



Research Article

Qualitative and quantitative ethnobotanical analysis of *Gymnanthemum amygdalinum* (Delile) Sch. Bip. (Asteraceae) - A new report from the foothills of Kumaun Himalaya, Uttarakhand

Sneh Lata, Sheetal Sharma*

Department of Botany, R.H. Govt. P.G. College, Kashipur, U.S. Nagar, Uttarakhand, India.

Abstract

Gymnanthemum amygdalinum (Delile) Sch. Bip., formerly known as *Vernonia amygdalina* Delile, is an exotic tree species belonging to the tribe Vernonieae within the family Asteraceae. The present study was carried out with an aim to document its qualitative and quantitative ethnobotanical studies in Kumaun Himalayan foothills. The plant was collected from various localities of the study area, and the species was identified as a new addition to the flora of the study area as well as Uttarakhand. Ethnobotanical information about the plant was gathered through interviews with tribal and local people from the study area.

The qualitative and quantitative methods in ethnobotany ensure the authenticity of research. As qualitative study involves non numerical data, the plant has been noted for its utility in treating various diseases, including diabetes, wounds, bone fractures, arthritis, and jaundice, as well as for other purposes. Quantitative studies on the other hand, rely on numerical data collected and analyzed using standard formulas. Leaf (PPV 0.346) was found to be the most commonly used part of the plant followed by the twig (PPV 0.269), the whole plant (PPV 0.230), and both the stem and petiole (PPV 0.076 each). The fidelity level (FL) was calculated for different disease categories, with the highest value observed for diabetes (35%) and the lowest for arthritis (5%). The present qualitative and quantitative analysis will be helpful for further phytochemical study and other related fields.

Keywords: Asteraceae, Ethnobotany, *Gymnanthemum amygdalinum*, Uttarakhand, Vernonieae.

Introduction

Gymnanthemum amygdalinum (Delile) Sch. Bip., also known by its synonym *Vernonia amygdalina* Delile and commonly referred to as 'bitter leaf,' belongs to the Vernonieae tribe within the Asteraceae family. The Asteraceae family has a cosmopolitan distribution, inhabiting all regions of the earth except the poles and thriving in all climate zones, predominantly in temperate and subtropical areas (Heydarova, 2020). Members of the Asteraceae family are generally highly adaptive and capable of surviving in diverse ecological environments, though some species struggle to coexist with other vegetation due to low genetic diversity (Rana *et al.*, 2004). The Vernonieae tribe comprises 70 genera and 1,500 species, most of which feature uniformly discoid flower heads with white, blue, violet, or red florets, with a few exceptions among African taxa (Bremer, 1987). The tribe is easily recognizable by its homogeneous head composed of tubular florets and often recurved style branches (Siniscalchi *et al.*, 2019). Vernonieae, also referred to as the 'Evil tribe,'

is distributed across both the New and Old Worlds, including islands (Keeley *et al.*, 2021).

G. amygdalinum is an exotic small tree species primarily found in seasonally dry tropical biomes. It is native to regions ranging from Eastern Bolivia to Brazil, Tropical Africa, and Western Yemen (POWO, 2024), and is mainly cultivated for its medicinal properties. Due to its bitter taste, *G. amygdalinum* is commonly known as 'bitter leaf' and is used to treat various ailments, including liver disease, gastrointestinal tract disorders, bacterial infections, fertility issues, kidney problems, helminthic infections, diabetes, malaria, and nausea (Farombi & Owioye, 2011). This species has been reported as new addition to the flora in various regions of India, such as central and eastern India (Bhattacharjee *et al.*, 2013), Peninsular India (Swamy *et al.*, 2015), South India (Manikandan *et al.*, 2019), Andman Nicobar (Das & Sivaperuman, 2020), Uttar Pradesh (Gupta *et al.*, 2023). This tree species has attracted various researchers to study its different aspects. Its medicinal uses have been

Received: 14th November, 2024

Accepted: 16th December, 2024

© CSIR-Central Institute of Medicinal and Aromatic Plants, (CSIR-CIMAP), Lucknow, India.

*Corresponding author; Email: sharmasheetal9211@gmail.com

reviewed by (Danladi *et al.*, 2018; Degu *et al.*, 2024; Frombi & Owioye, 2011; Ijeh & Ejike, 2011; Oyeyemi *et al.*, 2018; Yeap *et al.*, 2010). Devrari *et al.* (2022) have reported this plant in preparing herbal medicine for the management of Covid-19. Its ethnobotanical investigation has been conducted by Kumar and Verma (2011) in Bihar. The current study explores the qualitative and quantitative ethnobotanical aspects of *G. amygdalinum* (Delile) Sch. Bip. - a new addition to the flora in Uttarakhand. It also highlights its well-known and lesser-known uses among the local and tribal people of Uttarakhand.

Materials and Methods

Study area

Uttarakhand is a mountainous state which is divided into two administrative divisions, i.e., Garhwal and Kuamun. The present study was conducted in the Tarai and Bhabar regions of the Kumaun Himalaya which lies in the foothills of Uttarakhand. The climate of the study area is mainly subtropical (Uniyal *et al.*, 2007). These regions are inhabited by two tribal communities, namely the Tharu and Buksa, who heavily rely on plant resources for their daily needs. The Buksa tribe resides predominantly in the western part of Udham Singh Nagar district lying in the foothills of Kumaun himalaya while the Tharu tribe is concentrated in the eastern part of Udham Singh Nagar and also in the southern part of Champawat district.

Plant collection and herbarium preparation

The study area was thoroughly explored across all seasons, and photographs of plant species were taken at various locations. Plant specimens collected from diverse sites were identified with the help of scattered papers (Bhattacharjee *et al.*, 2013; Das & Sivaperuman, 2020; Gupta *et al.*, 2023; Swamy *et al.*, 2015) and efloras (POWO; eFlora of India). A total of 50 informants were interviewed for ethnobotanical study. Out of these, only 20 participants provided information about this plant. Demographic details such as gender, age, and occupation were recorded for these 20 informants. Among them, 06 were male and 14 were female. The informants' ages were categorized into four groups, i.e., up to 25 years, 26 to 40 years, 41 to 55 years, and 56 years and above. Informants were interviewed using a semi-structured questionnaire to gather detailed information on ethnobotanical uses of each plant part. Plant specimens were processed and poisoned for preparing herbarium specimens (Jain & Rao, 1977) and finally deposited in the Herbarium of the Taxonomic Laboratory, Department of Botany, R. H. Government Post Graduate College, Kashipur, Udham Singh Nagar, Uttarakhand (Figures 1 A-E & 2).

Data analysis

Qualitative analysis pertains to the examination of theoretical and obscure information, focusing on



Figure 1: A-E: *G. amygdalinum* (Delile) Sch. Bip., A- Collection of plant specimens, B- Floral head, C- Twig of plant, D- Interview with tribal community, E- Herbarium preparation

non-numerical data. This includes details about field characters of plants, uses for various purposes, methods of utilization, modes of administration, etc. Quantitative analysis, on the other hand, deals with numerical data and its interpretation using mathematical approaches. The different parts of *G. amygdalinum* are highly significant for various purposes such as ethnomedicine, fuel, and ornamental uses. For quantitative analysis, the collected numerical data was analyzed, and plant part value (PPV) and fidelity level (FL) were calculated using standard formulas.

Plant part value

PPV represents the comparative value of each plant part relative to others. This concept is expressed through formula as used by Hoffman and Gallaher (2007) and Rani and Sood (2020).

$$PPV = RUPP/RU$$

Where,

PPV = Plant part value

RUPP= Total number of reported uses for given plant part.

RU=Total reported uses of a given plant species.

Fidelity level

Fidelity refers to the percentage of informants who mentioned the use of a plant species for treating a specific



Figure 2: Herbarium specimen of *G. amygdalinum* (Delile) Sch. Bip.

disease in a particular area. This can be calculated using the following formula provided by Hoffman and Gallaher (2007) and Thakur *et al.* (2020).

$$FL (\%) = Ip/Iu \times 100$$

Where,

I_p = Number of informants who used plant species for particular category.

I_u = Total number of informants who used particular plant species for any category.

Results and Discussion

In the study area, *G. amygdalinum* (Delile) Sch. Bip is utilized for multiple purposes including fuel, fencing, ornamentation, and medicinal uses such as treating arthritis, bone fractures, wound healing, jaundice, and diabetes, etc. Table 1 represents specific details of the plant such as classification, botanical name, synonyms, family and tribe, local name, collection number, accession number, habit and habitat, flowering and fruiting patterns, description, parts used, ethnobotanical uses, etc. For ethnobotanical studies, interviews were conducted to record the utility of the plant for various purposes. Table 2 shows the demographic details of the informants. Among 20 informants, 06 were male and 14 were female.

The maximum informants (40%) belonged to 26 to 40 years age category.

For quantitative analysis, numerical data were collected through surveys conducted among tribal as well as local communities and analyzed using standard formulas. The PPV analysis highlights the significance of specific plant parts while FL indicates the disease categories for which the plant is most commonly recommended. Figure 3 shows that the highest PPV is 0.346 attributed to leaves, followed by twigs (0.269) and whole plants (0.230), while the lowest PPV values were observed for petioles and stems (both 0.076). This analysis demonstrates that leaves are the most valuable plant part compared to others. The highest FL recorded was 35% for diabetes, followed by 30% for bone fractures, and 10% each for wound healing and jaundice, with the lowest FL observed for arthritis at 5%. Figure 4 illustrates the FL values for various disease categories. These FL values indicate that *G. amygdalinum* is predominantly recognized for its effectiveness in treating diabetes (hyperglycemia). Similarly, in Bihar, Kumar and Verma (2011) have also reported the use of leaves for managing blood sugar levels in diabetes. They also found the leaves as a vital component for curing several other diseases including malaria, constipation, fever, cough, hepatic and liver disorders. This plant exhibits a wide range of pharmaceutical properties such as antibiotic/antimicrobial, antitumor, antioxidant, antidiabetic, hepatoprotective, nephroprotective, oxytocic, and serum lipid modulation properties, as well as pesticidal attributes (Ijeh & Ejike, 2011).

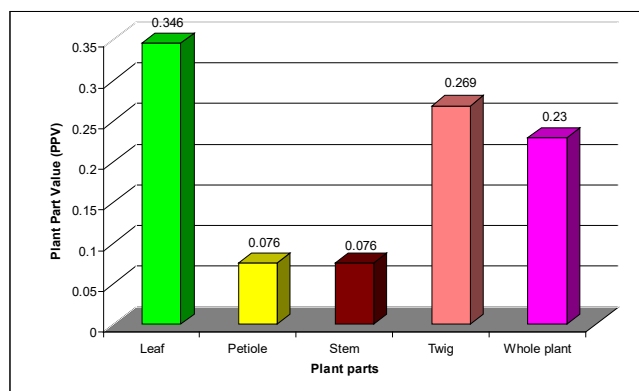


Figure 3: PPV for each plant part

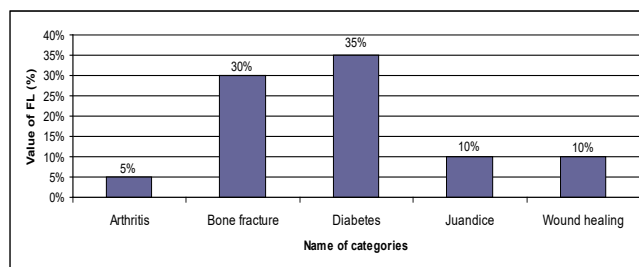


Figure 4: Value of FL for different disease categories

Table 1: Specific information on *G. amygdalinum* (Delile) Sch. Bip.

Classification	Kingdom – Plantae Phylum – Tracheophyta Class – Equisetopsida Subclass – Magnoliidae Order - Asterales Family - Asteraceae Genus – <i>Gymnanthemum</i> Species – <i>amygdalinum</i>
Botanical name	<i>G. amygdalinum</i> (Delile) Sch. Bip. Syn. <i>Vernonia amygdalina</i> Delile
Family and tribe	Asteraceae - Vernonieae
Local name	Safeda, sugar patta
Collection number	374, 340
Accession number	405, 382
Habit & habitat	Small tree, cultivated, along roadside,
Flowering and fruiting	December-March
Description	Tree up to 10–12 ft tall, branched. Stem solid, cylindrical, very fine short hair present on upper portion of stem, lower stem glabrous. Leaves ovate, entire, acute. Head 1.2 cm long and 0.75 cm in diameter, involucre bracts 3 seriate, corolla tube milky white 0.8 cm, 5 connate; Pappus milky white 0.6 cm long bristle like, style 1-cm bifid. Cypsela ciliated, 0.3 cm long and 0.15 cm in width.
Parts used	Leaf, stem, twig, petiole, whole plant.
Ethnobotanical uses	Two fresh leaves are chewed orally twice a day to cure diabetes. Two fresh leaves may be crushed with about one small cup of water and its filtrate is taken orally to control high sugar. Twigs with leaves and flowers are crushed to prepare paste which is applied externally on affected joints to cure arthritis and bone fracture. Garland of petiole is worn by patients to cure jaundice. Whole plant is cultivated for ornamental purposes and also for fencing boundaries. Dry stems are used as fuel to create fire for various purposes.

After critical literature consultation, it is recorded that *G. amygdalinum* (Delile) Sch. Bip.- a distinctive tree species of family Asteraceae, had not been previously reported in prominent taxonomic literature of Uttarakhand (Agarwal, 2017; Babu, 1977; Gaur, 1999; Gupta, 1968; Pande *et al.*, 2006; Pant, 1986; Rana *et al.*, 2003; Uniyal *et al.*, 2007). Consequently, this species represents a new addition to flora of Uttarakhand. Qualitative and quantitative analysis of ethnobotanical data of this newly identified tree species in Uttarakhand will be helpful for further phytochemical study and its commercial utilization. This plant species has adapted well to the climatic conditions of the study area and can be cultivated in the kitchen or herbal gardens as a magical medicinal tree. The climatic conditions of the study area are primarily subtropical, making it suitable for the introduction of this plant. The species can grow in all types of soil, though humus-rich soil is optimal (Oyeyemi *et al.*, 2018). As this exotic species has been reported for the first time in Uttarakhand, tribal and local communities play a crucial role in its conservation by actively cultivating this plant in their gardens for various purposes.

Table 2: Age, gender and occupation distribution of informants

Variables	Categories	Number of informants	Percentage
Gender	Male	04	20
	Female	16	80
Age groups (in years)	Up to 25	03	15
	26–40	08	40
	41–55	07	35
	56 above	02	10
Occupation	Agriculture	05	25
	Animal husbandry	02	10
	House worker	06	30
	Labor	02	10
	Folk healer	01	05
	Students	02	10
	Private job	01	05
	Business	01	05

Conclusion

The present paper reports the inclusion of *G. amygdalinum* (Asteraceae) as a new addition to the flora of Uttarakhand and explores its ethnobotanical uses. Family Asteraceae is predominantly recognized for herbaceous plants but *G. amygdalinum* is a tree species collected from the study area. Traditionally, tribal and local communities cultivate this plant species, for various purposes, with a primary focus on treating diabetes. This research is valuable for further phytochemical analysis and developing herbal products in the near future.

Author Contributions

The paper includes equal contribution of both authors in data collection, analysis and manuscript preparation.

Conflict of Interest

Authors have no conflict of interest.

Acknowledgments

The Authors extend their heartfelt gratitude to the Principal R.H. Govt. P.G. College Kashipur, Udham Singh Nagar, Uttarakhand for providing necessary facilities. They are also thankful to tribal communities and local people of the study area for sharing their valuable knowledge and kind cooperation.

References

- Agarwal, S. K. (2017). *Flora of Jaunsar Bawar* (Chakrata Hills, Western Himalaya): with Ethnobotanical Notes. Bishen Singh & Mahendra Pal Singh Dehradun, India.
- Babu, C. R. (1977). *Herbaceous Flora of Dehra Dun*. Council of Scientific & Industrial Research, New Delhi.
- Bhattacharjee, B., Lakshminarasimhan, P., Bhattacharjee, A., Agrawala, D. K., & Pathak, M. K. (2013). *Vernonia amygdalina* Delile (Asteraceae)- An African medicinal plant introduced in India. *Zoo's print*, XXVIII (5), 18-20.
- Bremer, K. (1987). Tribal Interrelationships of the Asteraceae. *Cladistics*, 3(3), 210-253. <https://pubmed.ncbi.nlm.nih.gov/34949040>
- Danladi, S., Hassan, M. A., Masaud, I. A., & Ibrahim, U. I. (2018). *Vernonia amygdalina* Del: A Mini Review. *Research Journal of Pharmacy and Technology*, 11(9), 4187-4190. <https://doi.org/10.5958/0974-360x.2018.00768.0>
- Das, A. K., & Sivaperuman, C. (2020). *Gymnanthemum amygdalina* (Delile) Sch. Bip. ex Walp (Asteraceae)-A new report to the flora of Andman and Nicobar Islands, India. *Bioscience Discovery*, 11(3), 133-136.
- Degu, S., Meresa, A., Animaw, Z., Jegnie, M., Asfaw, A., & Tegegn, G. (2024). *Vernonia amygdalina*: a comprehensive review of the nutritional makeup, traditional medicinal use, and pharmacology of isolated phytochemicals and compounds. *Frontiers in Natural Products*, 3.1347855. <https://doi.org/10.3389/fntpr.2024.1347855>
- Devrari, A., Saini, R., & Patil, S. M. (2022). Herbal Medicine used for the management of Covid-19. *Journal of Emerging Technologies and Innovative Research*, 9(4), g653-g664.
- eFlora of India- <https://efloraofindia.com> /(Accessed 1/03/2024)
- Frombi, E. O., & Owioye, O. (2011). Antioxidative and Chemopreventive properties of *Vernonia amygdalina* and *Garcinia biflavonoid*. *International Journal of Environmental Research and Public Health*, 8, 2533-2555. <https://doi.org/10.3390/ijerph8062533>
- Gaur, R. D. (1999). *Flora of the District Garhwal, North West Himalaya* (with Ethnobotanical notes). Trans Media Srinagar, Garhwal.
- Gupta, P., Madhukar, V. K., & Shekhar, S. (2023). *Gymnanthemum amygdalinum*: an addition to the Asteraceous flora of Uttar Pradesh, India. *Indian Journal of Forestry*, 46(2), 115-117. <https://doi.org/10.54207/bmsps1000-2023-FN6T91>
- Gupta, R. K. (1968). *Flora Nainitalensis*. Navayug Traders, New Delhi.
- Heydarova, A. (2020). Taxonomic composition and Life forms of the family Asteraceae spreading in Daridagh Massif Area. *Bulletin of Science and Practice*, 68-72. <https://doi.org/10.33619/2414-2948/55>
- Hoffman, B., & Gallaher, T. (2007). Importance Indices in Ethnobotany. *Ethnobotany Research & Application*, 5, 201-218.
- Ijeh II, & Ejike, C. E. C. C. (2011). Current perspectives on the medicinal potentials of *Vernonia amygdalina* Del. *Journal of Medicinal Plant Research*, 5(7), 1051-1061.
- Jain, S. K. & Rao, R. R. (1977). *A Handbook of Field and Herbarium Methods*. Today and Tomorrow's Printers and Publishers New Delhi.
- Keeley, S. C., Cantley, J. T., & Gallaher, T. J. (2021). The "evil tribe" spreads across the land: A dated molecular phylogeny provides insight into dispersal, expansion, and biogeographic relationships within one of the largest tribes of the sunflower family (Vernonieae: Compositae). *American Journal of Botany*, 108(3), 505-519. <https://doi.org/10.1002/ajb2.1614>
- Kumar, S., & Verma, S. K. (2011). Ethnobotanical investigations on *Vernonia amygdalina* (Asteraceae) in Bihar. *Ethnobotany*, 23, 135-137.
- Manikandan, R., Murugan, C. & Nithya, S. P. (2019). Introduction and proliferation of *Gymnanthemum amygdalinum* (Delile) Sch.- Bip. in South India. *ENVIS Newsletter*, 24(2), 9-10.
- Oyeyemi, I. T., Akinlabi, A. A., Adewumi, A., Aleshinloye, A. O., & Oyeyemi, O. T. (2018). *Vernonia amygdalina*: A folkloric herb with anthelmintic properties. *Beni-Suef University Journal of Basic and Applied Sciences*, 7(1), 43-49.
- Pande, P. C., Tiwari, L., Pande, H. C. (2006). *Folk- Medicine and Aromatic Plants of Uttaranchal*. Bishen Singh

- Mahendra Pal Singh, Dehradun.
- Pant, P. C. (1986). *Flora of Corbett National Park*. Botanical Survey of India, Howrah.
- POWO- Plants of the World online <https://powo.science.kew.org/> (Accessed 1/03/2024)
- Rana, T. S., Datt, J. B., & Rao, R. R. (2003). *Flora of Tons Valley Garhwal Himalaya (Uttaranchal)*. Bishen Singh Mahendra Pal Singh Dehradun.
- Rana, T. S., Datt, B., Saklani, A., & Rao, R. R. (2004). Endemic and Endangered taxa of Compositae in Western Himalaya, India. *Journal of Economic and Taxonomic Botany*, 28(1), 25-30.
- Rani, P., & Sood, N. (2020). Qualitative and quantitative Ethnobotanical Analysis of *Ricinus communis* L. and *Azadirachta indica* A. Juss in Sonapat District of Haryana India. *Journal of Natural Remedies*, 2. <https://doi.org/10.18311/jnr/2021/25708>
- Siniscalchi, C. M., Loeville, B., Funk, V. A., Mandel, J. R., & Pirani, J. R. (2019). Phylogenomics yields New Insight In to Relationships with Vernonieae (Asteraceae). *Frontiers in Plant Science*, 10, 1224. <https://doi.org/10.3389/fpls.2019.01224>
- Swamy, J., Prabhakar, G., Rasingam, L., & Kamalakar, P. (2015). *Gymnanthemum amygdalinum* (Asteraceae) A New Addition to the flora of Peninsular India. *International Journal of Advanced Research in Science and Technology*, 4(7), 449-451. <https://doi.org/10.62226/ijarst20150755>
- Thakur, S., Tashi, N., Singh, B., Dutt, H. C., & Singh, B. (2020). Ethnobotanical plants used for gastrointestinal ailments by the inhabitants of Kishtwar plateau in Northwestern Himalaya, India. *Indian Journal of Traditional Knowledge*, 19(2), 288-298.
- Uniyal, B. P., Sharma, J. R., Choudhery, U., & Singh, D. K. (2007). *Flowering Plants of Uttarakhand (A Checklist)*. Bishen Singh Mahendra Pal Singh, Dehradun.
- Yeap, S. K., Ho Wan Y., Beh B. K., Liang, W. S., Ky Huynh, Yousr, H. A. N, & Alitheen, N. B. (2010). *Vernonia amygdalina* an ethnoveterinary and ethnomedical used green vegetables with multiple bio-actives. *Journal of Medicinal Plants Research*, 4(25), 2787-2812.