml decoction of the root is drunk early in the morning to reduce hypertension.	45	0.31	0.54	6.99
<i>Sida cordifolia</i> L.	Dragain	Malvaceae	Shrub	Seed	Powder	The powder of the seed is taken with lukewarm water to decrease hypertension.	32	0.22	0.55	3.49
<i>Thalictrum foliolosum</i> DC.	Barmot	Ranunculaceae	Herb	Leaf	Fresh	Fresh juice is used to treat pimples and boils.	56	0.39	0.74	10.48
<i>Trigonella emodi</i> Benth.	Kuchona	Fabaceae	Herb	Leaf	Fresh	Fresh leaves are eaten to decrease hypertension.	23	0.16	0.36	20.97
<i>Viola canescens</i> Wall.	Banfshah	Violaceae	Herb	Flower	Powder	One teaspoonful powder of dried flower is given with mildly heated water to decrease high blood pressure.	59	0.41	0.68	3.49

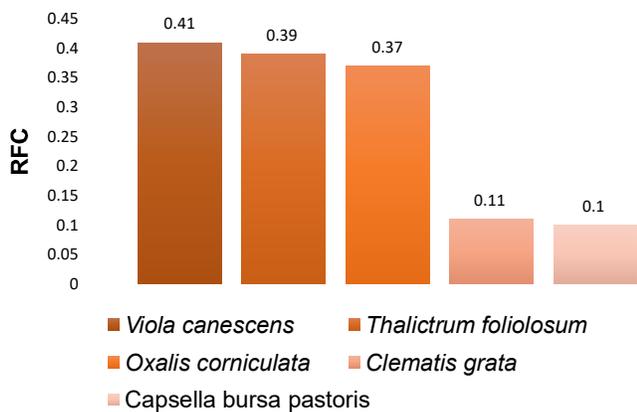


Fig. 1. RFC of polypetalous plants

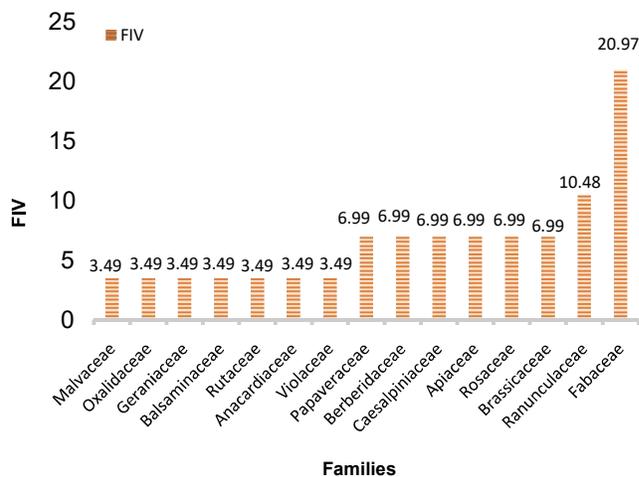


Fig. 2. FIV of polypetalous plants

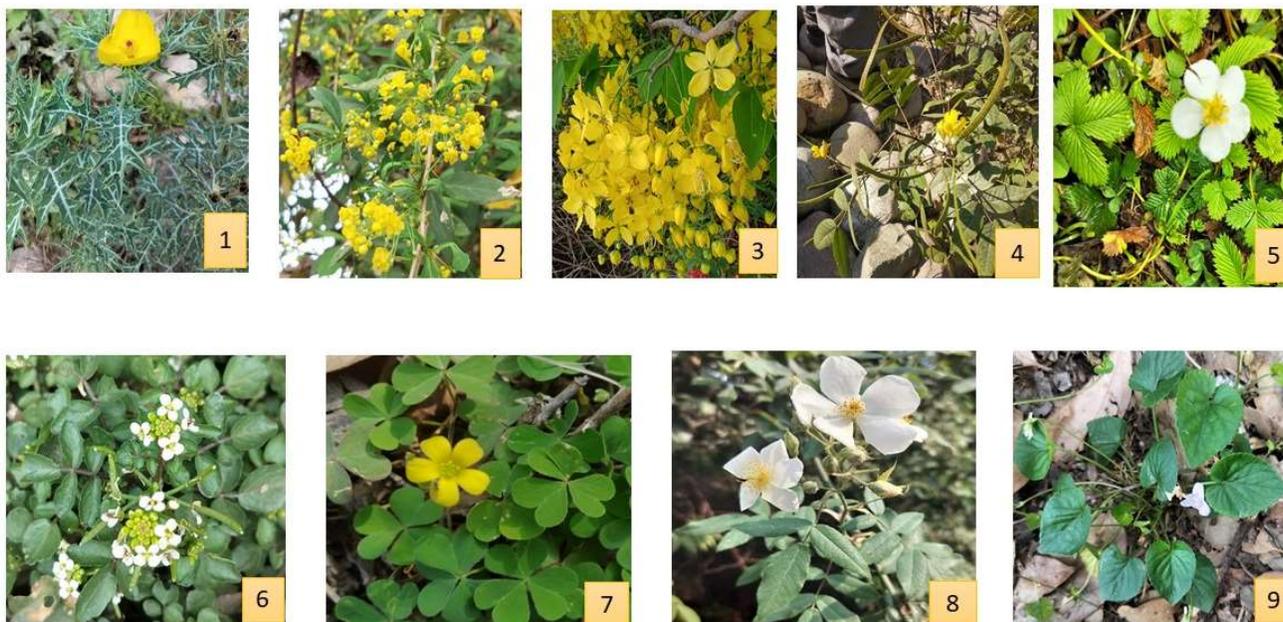


Fig. 3. Some polypetalous plants 1. *Argemone mexicana* 2. *Berberis lycium* 3. *Cassia fistula* 4. *Cassia occidentalis* 5. *Fragaria nubicola* 6. *Nasturtium officinale* 7. *Oxalis corniculata* 8. *Rosa brunonii* 9. *Viola canescens*

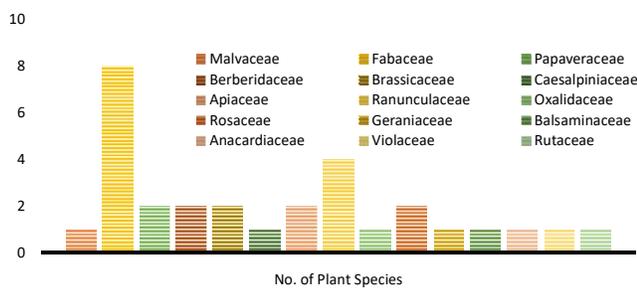


Fig. 4. Families of polypetalous plants

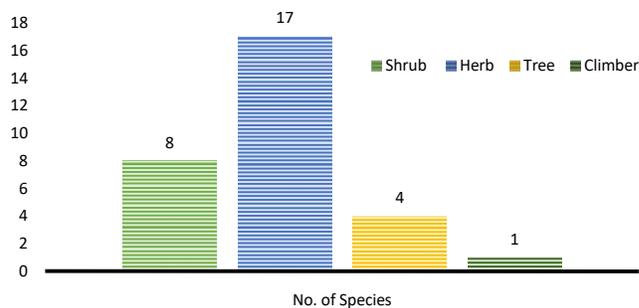


Fig. 5. Habit of polypetalous plants

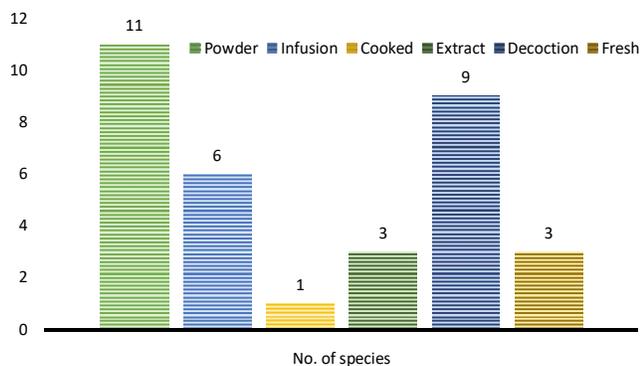


Fig. 6. Mode of preparations

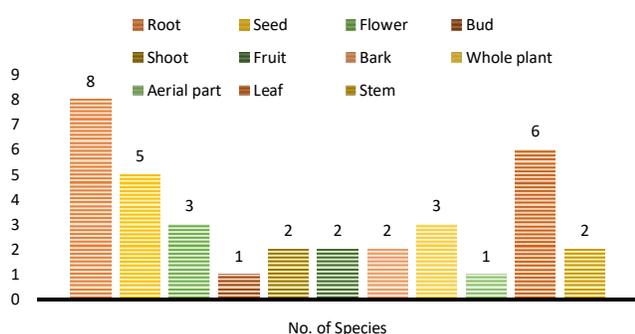


Fig. 7. Plant parts of polypetalous plants

against numerous ailments (Yaseen et al 2015). This research focused mainly on the use of roots as the main parts of the plant for medicinal purposes. When comparing our results with previous studies, significant variations were observed in terms of the Jaccard Index (JI). The JI ranged from 0.41 to 0.77. In RFC, *Viola canescens*, *Thalictrum foliolosum*, and *Oxalis corniculata* were identified as the most significant plants. This study highlights numerous medicinal plant species that exhibit pharmacological activity but remain largely unexplored, emphasizing the need for further research.

Plant parts used: Different plant parts used in preparing herbal remedies include roots, stems, leaves, flowers, seeds, fruits, bark, aerial parts, and whole plants, especially when dealing with small herbal plants. Root was the most commonly used part (8), followed by leaf (6 each), flower, and whole plant (3 each), shoot, fruit, bark, and stem (2 species each), and bud, and aerial parts (only 1 species) (Fig. 7). Herbs constituted the main source of native medicines (17), followed by shrubs (8), trees (4), and climbers (1) (Fig. 5).

Mode of preparation: Herbal preparations were created using various methods such as infusion, powder, decoction, extract, and cooking. The most common usage method was powder (11), followed by decoction, infusion, extract, fresh, and cooked (Fig. 6). Local communities used varied quantities of herbal concoctions to cure a variety of illnesses.

Quantitative Analysis

Relative frequency of citation (RFC): *Viola canescens* had the maximum RFC value (0.41), followed by *Thalictrum foliolosum*, *Oxalis corniculata*, and *Clematis grata* (0.11) had the lowest RFC (Fig. 1).

Family importance value (FIV): Fabaceae was the most prevalent medicinal plant family in terms of both species and FIV index, with 8 species and an FVI of 20.97%. This was followed by Ranunculaceae (10.48%), and Apiaceae, Papaveraceae, Caesalpiniaceae, Berberidaceae, Brassicaceae, and Rosaceae (6.99%). The remaining families have fewer species such as Anacardiaceae, Geraniaceae, Balsaminaceae, Rutaceae, Malvaceae, Oxalidaceae, and Violaceae each containing one species with an FIV of 3.49% (Fig. 2).

CONCLUSION

The ethnobotanical survey presented herein provides a valuable understanding of the use of polypetalous herbs by tribal people to treat hypertension. The total of 143 informants, including 65 men and 78 women, were randomly chosen for interviews via semi-structured questionnaires. A total of 30 polypetalous plant species distributed among 15 different families were identified for their use in treating hypertension in Himachal Pradesh. The predominant was herbs. The most typical preparation mode was powder and plant parts were root. Among the families, Fabaceae showed the highest family importance value. RFC. These findings offer a foundation for further research aimed at connecting the healing potential of therapeutic herbs in the growth of harmless and effective treatment for hypertension.

REFERENCES

- Ahmed N, Mahmood A, Ashraf A, Bano A, Tahir SS and Mahmood A 2015. Ethnopharmacological relevance of indigenous medicinal plants from district Bahawalnagar, Punjab, Pakistan. *Journal of Ethnopharmacology* **175**: 109-123.
- Ajayi TO, Moody JO and Anthony CS 2019. Ethnobotanical survey of plants used in the management of hypertension in Ibadan North Local Government Area of Oyo State, Nigeria. *Nigerian Journal of Pharmaceutical Research* **15**(1): 61-73.
- Aumeeruddy MZ and Mahomoodally MF 2020. Traditional herbal therapies for hypertension: A systematic review of global ethnobotanical field studies. *South African Journal of Botany* **135**: 451-464.
- Baharvand-Ahmadi B and Asadi-Samani M 2017. A mini-review on the most important effective medicinal plants to treat hypertension in ethnobotanical evidence of Iran. *Journal of Nephro Pharmacology* **6**(1): 3-12.
- Baharvand-Ahmadi B, Bahmani M, Eftekhari Z, Jelodari M and Mirhoseini M 2015. Overview of medicinal plants used for cardiovascular system disorders and diseases in ethnobotany of different areas in Iran. *Journal of HerbMed Pharmacology* **5**(1): 39-44.
- Diallo MST, Traore MS, Balde MA, Camara AK, Baldé ES, Traore S and Balde AM 2019. Prevalence, management and

- ethnobotanical investigation of hypertension in two Guinean urban districts. *Journal of Ethnopharmacology* **231**: 73-79.
- Faruque MO, Uddin SB, Barlow JW, Hu S, Dong S, Cai Q and Hu X 2018. Quantitative ethnobotany of medicinal plants used by indigenous communities in the Bandarban District of Bangladesh. *Frontiers in pharmacology* **9**: 40.
- Gbekley HE, Karou SD, Katawa G, Tchacondo T, Batawila K, Ameyapoh Y and Simpore J 2018. Ethnobotanical survey of medicinal plants used in the management of hypertension in the maritime region of Togo. *African Journal of Traditional, Complementary and Alternative Medicines* **15**(1): 85-97.
- Hassaïne S, Saïdi A and Belhadj O A 2019. Ethnobotanical study of medicinal plants used in the treatment of high blood pressure in the region of Tlemcen (Northwestern Algeria). *Journal of Pharmacy & Pharmacognosy Research* **7**(1): 1-11.
- Kayani S, Ahmad M, Sultana S, Shinwari ZK, Zafar M, Yaseen G and Bibi T 2015. Ethnobotany of medicinal plants among the communities of Alpine and Sub-alpine regions of Pakistan. *Journal of Ethnopharmacology* **164**: 186-202.
- Malik K, Ahmad M, Bussmann RW, Tariq A, Ullah R, Alqahtani AS and Shah SN 2018. Ethnobotany of anti-hypertensive plants used in northern Pakistan. *Frontiers in Pharmacology* **9**: 789.
- Meresa A, Fekadu N, Degu S, Tadele A and Geleta B 2017. An ethnobotanical review on medicinal plants used for the management of hypertension. *Journal of Clinical and Experimental Pharmacology* **7**(2): 1-16.
- Nadaf M, Joharchi M and Amiri MS 2019. Ethnomedicinal uses of plants for treating nervous disorders at the herbal markets of Bojnord, North Khorasan Province, Iran. *Avicenna Journal of Phytomedicine* **9**(2): 153.
- Nunes MGS, Bernardino A and Martins RD 2015. Use of medicinal plants by people with hypertension. *Northeast Network Nursing Journal* **16**(6): 775-781.
- Ozturk M, Altay V, Latiff A, Shareef S, Shaheen F and Iqbal Choudhry M 2018. Potential medicinal plants used in hypertension in Turkey, Pakistan, and Malaysia. *Plant and Human Health, Volume 1: Ethnobotany and Physiology* 595-618.
- Panmei R, Gajurel PR and Singh B 2019. Ethnobotany of medicinal plants used by the Zeliangrong ethnic group of Manipur, northeast India. *Journal of Ethnopharmacology* **235**: 164-182.
- Yaseen G, Ahmad M, Sultana S, Alharrasi AS, Hussain J and Zafar M 2015. Ethnobotany of medicinal plants in the Thar Desert (Sindh) of Pakistan. *Journal of Ethnopharmacology* **163**: 43-59.

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