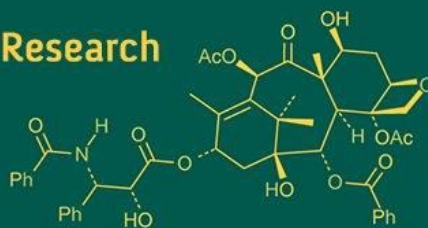


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Floral diversity of bee Propolis sources in the Jammu region (Jammu & Kashmir, India)

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Abstract

Propolis is a biologically active resinous substance produced by honeybees (*Apis mellifera*) from plant-derived exudates, and its composition is largely influenced by local floral diversity. The present study investigates the distribution of plant species associated with bee propolis sources across eight locations in the Jammu region (Jammu & Kashmir, India), covering an altitudinal range of approximately 300-1100 m. Propolis samples were collected from multiple apiaries, and the surrounding vegetation was documented based on field observations and supporting literature. The results revealed a clear variation in floral diversity along altitudinal and climatic gradients. Subtropical regions such as Jammu, Samba, and Kathua exhibited higher species diversity dominated by *Acacia*, *Mangifera*, *Azadirachta*, and *Terminalia* species. In contrast, mid-to high-altitude regions including Udhampur, Reasi, Ramban, Doda, and Poonch were characterized by mixed and coniferous vegetation, with dominance of *Pinus*, *Cedrus*, *Picea*, *Populus*, and *Salix* species. These plant groups are known to produce gums, resins, and bioactive compounds such as phenolics, flavonoids, and terpenoids, which contribute to the chemical and biological properties of propolis. The study highlights a strong relationship between floral composition and potential propolis quality, indicating that regional vegetation plays a crucial role in determining its variability and therapeutic value. The findings emphasize the importance of conserving native plant diversity and promoting sustainable vegetation management to support beekeeping and enhance propolis production in the Jammu region.

Keywords: Propolis, floral diversity, plants, altitudinal variation, Jammu region, *Apis mellifera*

1. Introduction

Propolis, often known as “bee glue,” is a natural resinous substance produced by honeybees through the collection of plant materials such as buds, bark exudates, and resins. These materials are mixed with beeswax and enzymatic secretions to form a protective compound that plays an essential role in maintaining hive sanitation and defending colonies against microbial infections (Wagh, 2013) ^[1]. The composition of propolis is highly variable and complex, typically comprising approximately 50% plant resins, 30% waxes, 10% essential oils, 5% pollen, and 5% other organic constituents. It contains a wide range of bioactive compounds, including flavonoids, phenolic acids, and terpenoids, which are largely responsible for its diverse biological and pharmacological properties (Wagh, 2013) ^[1]. The chemical profile of propolis is strongly influenced by its botanical origin. Honeybees selectively collect resins from specific plant species such as *Populus*, *Salix*, *Betula*, *Acacia*, and *Pinus*, depending on their availability and environmental conditions (Tran *et al.*, 2022) ^[2]. These plant-derived compounds contribute significantly to the antimicrobial, antioxidant, anti-inflammatory, and anticancer potential of propolis.

India's wide range of agro-climatic conditions, extending from tropical to temperate regions, supports a rich diversity of flora that is highly favourable for beekeeping. The presence of diverse plant species enhances both the productivity of honeybees and the quality of hive products, including propolis (Thomas *et al.*, 2002) ^[3]. The Jammu region of Jammu & Kashmir represents an ecologically diverse transition zone, characterized by vegetation ranging from subtropical forests to temperate coniferous ecosystems. Previous ethnobotanical investigations have documented several important resin- and gum-producing plant species in this region, including *Acacia nilotica*, *Boswellia serrata*, *Pinus roxburghii*, and *Terminalia* species, many of which are traditionally valued for their medicinal properties (Kaur *et al.*, 2023) ^[4].

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Despite the high floral diversity of this region, there is limited systematic information linking plant diversity with propolis sources. Therefore, the present study aims to evaluate the distribution of resin-and gum-yielding flora across different locations in the Jammu region and to assess their role in propolis production.

2. Materials and Methods

2.1 Study Area

Propolis samples were collected from apiaries located in different regions of the Jammu division *viz.* Jammu, Kathua, Ramban, Samba, Doda, Poonch, Reasi and Udhampur (Figure 1).

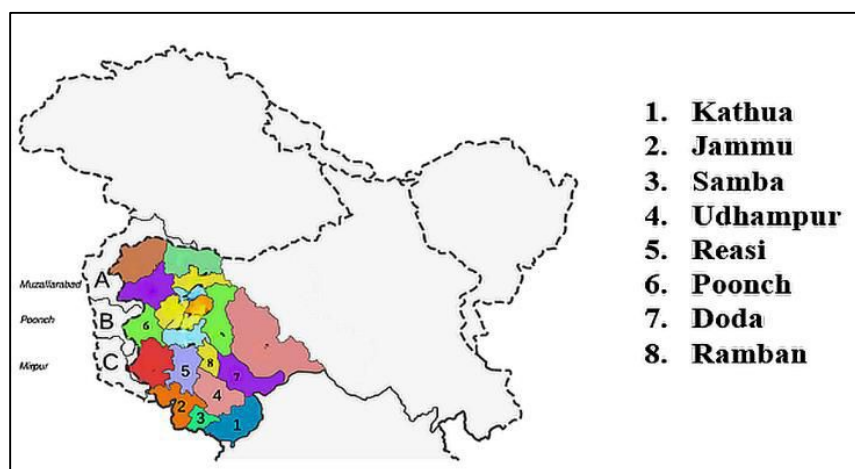


Fig 1: Propolis sampling sites in Jammu division districts.

2.2 Sample Collection

Five propolis samples were collected from apiaries at each location using sterile tools. Samples were stored in airtight containers and maintained at 4 °C in dark conditions until analysis.

2.3 Floral Source Identification

The local floral sources contributing to propolis production were identified with the help of local beekeepers and confirmed using published literature are presented in Table 1.

2.4 Data Recording

Site details including coordinates, altitude, climate and vegetation were recorded. Data were analysed to assess variation in floral diversity across locations.

3. Results and Discussion

The present study revealed a clear variation in floral diversity of bee propolis sources across the Jammu region, influenced by altitude, climate, and vegetation type (Table 1).

The low-altitude subtropical regions of Jammu (32.73°N, 74.87°E; 300 m), Samba (32.57°N, 75.12°E; 384 m), and Kathua (32.37°N, 75.52°E; ~330 m) exhibited high plant diversity dominated by species such as *Acacia nilotica*, *Acacia catechu*, *Butea monosperma*, *Mangifera indica*, *Azadirachta indica*, *Dalbergia sissoo*, and *Terminalia* spp. These plants are important sources of gums, tannins, and phenolic compounds, which contribute to the chemical composition of propolis (Champion and Seth, 1968; Kaur *et al.*, 2023) [5, 4]. Kathua, in particular, showed higher diversity with the presence of *Boswellia serrata*, *Sterculia urens*, and *Eucalyptus tereticornis*, indicating a transition towards resin-rich vegetation (Sharma and Kachroo, 1981) [9].

The mid-altitude regions of Udhampur (32.9160°N, 75.1416°E; 755 m) and Reasi (33.09°N, 74.84°E; 466 m) showed mixed vegetation comprising both subtropical and temperate species, including *Pinus roxburghii*, *Pinus*

wallichiana, *Cedrus deodara*, *Populus* spp., *Salix* spp., and *Boswellia serrata*. This transitional vegetation enhances resin diversity and ensures continuous availability of plant exudates for propolis production (Swami and Gupta, 1998; Sharma and Kachroo, 1981) [10, 9].

In contrast, higher altitude regions such as Ramban (33.25°N, 75.25°E; 747 m), Doda (33.13°N, 75.57°E; 1107 m), and Poonch (33.77°N, 74.09°E; ~1000 m) were dominated by coniferous and temperate species including *Pinus roxburghii*, *Cedrus deodara*, *Picea abies*, *Betula utilis*, *Populus* spp., and *Salix* spp. These species are known to produce resin rich in terpenoids and flavonoids, which significantly influence the biological activity of propolis (Salatino *et al.*, 2005; Singh and Kachroo, 1976) [11, 12].

Overall, the results indicate a strong relationship between altitude and floral composition, with subtropical regions showing higher species diversity and temperate regions characterized by resin-rich coniferous flora. This variation in plant sources directly influences the chemical composition and biological activity of propolis, as different plant groups contribute distinct classes of bioactive compounds such as phenolics, terpenoids, and flavonoids (Bankova *et al.*, 2016; Tran *et al.*, 2022) [8, 2]. For instance, angiosperm species like *Acacia* and *Terminalia* are rich in phenolic compounds and tannins, whereas coniferous species such as *Pinus* and *Cedrus* provide terpenoid-rich resins. Similarly, *Populus* and *Salix* species contribute flavonoid-rich exudates, which are widely associated with strong antioxidant and antimicrobial properties of propolis. Furthermore, many of the identified plant species, including *Boswellia serrata*, *Azadirachta indica*, and *Terminalia* spp., are well recognized in traditional medicine for their antimicrobial, anti-inflammatory, and wound-healing properties, indicating a close relationship between ethnobotanical knowledge and propolis composition (Kaur *et al.*, 2023) [4]. This overlap suggests that bees may preferentially collect resins from biologically active plant sources, thereby enhancing the protective function of propolis within the hive. Therefore, the diversity and availability of rich flora in the Jammu region play a crucial

role in determining the quality, chemical variability and therapeutic potential of propolis. These findings also emphasize the need for conservation of native plant species

and sustainable management of vegetation to support beekeeping and maintain the ecological balance of the region.

Table 1: Predominant vegetation in the geographical locations of the propolis samples

S. No.	Location	Coordinates (Latitude, Longitude)	Altitude (m)	Climate type	No. of apiaries (samples)	Predominant resin-and gum-yielding vegetation	References
1	Jammu (P1)	32.73°N, 74.87°E	300	Humid subtropical	5	<i>Acacia nilotica</i> , <i>A. catechu</i> , <i>Butea monosperma</i> , <i>Mangifera indica</i> , <i>Azadirachta indica</i> , <i>Dalbergia sissoo</i> , <i>Ziziphus mauritiana</i> , <i>Eucalyptus</i> spp.	Champion and Seth (1968) ^[5] ; Anonymous (1985) ^[6] and Bankova <i>et al.</i> (2016) ^[8]
2	Samba (P2)	32.57°N, 75.12°E	384	Subtropical	5	<i>Acacia nilotica</i> , <i>A. catechu</i> , <i>Mangifera indica</i> , <i>Azadirachta indica</i> , <i>Dalbergia sissoo</i> , <i>Eucalyptus</i> spp., <i>Terminalia arjuna</i> , <i>T. bellirica</i> ,	Champion and Seth (1968) ^[5] ; Anonymous (1985) ^[6]
3	Kathua (P3)	32.37°N, 75.52°E	~330	Subtropical	5	<i>Acacia nilotica</i> , <i>A. catechu</i> , <i>Anogeissus latifolia</i> , <i>Bombax ceiba</i> , <i>Butea monosperma</i> , <i>Azadirachta indica</i> , <i>Mangifera indica</i> , <i>Terminalia arjuna</i> , <i>T. bellirica</i> , <i>Boswellia serrata</i> , <i>Sterculia urens</i> , <i>Pinus roxburghii</i> , <i>Picea abies</i> , <i>Eucalyptus tereticornis</i>	Kaur <i>et al.</i> (2023) ^[4] ; Sharma and Kachroo (1981) ^[9]
4	Udhampur (P4)	32.9160°N, 75.1416°E	755	Subtropical	5	<i>Pinus roxburghii</i> , <i>P. wallichiana</i> , <i>Cedrus deodara</i> , <i>Populus</i> spp., <i>Salix</i> spp., <i>Acacia catechu</i> , <i>Azadirachta indica</i> , <i>Mangifera indica</i> , <i>Terminalia arjuna</i> , <i>T. bellirica</i> ,	Swami and Gupta (1998) ^[10] ; Bankova (2005) ^[8]
5	Reasi (P5)	33.09°N, 74.84°E	466	Sub-tropical to temperate	5	<i>Pinus roxburghii</i> , <i>P. wallichiana</i> , <i>Cedrus deodara</i> , <i>Boswellia serrata</i> , <i>Sterculia urens</i> , <i>Azadirachta indica</i> , <i>Mangifera indica</i> , <i>Terminalia arjuna</i> , <i>T. bellirica</i> ,	Sharma and Kachroo (1981) ^[9] ; Kaur <i>et al.</i> (2023) ^[5]
6	Ramban (P6)	33.25°N, 75.25°E	747	Temperate to subtropical	5	<i>Pinus roxburghii</i> , <i>Pinus wallichiana</i> , <i>Cedrus deodara</i> , <i>Picea abies</i> , <i>Boswellia serrata</i>	Sharma and Kachroo (1981) ^[9] ; Salatino <i>et al.</i> (2005) ^[11]
7	Doda (P7)	33.13°N, 75.57°E	1107	Sub-tropical to temperate	5	<i>Pinus roxburghii</i> , <i>P. wallichiana</i> , <i>Cedrus deodara</i> , <i>Picea abies</i> , <i>Boswellia serrata</i>	Sharma and Kachroo (1981) ^[9] ; Salatino <i>et al.</i> (2005) ^[11]
8	Poonch (P8)	33.77°N, 74.09°E	~1000	Temperate	5	<i>Pinus roxburghii</i> , <i>P. wallichiana</i> , <i>Cedrus deodara</i> , <i>Boswellia serrata</i> , <i>Betula utilis</i> , <i>Populus</i> spp., <i>Salix</i> spp.	Singh and Kachroo (1976) ^[12] ; Sharma and Kachroo (1981) ^[9]

4. Conclusion

This study demonstrates that floral diversity of bee propolis sources in the Jammu region is strongly governed by altitudinal and climatic variation. Subtropical locations showed higher plant diversity dominated by *Acacia*, *Mangifera*, and *Terminalia*, whereas higher altitudes were characterized by resin-rich coniferous species such as *Pinus*, *Cedrus*, and *Picea*. These differences in vegetation directly influence the composition and biological properties of propolis, as distinct plant groups contribute specific bioactive compounds including phenolics, flavonoids, and terpenoids. The occurrence of ethnomedicinally important species further supports the functional significance of regional flora in shaping propolis quality. Overall, the study highlights the critical role of floral diversity in determining propolis variability and underscores the need for conservation and sustainable management of plant species to support beekeeping and maintain ecosystem stability.

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