

## Cultural significance and ethnobotanical importance of sacred plants use among indigenous communities of Bhaba valley in District Kinnaur, Himachal Pradesh, India

Gayatri Deryan\*, Dhiraj S Rawat & Sheetal

Department of Biosciences, Himachal Pradesh University, Shimla 171 005, India

\*E-mail: gayatrideryan@gmail.com

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Plants hold significant cultural and religious importance in rural societies worldwide. The present study aimed to explore the cultural significance and ethnobotanical importance of sacred plants use among indigenous communities of Bhaba valley in Kinnaur, Himachal Pradesh, India. Ethnobotanical insights were collected through semi-structured questionnaires and open-ended interviews with 30 local informants, primarily elderly individuals without formal education. A total of 27 plant species belonging to 17 families were documented from the studied area, with most dominating family Rosaceae (5 species), Poaceae (3 species), Pinaceae, Polygonaceae, Apiaceae and Asteraceae (2 species each). Among plant habits, the herbs were predominant (14 species), followed by trees (7 species), shrubs (5 species) and climber (1). Seeds were the most commonly used plant parts (37.03%), followed by flowers (25.93%), leaves (18.52%) and fruits (14.81%). Notably, *Amaranthus caudatus* L., *Juglans regia* L. and *Saussurea obvallata* (DC.) Sch. Bip. were the most significant species, each exhibiting a Cultural Importance Index (CI) of 1.46. The study emphasizes the intricate richness of traditionally significant sacred plant species within the area, thus highlighting the vital need for their conservation through comprehensive documentation to ensure the sustenance of these customs for posterity.

**Keywords:** Conservation, Ethnobotany, Indigenous communities, Sacred plants

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Since time immemorial, plants have been closely associated with mankind, impacting observances, traditions, myths, folk tales, folk songs and healthcare practices<sup>1</sup>. Globally, plants are revered by indigenous communities and integrated into their rituals, worship and conservation practices<sup>2</sup>. Besides their cultural and ritual significance, plants are extensively utilized in traditional healthcare systems for medicinal purposes<sup>3</sup>. India has a long history of sacred plant worship, rooted in the Harappan culture of the third or fourth millennium B.C.<sup>4,5</sup>. Notably, plants such as *Ficus religiosa* L. (Peepal) and *Aegle marmelos* (L.) Correa (Bael) are closely linked with the Hindu pantheon, being valued to deities like Vishnu and Shiva<sup>6</sup>. Around 468 sacred and medico-religious plant species, spanning 133 families and 340 genera, are integral to India's cultural traditions<sup>7</sup>. Among India's many regions, the Indian Himalayan Region (IHR) is notable for preserving plant-based traditions, with communities maintaining strong ecological and spiritual connections to local flora<sup>8</sup>.

Himachal Pradesh, located in the western-Himalayas, has altitudes ranging from 350 m to 6,975 m above sea level and covers an area of 55,673 square kilometres. It is home to seven tribal communities: Kinnaur, Gujjar, Lahauli, Gaddi, Swangla, Pangwal and Khampa<sup>9,10</sup>. District Kinnaur (H.P.), renowned as 'Dev Bhoomi' is a region where the local populace venerates their deities as supreme while concurrently adhering to Buddhist practices<sup>11</sup>. Due to its relative geographical isolation, the plant species used by the tribal denizens play a significant role in their ritual, spiritual and cultural practices, reflecting a deep integration of ecological knowledge within the region's hybrid belief systems<sup>12,13</sup>. Considering the significance of ethnobotany, numerous researchers have conducted studies on the plants of the Kinnaur region<sup>14,15</sup>. However, sacred plant species, which uphold profound cultural and ritual value in the region, remain underexplored in previous research. Unfortunately, knowledge about plants declines over time in tribal communities because of ignorance, illiteracy and lack of proper documentation<sup>16</sup>. Hence, documenting sacred

\*Corresponding author

plant use not only supports the preservation of biocultural heritage but also contributes to the preservation of traditional ecological knowledge, elucidates the intricate relationship between spirituality and plant use and emphasizes the need for the conservation of culturally significant Himalayan flora.

The aim of the present study is to document the cultural significance and ethnobotanical roles of sacred plants among the aboriginal communities of study area, emphasizing that systematic documentation is essential to preserve these traditions for future generations.

## Materials and Methods

### Study area

Kinnaur, one of the twelve administrative districts of Himachal Pradesh, is located between longitudes  $77^{\circ}45'00''$ - $79^{\circ}00'50''$ E and latitudes  $31^{\circ}05'55''$ - $32^{\circ}05'20''$ N (Fig. 1). It is divided into three blocks, viz., Pooh, Nichar and Kalpa. The present study was conducted in the Bhaba Valley of block Nichar of Kinnaur district, Himachal Pradesh. The valley lies between  $31.54^{\circ}$ - $31.78^{\circ}$  N latitude and  $77.95^{\circ}$ - $78.05^{\circ}$  E

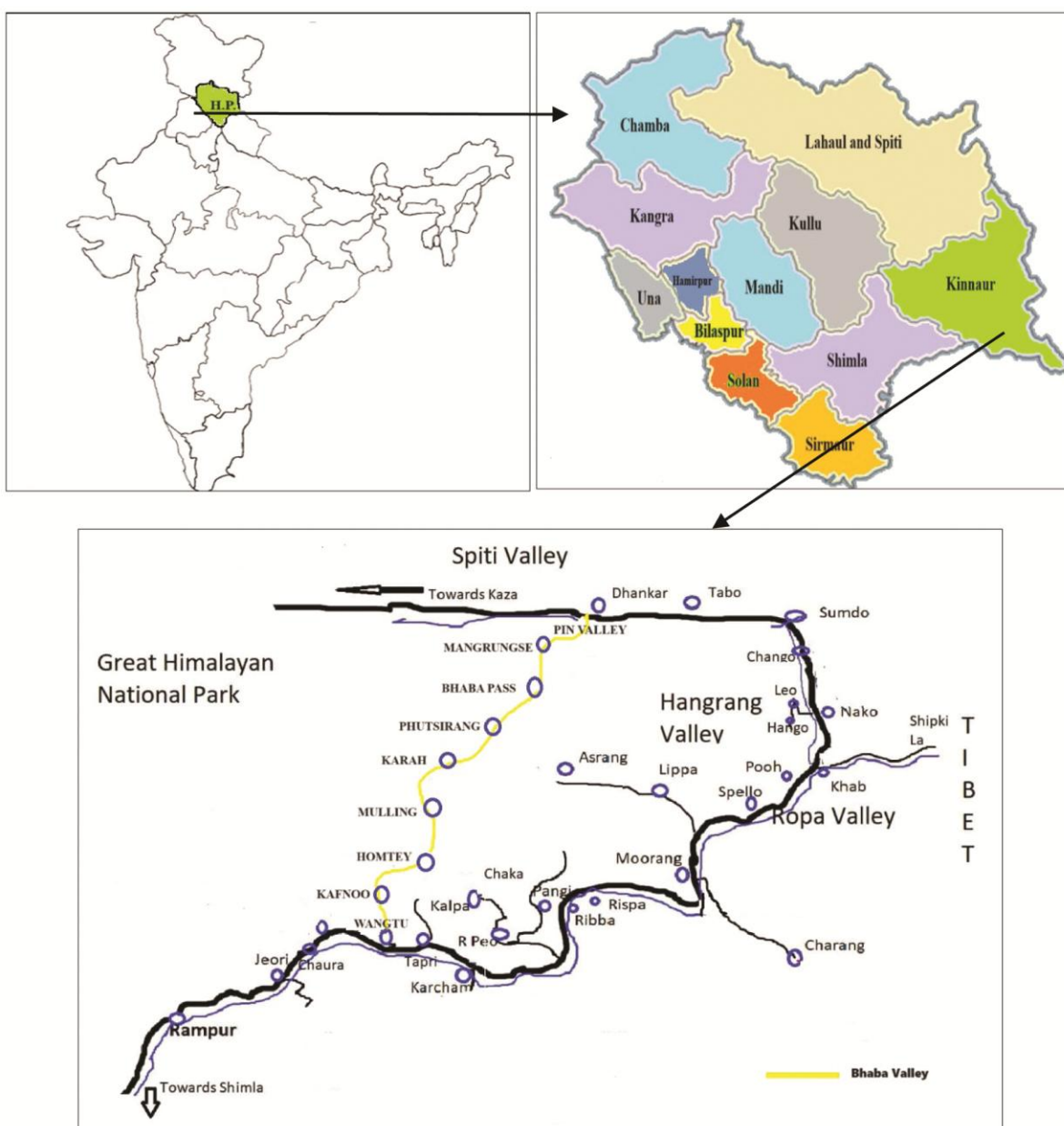


Fig. 1 — The study area and location map of Bhaba valley, Kinnaur District of Himachal Pradesh.  
(Source: <https://earth.google.com/web/>.)

longitude, with an altitudinal range of 1,500 to 5,600 m above mean sea level. At its North, Bhaba Pass connects the valley with Pin Valley Spiti (Lahaul and Spiti), H.P. The area exhibits diverse altitudinal gradients, climatic conditions and topography, forming a heterogeneous landscape. It receives an average annual precipitation of about 816 mm, with temperatures ranging from 15°C (maximum) to -5°C (minimum). The region is dominated by various cultural significant plants including *Aconitum violaceum* Jacquem. ex Stapf, *Amaranthus caudatus* L., *Angelica glauca* Edgew., *Betula utilis* D. Don, *Juniperus squamata* D. Don, *Saussurea laniceps* Hand.-Mazz. and *Saussurea obvallata* (DC.) Sch.Bip<sup>17</sup>.

#### Data collections

An extensive systematic survey was conducted in various villages of Bhaba valley from June 2024 to March 2025 for documenting ritualistic plant use among the local tribal denizens. Data on plant usage during celebratory events were gathered through personal observations, in-depth oral interviews and discussions with tribal communities. Such survey was conducted in both the local dialect 'Kinnauri' and 'Hindi'. Plant specimens were meticulously collected and dried following standard botanical collection and herbarium techniques<sup>18</sup>. These specimens were subsequently identified and preserved onto herbarium sheets, as per mentioned protocols<sup>19</sup>. The taxonomic classification of species and families was verified through reputable online resources including the POWO (Plants of the World Online) (<https://powo.science.kew.org/>)<sup>20</sup> (accessed on 22 March 2025).

#### Attributes of the informants

The socio-economic information of 30 informants includes age, gender, educational level and occupation (Table 1). The age ranges from 20 to 90 years old, and as per sex of informants, 12 females and 18 males were interviewed.

#### Data analysis

The ethno-botanical information was categorized into seven use categories (UC) namely uses for Sacred/Offering/Pooja/Hawans/Worshipping (SAC), Ceremonies/Marriage/Religious ceremony/Faith (CER), Alcoholic Beverages (AB), Oil (O), Vegetable (VEG), Tea (T) and Timber & Wood Craft (TW) (Table 2).

#### Quantitative approaches

The basic variables like frequency of citation (FC), use reports (UR), the number of uses (NU) and the

ethno-botanical indices like relative frequency of citations (RFC), cultural importance index (CI) and are rank accordingly. These above-cited ethno-botanical indices were determined by using formulae as given below<sup>21</sup>.

#### Frequency of citation (FC)

Use reports (UR)

$$UR_s = \sum(u = u_1 \text{ to } u_{NC}) \sum(i = i_1 \text{ to } i_N) UR_{ui}$$

Where,  $UR_s$  = use report of species  $UR_{ui}$  = sum of the uses reported for each species under each category; NC = the total number of use categories.

#### Relative frequency of citation (RFC)

$$RFC_s = FC_s / N = (\sum(i = i_1 \text{ to } i_N) UR_{ui}) / N$$

Where, FC = frequency of citations, N is the number of informants, UR is the number of use reports.

Table 1 — Demographic characteristics of informants (n=30).

| Category            | Subcategory            | Number | Percentage (%) |
|---------------------|------------------------|--------|----------------|
| Age (years)         | 20–30                  | 2      | 6.6%           |
|                     | 30–40                  | 2      | 6.6%           |
|                     | 40–50                  | 8      | 26.0%          |
|                     | 50–60                  | 2      | 6.6%           |
|                     | 60–70                  | 9      | 30.0%          |
|                     | Above 70               | 7      | 24.0%          |
| Sex                 | Female                 | 18     | 60.0%          |
|                     | Male                   | 12     | 40.0%          |
| Education level     | Primary                | 4      | 13.4%          |
|                     | Secondary              | 4      | 13.4%          |
|                     | Higher Secondary       | 12     | 40.0%          |
|                     | Graduate               | 6      | 20.0%          |
|                     | Post Graduate          | 2      | 6.6%           |
|                     | University/Other       | 2      | 6.6%           |
| Occupation (Female) | Housewife              | 10     | 33.4%          |
| Occupation (Male)   | Pradhan (village Head) | 8      | 26.6%          |
|                     | Local Informants       | 4      | 13.4%          |
|                     | Pujari (priest)        | 8      | 26.6%          |

Table 2 — Documented plants under each UC (Use Category) and its percentage.

| Use Categories (UC)               | No. of Species | % of Species |
|-----------------------------------|----------------|--------------|
| Sacred/offering/worshipping (SAC) | 9              | 24%          |
| Ceremonies (CER)                  | 16             | 42.1%        |
| Alcoholic beverage (AB)           | 4              | 10.5%        |
| Oil (O)                           | 1              | 2.6%         |
| Vegetable (V)                     | 3              | 7.8%         |
| Tea(T)                            | 3              | 7.8%         |
| Timber/ Woodcraft (TW)            | 2              | 5.2%         |
| Total                             | 38             | 100          |

**Relative importance index (RI)**

$$RI_s = (RFC_s(\max) + RNU_s(\max))/2$$

Where,

$$RFC_s(\max) = FC_s/\max(FC)$$

$$RNU_s(\max) = NU_s/(\max(NU))$$

Where,

$RFC_s(\max)$ = maximum relative frequency of citation:  $RNU_s(\max)$ = maximum relative number of uses:  $\max(FC)$ = maximum frequency of citation,  $\max(NU)$ = maximum number of uses.

**Cultural importance index (CI)**

$$CV_s = (NU_s/NC) \times (FC_s/N) \times (\sum(u = u_1 \text{ to } u_{NC}) \sum(i = i_1 \text{ to } i_N) UR_{ui})/UN$$

where,  $NU_s/NU$ = relationship between use diversity of a species and the total number of use-categories,  $FC_s/N$ = relative citation frequency,  $\sum(u = u_1 \text{ to } u_{NC}) \sum(i = i_1 \text{ to } i_N) UR_{ui}/N$ = total UR for a species divided by N

**Cultural importance index (CI)**

$$CI_s = \sum_{u=u_1}^{u_{NC}} \sum_{i=i_1}^{i_N} \frac{UR_{ui}}{N} \quad CI_s = (\sum(u = u_1 \text{ to } u_{NC}) \sum(i = i_1 \text{ to } i_N) UR_{ui})/N$$

Where, UR= use reports per species within each category divided by N (Total informants).

**Observation**

The documented species were characterized by their scientific and local names, plant families, parts used and beliefs/uses as shown in (Table 3).

Table 3 — Traditionally used plants of Bhaba valley of Kinnaur (Himachal Pradesh)

| Sr. No | Botanical Name                               | Vernacular Name | Family        | Habit | Part Used    | Uses                                                                                                         | Festivals                   | Use Categories (UC) |
|--------|----------------------------------------------|-----------------|---------------|-------|--------------|--------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------|
| 1.     | <i>Aconitum violaceum</i> Jacquem. ex Stapf  | Bangat Kaiser   | Ranunculaceae | Herb  | Flower       | Flowers are offered to local deities.                                                                        | Fulaich                     | (CER)<br>(SAC)      |
| 2.     | <i>Amaranthus caudatus</i> L.                | Dankhar         | Amaranthaceae | Herb  | Leaves, Seed | Leaves are used for making vegetable. Roasted seeds are consumed with milk to make the sweet desert (kheer). | Marriage                    | (V)<br>(CER)        |
| 3.     | <i>Angelica glauca</i> Edgew.                | Spal            | Apiaceae      | Herb  | Root         | Powder of root is used as spices and condiments for flavouring meat.                                         | Shukudh                     | (CER)               |
| 4.     | <i>Betula utilis</i> D.Don                   | Shag            | Betulaceae    | Tree  | Bark         | Powder of bark used for preparing 'Namkeen chai'.                                                            | Porishtang                  | (T)                 |
| 5.     | <i>Brassica rapa</i> L.                      | Sarson          | Brassicaceae  | Herb  | Seed         | Seed oil is used for lightning jot-batti (lamps).                                                            | Marriages, Death ceremonies | (O)                 |
| 6.     | <i>Carum carvi</i> L.                        | Kala zeera      | Apiaceae      | Herb  | Seed         | Seeds are used as spices and condiments for making food and chutney.                                         | Marriages, Bishu            | (V)<br>(CER)        |
| 7.     | <i>Cedrus deodara</i> (Roxb. ex D.Don) G.Don | Kelmang         | Pinaceae      | Tree  | Whole plant  | Whole plant is considered sacred and timber is used in temple construction.                                  | Porishtang                  | (TW)                |
| 8.     | <i>Eleusine coracana</i> (L.) Gaertn.        | Koda            | Poaceae       | Herb  | Seed         | Seed flour used in preparation of famous local cuisine known as 'Khororotich' and served with butter.        | Marriages, Bishu            | (CER)               |
| 9.     | <i>Fagopyrum esculentum</i> Moench           | Olgo            | Polygonaceae  | Herb  | Seed         | Seed flour used in preparation of famous cuisine known as 'Dhuu' and eaten with butter.                      | Fulaich, Airachang          | (CER)               |
| 10.    | <i>Fagopyrum tataricum</i> (L.) Gaertn.      | Bras            | Polygonaceae  | Herb  | Seed, Leaves | Seed flour is used to make 'Brasu hod' and dried leaves are used as vegetable popularly known as 'Bras kan'. | Bishu                       | (V)<br>(CER)        |

... Contd.

Table 3 — Traditionally used plants of Bhaba valley of Kinnaur (Himachal Pradesh) (Contd.)

| Sr. No | Botanical Name                            | Vernacular Name | Family       | Habit   | Part Used      | Uses                                                                                                                      | Festivals                            | Use Categories (UC) |
|--------|-------------------------------------------|-----------------|--------------|---------|----------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------|---------------------|
| 11.    | <i>Glycine max</i> (L.) Merr.             | Botang          | Fabaceae     | Herb    | Seed           | Roasted seeds eaten with dry fruits and seed flour (Botangyud) eaten with salted tea and apricot oil.                     | Phagul, Bishu                        | (CER)               |
| 12.    | <i>Hordeum vulgare</i> L.                 | Chag            | Poaceae      | Herb    | Seed           | Seed flour used in preparation of 'Sattu' locally called 'yudh'.                                                          | Buddha Purnima                       | (CER)               |
| 13.    | <i>Juglans regia</i> L.                   | Kaa             | Juglandaceae | Tree    | Seed, Stem     | Seeds are edible and used for making garlands as token of respect to guests. Timber used in temples is considered sacred. | Marriages, Death ceremonies          | (TW)<br>(T)         |
| 14.    | <i>Juniperus squamata</i> D.Don           | Dhupang         | Cupressaceae | Shrub   | Leaves         | Dried leaves used as incense.                                                                                             | Shukudh, Fulaich                     | (CER)<br>(SAC)      |
| 15.    | <i>Malus domestica</i> (Suckow) Borkh.    | Sayo            | Rosaceae     | Tree    | Fruits         | Fruit liquor is offered to local deities.                                                                                 | Fulaich                              | (AB)<br>(CER)       |
| 16.    | <i>Pinus gerardiana</i> Wall. Ex D.Don    | Ree             | Pinaceae     | Tree    | Seed           | Seeds are used for making garlands and as token of respect to guests and local deity.                                     | Marriages                            | (CER)<br>(T)        |
| 17.    | <i>Prinsepia utilis</i> Royle             | Brekling        | Rosaceae     | Shrub   | Whole plant    | Twig is hung at the main entrance of house to ward off the evil spirits.                                                  | Marriages                            | (SAC)               |
| 18.    | <i>Prunus armeniaca</i> L.                | Chuli           | Rosaceae     | Tree    | Fruit          | Fruit liquor is offered to local deities.                                                                                 | Fulaich, Bishu                       | (AB)                |
| 19.    | <i>Prunus mira</i> Koehne                 | Reg             | Rosaceae     | Tree    | Fruit          | Fruits are used for wine preparation and offered to local deities.                                                        | Porishtang                           | (AB)                |
| 20.    | <i>Rhododendron campanulatum</i> D.Don    | Buras           | Ericaceae    | Shrub   | Flower         | Flowers are offered to local deities.                                                                                     | Fulaich                              | (CER)<br>(SAC)      |
| 21.    | <i>Rosa rubiginosa</i> L.                 | Gulab           | Rosaceae     | Shrub   | Flower         | Flowers are used during various religious ceremonies.                                                                     | Fulaich                              | (CER)<br>(SAC)      |
| 22.    | <i>Saussurea laniceps</i> Hand.-Mazz.     | Khasbal         | Asteraceae   | Herb    | Flower, Leaves | Leaves and flowers are used in 'Poojas'.                                                                                  | Marriages                            | (SAC)<br>(CER)      |
| 23.    | <i>Saussurea obvallata</i> (DC.) Sch.Bip. | Dongur          | Asteraceae   | Herb    | Flower         | Flowers are offered to local deities.                                                                                     | Fulaich, Shoenaychang                | (SAC)<br>(CER)      |
| 24.    | <i>Skimmia laureola</i> (DC.) Decne.      | Shashuri        | Rutaceae     | Shrub   | Leaves, Flower | Leaves and flowers are offered.                                                                                           | Shoenaychang                         | (SAC)               |
| 25.    | <i>Triticum aestivum</i> L.               | Zod             | Poaceae      | Herb    | Seed           | Seed powder used to make salted roties (Poley).                                                                           | Marriages, Fulaich, Death ceremonies | (CER)               |
| 26.    | <i>Viola pilosa</i> Blume                 | Banaksha        | Violaceae    | Herb    | Flowers        | Flowers are offered to local deities.                                                                                     | Fulaich                              | (CER)<br>(SAC)      |
| 27.    | <i>Vitis vinifera</i> L.                  | Dakhang         | Vitaceae     | Climber | Fruits         | Fruit liquor is offered to local deities.                                                                                 | Fulaich, Marriages                   | (AB)                |

Abbreviations: Sacred/Offering/Pooja/Hawans/Worshiping (SAC), Ceremonies/Marriage/Religious ceremony/Faith (CER), Alcoholic Beverages (AB), Oil (O), Vegetable (VEG), Tea (T) and Timber & Wood Craft (TW); Use categories (UC), Number of Uses (NU), Total number of use categories (NC), Cultural Importance Index (CI), Frequency of Citation (FC), Use Reports (UR) and Relative Frequency of Citation (RFC)

## Results

### Demography of informants

A total of 30 informants were interviewed during entire survey in Bhaba valley, Kinnaur district, Himachal Pradesh. Out of total informants, 18 (60%)

were female and 12 (40%) were male. Most of the respondents (30.0%) belong to 60-70 years age group, followed by those aged 40-50 years old (26.0%) and above 70 years old (24.0%). The least represented age groups were 20-30 years, 30-40 years and 50-60 years,

each comprising only 6.6% of the total respondents in each. This reflects the predominance of elderly individuals in ritual plant knowledge and practice, with younger informants contributing comparatively less. In terms of educational background, the majority of the respondents had received higher secondary education (40.0%), followed by graduates (20.0%). Primary and secondary education each characterized 13.4% of the respondents. Postgraduate qualifications and university or other educational backgrounds each contributed 6.6% to the total sample. The findings reflect greater participation of individuals with school-level education than those possessing advanced academic qualifications. Among women, housewives comprised the largest occupational category (33.4%), followed by village heads (Pradhans) at 26.6%. Male informants included priests or pujaris (26.6%) and local knowledge holders (13.4%), reflecting their active participation in religious and cultural practices involving plant use (Table1)<sup>22,23</sup>.

#### Use categories

The documented plant species were categorized into seven ethnobotanical use categories based on their traditional functions within the indigenous communities. The highest number of species (42.1%) were used during ceremonies (CER), indicating the deep-rooted cultural role of plants in ritualistic practices. This was followed by sacred/offering/worshipping (SAC) uses, accounting for 24% of the total species. Plants used in the preparation of alcoholic beverages (AB) represented 10.5%, while those used as vegetables (V) and for tea (T) each accounted for 7.8%. Only a small proportion of species were associated with timber/woodcraft (TW) (5.2%) and oil extraction (O) (2.6%) (Table 2). These findings underscore the multifaceted roles of ethnobotanically important plants

in religious, nutritional and utilitarian aspects of local traditions<sup>24,25</sup>.

#### Plant diversity and usage

An ethnobotanical survey of the study area documented 27 plant species belonging to 17 families, including Rosaceae (n = 5 species), Poaceae (n = 3) and Pinaceae, Polygonaceae, Apiaceae, and Asteraceae (n = 2 species each), while the remaining families contributed for single plant species (Fig. 2). Among the plant habits recorded, herbs were predominant (14 species), followed by trees (7), shrubs (5) and climber (1) (Fig. 3). The most commonly used plant parts used were seeds (37.03%), flowers (25.93%), leaves (18.52%) and fruits (14.81%) (Fig. 4)<sup>26-28</sup>.

Figure 4 (a) Palanquin decorated with *Saussurea obvallata* (DC.) Sch.Bip. flower (b) Garland of *Juglans regia* L. kernel wear by married couples (c) Tribal ladies wearing *Skimmia laureola* (DC.) Decne. crown (d) Dessert made by the roasted seeds of *Amaranthus caudatus* L. (e) Celebrating shoenaychang festival (f) Incense of *Juniperus squamata* D.Don (g) 'Brasu hod' made up of seed flour of *Fagopyrum tataricum* (L.) Gaertn. (h) Tribal denizens with *Skimmia laureola* (DC.) Decne. garland (i) Dish made from the flour of *Hordeum vulgare* L. seeds.

#### Cultural importance index species with use-category components

Each use category to the total cultural importance index (CI) of 27 most relevant species found in the study area (Table 4). *Amaranthus caudatus* L., *Juglans regia* L. and *Saussurea obvallata* (DC.) Sch.Bip. were the most culturally significant plant under the category of (V), (CER), (TW), (T), (SAC) and (CER) with a CI index value of 1.46 since it includes all the citations (FC=22), followed by

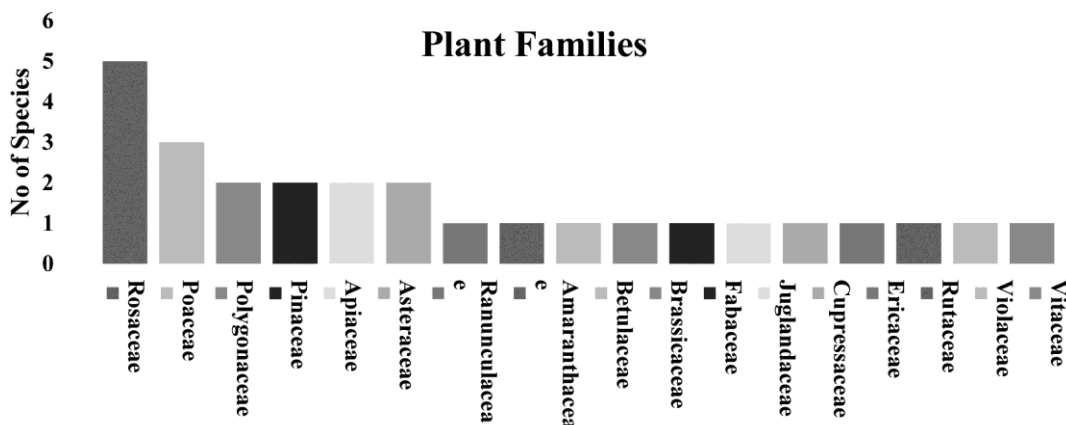


Fig. 2 — Contribution of different plant families to species number

*Aconitum violaceum* Jacquem. ex Stapf and *Juniperus squamata* D.Don with a CI of 1.33. *Rosa rubiginosa* L. also stood out in the use category of (CER) and (SAC) with a CI of 1.20, followed by *Saussurea laniceps* Hand.-Mazz. (CI=1.06), *Rhododendron campanulatum* D.Don (CI=1) while the species with lowest CI is *Prunus armeniaca* L. (0.20). The 27 plants showed the basic values (FC, UR and NU), ethno-botanical indices (CI and RFC) and species ranking based on ethnobotanical values. The other indices also consider the variety of uses mentioned for a species whereas the FC value only considers the number of people who mention them as helpful<sup>29,30</sup>.

#### Cultural importance ranking

The table summarizes a study on ethnobotanical importance of ritualistic plant and usage of various

plant species, evaluated through indices such as Number of Uses (NU), Frequency of Citation (FC),

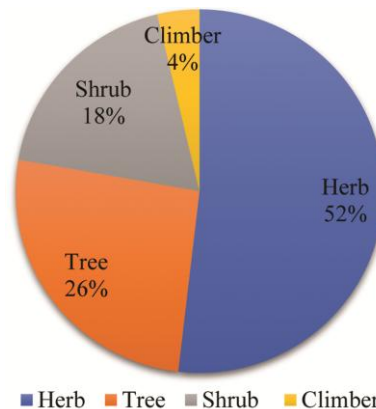


Fig. 3 — Pie chart showing habit-wise distribution of documented plant species in percent

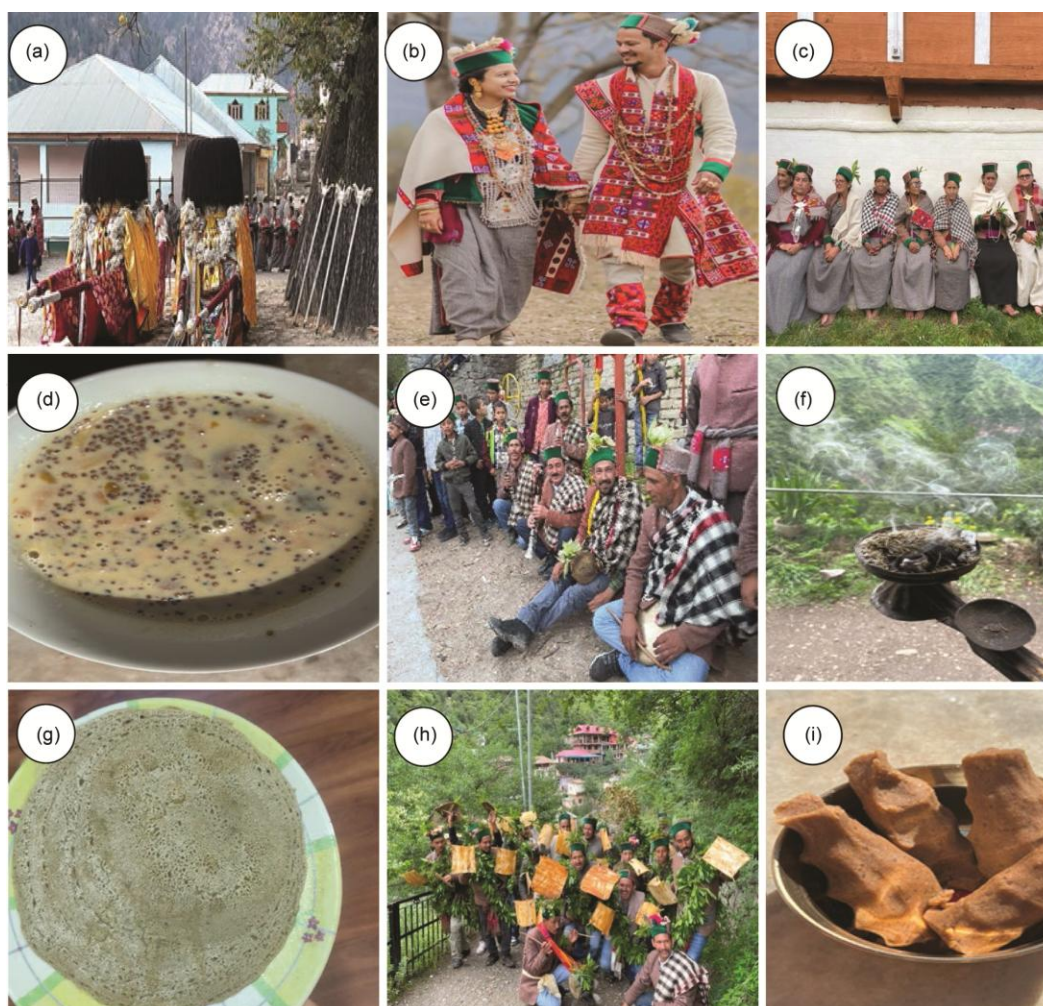


Fig. 4 — (a) Palanquin decorated with *Saussurea obvallata* (DC.) Sch.Bip. flower (b) Garland of *Juglans regia* L. kernel wear by married couples (c) Tribal ladies wearing *Skimmia laureola* (DC.) Decne. crown (d) Dessert made by the roasted seeds of *Amaranthus caudatus* L. (e) Celebrating shoenaychang festival (f) Incense of *Juniperus squamata* D.Don (g) 'Brasu hod' made up of seed flour of *Fagopyrum tataricum* (L.) Gaertn. (h) Tribal denizens with *Skimmia laureola* (DC.) Decne. garland (i) Dish made from the flour of *Hordeum vulgare* L. seeds

Use Reports (UR), Cultural Importance Index (CI) and Relative Frequency of Citation (RFC). The findings indicate that the most culturally significant species, ranked first, include *Amaranthus caudatus* L., *Juglans regia* L. and *Saussurea obvallata* (DC.) Sch.Bip. each exhibiting the highest values of NU = 2, FC = 22, and UR = 44, with a CI of 1.46 and an RFC of 0.73. These taxa feature prominently in the community's ethnobotanical heritage and customary traditions. Following closely in importance are *Aconitum violaceum* Jacquem. ex Stapf and *Juniperus squamata* D.Don (rank 2) with CI and RFC values of 1.33 and 0.66 respectively. Moderately ranked species include *Rosa rubiginosa* L. (rank 3) with NU= 2, FC= 18 and UR= 36, resulting in a CI of 1.20 and an RFC of 0.60. Additional species like *Saussurea laniceps* Hand.-Mazz. and *Rhododendron campanulatum* D.Don are ranked 4<sup>th</sup> and 5<sup>th</sup> showing a gradual decline in CI values. Species such as *Pinus gerardiana* Wall. ex D.Don (ranked 6<sup>th</sup>) and *Brassica rapa* L. (ranked 7<sup>th</sup>) have progressively lower values indicating a reduced but still notable cultural relevance within the community. The least significant species according to the table is *Prunus armeniaca* L. which ranks last (15<sup>th</sup>) with NU = 1, FC = 6 and UR

= 6 resulting in the lowest CI (0.20) and RFC (0.20). This suggests that *Prunus armeniaca* L. holds minimal cultural importance and usage compared to the other listed species (Table 5)<sup>31</sup>.

NU: No. of uses, FC: Frequency of Citation, UR: Use report, CI: Cultural Importance, RFC: Relative Frequency of Citation.

## Discussion

The present study underscores the profound ethnobotanical connection between indigenous communities of study area, with 27 species across 26 families highlighting the underexplored spiritual dimension of plant use. The dominance of Rosaceae, Poaceae, Pinaceae and Polygonaceae families signifies their extensive cultural relevance, attributable to their ecological richness and symbolic relevance in customary rites. The findings indicate that ceremonial use (CER) comprised the dominant use category (42.1%), followed by sacred offerings and worship (SAC) (24%). These data indicate the spiritual symbolism ingrained in plant use, notably during traditional festivals such as Fulaich, Bishu and Shoenaychang. Similar customary observances have been recorded in other Himalayan communities, where

Table 4 — Cultural importance index (CI) for 27 species with the CI component of each use category

| Sr.No | Botanical name                               | CER  | SAC  | AB   | V    | T    | TW   | O    | TOTAL CI |
|-------|----------------------------------------------|------|------|------|------|------|------|------|----------|
| 1.    | <i>Aconitum violaceum</i> Jacquem. ex Stapf  | 0.66 | 0.66 |      |      |      |      |      | 1.33     |
| 2.    | <i>Amaranthus caudatus</i> L.                | 0.73 |      |      | 0.73 |      |      |      | 1.46     |
| 3.    | <i>Angelica glauca</i> Edgew.                | 0.33 |      |      |      |      |      |      | 0.33     |
| 4.    | <i>Betula utilis</i> D.Don                   |      |      |      |      | 0.5  |      |      | 0.5      |
| 5.    | <i>Brassica rapa</i> L.                      |      |      |      |      |      |      | 0.73 | 0.73     |
| 6.    | <i>Carum carvi</i> L.                        | 0.36 |      |      | 0.36 |      |      |      | 0.73     |
| 7.    | <i>Cedrus deodara</i> (Roxb. ex D.Don) G.Don |      |      |      |      |      | 0.4  |      | 0.4      |
| 8.    | <i>Eleusine coracana</i> (L.) Gaertn.        | 0.33 |      |      |      |      |      |      | 0.33     |
| 9.    | <i>Fagopyrum esculentum</i> Moench           | 0.26 |      |      |      |      |      |      | 0.26     |
| 10.   | <i>Fagopyrum tataricum</i> (L.) Gaertn.      | 0.3  |      |      | 0.3  |      |      |      | 0.6      |
| 11.   | <i>Glycine max</i> (L.) Merr.                | 0.26 |      |      |      |      |      |      | 0.26     |
| 12.   | <i>Hordeum vulgare</i> L.                    | 0.33 |      |      |      |      |      |      | 0.33     |
| 13.   | <i>Juglans regia</i> L.                      |      |      |      |      | 0.73 | 0.73 |      | 1.46     |
| 14.   | <i>Juniperus squamata</i> D.Don              | 0.66 | 0.66 |      |      |      |      |      | 1.33     |
| 15.   | <i>Malus domestica</i> (Suckow) Borkh.       | 0.33 |      | 0.33 |      |      |      |      | 0.66     |
| 16.   | <i>Pinus gerardiana</i> Wall. ex D.Don       | 0.4  |      |      |      | 0.4  |      |      | 0.8      |
| 17.   | <i>Prinsepia utilis</i> Royle                |      | 0.26 |      |      |      |      |      | 0.26     |
| 18.   | <i>Prunus armeniaca</i> L.                   |      |      | 0.2  |      |      |      |      | 0.2      |
| 19.   | <i>Prunus mira</i> Koehne                    |      |      | 0.26 |      |      |      |      | 0.26     |
| 20.   | <i>Rhododendron campanulatum</i> D.Don       | 0.5  | 0.5  |      |      |      |      |      | 1        |
| 21.   | <i>Rosa rubiginosa</i> L.                    | 0.6  | 0.6  |      |      |      |      |      | 1.2      |
| 22.   | <i>Saussurea laniceps</i> Hand.-Mazz.        | 0.53 | 0.53 |      |      |      |      |      | 1.06     |
| 23.   | <i>Saussurea obvallata</i> (DC.) Sch.Bip.    | 0.73 | 0.73 |      |      |      |      |      | 1.46     |
| 24.   | <i>Skimmia laureola</i> (DC.) Decne.         |      | 0.5  |      |      |      |      |      | 0.5      |
| 25.   | <i>Triticum aestivum</i> L.                  | 0.33 |      |      |      |      |      |      | 0.33     |
| 26.   | <i>Viola pilosa</i> Blume                    | 0.36 | 0.36 |      |      |      |      |      | 0.73     |
| 27.   | <i>Vitis vinifera</i> L.                     |      |      | 0.6  |      |      |      |      | 0.6      |

Table 5 — Evaluation of useful plants using four quantitative indices (list of the 27 species following the CI index and plant ranking based on each index)

| Sr. No | Name of Species                              | Basic values |    |    | Indices |      | Ranking |
|--------|----------------------------------------------|--------------|----|----|---------|------|---------|
|        |                                              | NU           | FC | UR | CI      | RFC  | CI      |
| 1      | <i>Amaranthus caudatus</i> L.                | 2            | 22 | 44 | 1.46    | 0.73 | 1       |
| 2      | <i>Juglans regia</i> L.                      | 2            | 22 | 44 | 1.46    | 0.73 | 1       |
| 3      | <i>Saussurea obvallata</i> (DC.) Sch.Bip.    | 2            | 22 | 44 | 1.46    | 0.73 | 1       |
| 4      | <i>Aconitum violaceum</i> Jacquem. ex Stapf  | 2            | 20 | 40 | 1.33    | 0.66 | 2       |
| 5      | <i>Juniperus squamata</i> D.Don              | 2            | 20 | 40 | 1.33    | 0.66 | 2       |
| 6      | <i>Rosarubiginosa</i> L.                     | 2            | 18 | 36 | 1.20    | 0.60 | 3       |
| 7      | <i>Saussurea laniceps</i> Hand.-Mazz.        | 2            | 16 | 32 | 1.06    | 0.53 | 4       |
| 8      | <i>Rhododendron arboreum</i> Sm.             | 2            | 15 | 30 | 1       | 0.50 | 5       |
| 9      | <i>Pinus gerardiana</i> Wall. ex D.Don       | 2            | 12 | 24 | 0.80    | 0.4  | 6       |
| 10     | <i>Brassica rapa</i> L.                      | 1            | 22 | 22 | 0.73    | 0.73 | 7       |
| 11     | <i>Carum carvi</i> L.                        | 2            | 11 | 22 | 0.73    | 0.36 | 7       |
| 12     | <i>Malus domestica</i> (Suckow) Borkh.       | 2            | 10 | 20 | 0.66    | 0.33 | 8       |
| 13     | <i>Fagopyrum tataricum</i> (L.) Gaertn.      | 2            | 9  | 18 | 0.30    | 0.60 | 9       |
| 14     | <i>Vitis vinifera</i> L.                     | 1            | 18 | 18 | 0.60    | 0.60 | 9       |
| 15     | <i>Betula utilis</i> D.Don                   | 1            | 15 | 15 | 0.50    | 0.50 | 10      |
| 16     | <i>Skimmia laureola</i> (DC.) Decne.         | 1            | 15 | 15 | 0.50    | 0.50 | 10      |
| 17     | <i>Cedrus deodara</i> (Roxb. ex D.Don) G.Don | 1            | 12 | 12 | 0.40    | 0.4  | 11      |
| 18     | <i>Viola pilosa</i> Blume                    | 2            | 11 | 22 | 0.36    | 0.73 | 12      |
| 19     | <i>Angelica glauca</i> Edgew.                | 1            | 10 | 10 | 0.33    | 0.33 | 13      |
| 20     | <i>Eleusine coracana</i> (L.) Gaertn.        | 1            | 10 | 10 | 0.33    | 0.33 | 13      |
| 21     | <i>Hordeum vulgare</i> L.                    | 1            | 10 | 10 | 0.33    | 0.33 | 13      |
| 22     | <i>Triticum aestivum</i> L.                  | 1            | 10 | 10 | 0.33    | 0.33 | 13      |
| 23     | <i>Fagopyrum esculentum</i> Moench           | 1            | 8  | 8  | 0.26    | 0.26 | 14      |
| 24     | <i>Glycine max</i> (L.) Merr.                | 1            | 8  | 8  | 0.26    | 0.26 | 14      |
| 25     | <i>Prinsepia utilis</i> Royle                | 1            | 8  | 8  | 0.26    | 0.26 | 14      |
| 26     | <i>Prunus mira</i> Koehne                    | 1            | 8  | 8  | 0.26    | 0.26 | 14      |
| 27     | <i>Prunus armeniaca</i> L.                   | 1            | 6  | 6  | 0.20    | 0.20 | 15      |

NU: No. of uses, FC: Frequency of Citation, UR: Use report, CI: Cultural Importance, RFC: Relative Frequency of Citation.

sacred plants were regarded as bridge between the divine and human domains<sup>32</sup>.

The predominantly used plant parts were seeds (37.03%), flowers (25.93%) and leaves (18.52%). Seeds of *Juglans regia* L. and *Pinus gerardiana* Wall. ex D.Don were utilized to weave garlands or offered to deities, symbolizing fertility and abundance. Flowers of *Saussurea obvallata* (DC.) Sch.Bip., *Aconitum violaceum* Jacquem. ex Stapf and *Rhododendron campanulatum* D.Don were often offered in poojas and celebrations, emphasizing their sanctity. These parts embody symbolic value and indicate ethnobotanical awareness of seasonal abundance. The Cultural Importance Index (CI) and Relative Frequency of Citation (RFC) were strong indicators of a species' prominence within the region's cultural heritage. *Amaranthus caudatus* L., *Juglans regia* L. and *Saussurea obvallata* (DC.) Sch.Bip. ranked among the most culturally significant species with CI values of 1.46 and RFC of 0.73, highlighting their diverse roles across several use categories (CER, SAC, V, TW, T). Their widespread

appearance in ceremonies and offerings reinforce their role as symbolic conduits of sacredness, protection and prosperity. These findings agree with earlier ethnobotanical works in Himachal Pradesh, where *Juglans regia* L. and *Saussurea obvallata* (DC.) Sch.Bip. were also documented as central to local deity worship and temple rituals<sup>33,34</sup>.

Plants including *Juniperus squamata* D.Don and *Rosa rubiginosa* L., with high CI values (1.33 and 1.20 respectively), were entrenched in community traditions for their aromatic and ornamental properties. *Juniperus squamata* D.Don used as an incense, is particularly significant during purification rituals, a practice that resonates with Buddhist and animistic traditions prevalent in Bhaba valley of Kinnaur. *Rosa rubiginosa* L. finds widespread use in poojas and is associated with purity and devotion, reflecting a gendered aesthetic often reported in flower rituals. Conversely, species such as *Prunus armeniaca* L., *Prinsepia utilis* Royle and *Fagopyrum esculentum* Moench showed lower CI and RFC values, indicating limited ceremonial relevance or a

gradual decline in their ritual use. The low rank of *Prunus armeniaca* L. (CI= 0.20) despite its availability suggests either a loss of traditional knowledge or replacement by more culturally favoured species. This change may indicate broader social and economic changes, shifting religious practices and beliefs, or a decline in transfer of knowledge across generations<sup>35,36</sup>.

This study presents a novel ethnobotanical documentation of sacred plant utilized by aboriginal communities of Bhaba Valley of district Kinnaur, an under studied region of Himachal Pradesh. Unlike earlier research that emphasized medicinal or general plant use, this research comprehensively documents the cultural, spiritual and ritualistic significance of plant species and quantitatively assesses their relevance using indices such as Cultural Importance Index (CI), Fidelity Level (FL) Relative Frequency of Citation (RFC) and Use Value (UV). The documentation of culturally prominent species such as *Amaranthus caudatus* L., *Juglans regia* L. and *Saussurea obvallata* (DC.) Sch.Bip. underscores the integration of indigenous knowledge with quantitative frameworks.

The findings also have substantial conservation relevance, as many of these plant species are conserved through religious customs and ritual protection. Such tradition-based use supports in-situ conservation and sustainable use of plant resources. Therefore, documenting and promoting ancestral knowledge systems can play a vital role in conservation of biodiversity, particularly in ecologically vulnerable Himalayan regions where indigenous traditions continue to aid preservation of sacred flora. Collectively, integrated qualitative and quantitative methodology utilized in this study offers new perspectives into the conservation of plant biodiversity and the preservation of related cultural heritage.

## Conclusion

The current study scrutinizes into the heterogeneous and complex aspects of the profound ethnobotanical beliefs held by the tribal denizens of Bhaba valley in Kinnaur region. Plants used in festivals uphold prominent position in cultural customs and religious practices. These plants have an integral role in the local culture's sacred beliefs, customs and traditions. Sustaining and revering these plants not only enhances the indigenous heritage but also signifies the prominence of preserving a balanced relationship between humans and nature. The ethnobotanical

knowledge is diminishing progressively over time as a result of the tribal community's sun awareness, illiteracy, insufficient documentation and other factors. The investigation elucidates the extensive diversity of sacred plant taxa within the area, emphasizing the imperative need for their conservation through comprehensive documentation to secure the continuation of these traditions for descendants.

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## Author Contributions

GD planned and implemented the research, performed the analyses and interpreted the results. DSR and S provided supervision and guidance.

## Conflict of Interest

The authors report no conflicts of interest.

## Ethics Statement

Ethical and legal guidelines for research involving traditional knowledge were followed. Prior informed consent was obtained from each participant, and explicit permission was secured for publication of photographs and associated personal or contextual information.

## Use of Artificial Intelligence (AI)

During manuscript preparation, AI-based writing assistance was utilized exclusively for editorial purposes, including language refinement and readability enhancement. The research process, including study design, data acquisition, analysis, interpretation and reporting of results, was performed independently by the authors without AI involvement. The authors accept complete responsibility for the authenticity, accuracy and scientific integrity of the work presented.

## Data Availability

All data supporting this study are included within the article and its supplementary materials.

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