# Exploring traditional knowledge: an ethnobotanical survey of medicinal flora for determining memory-enhancing activity in South Odisha, India

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**Ethnobotany Research and Applications 34:48 (2026)** - http://dx.doi.org/10.32859/era.34.48.1-20
Manuscript received: 13/03/2026 - Revised manuscript received: 29/05/2026 - Published: 30/05/2026

## Research

## Abstract

*Background:* Memory is essential for learning and daily life, and its impairment is a growing public health concern. Traditional medicinal systems, especially among indigenous communities, have long used herbal remedies to enhance memory and cognitive performance.

*Methods:* An ethnobotanical survey was conducted in 2023-2024 across fifteen tribal villages in Rayagada district, Odisha. Data from 105 informants were gathered through semi-structured interviews and participatory observations. Ethnobotanical indices, including Relative Frequency of Citation (RFC), Cultural Importance Index (CI), and Use Value (UV), were calculated to assess the significance of the documented species.

*Results:* A total of 33 medicinal plant species from 25 families were recorded, with Fabaceae as the dominant family. Herbs were the most common life form, while leaves and rhizomes were the most frequently used parts. Oral administration was the main route, and decoctions and powders were the most common preparation methods (17 reports each). Several species showed high cultural significance, including *Curculigo orchioides* (CI = 0.95, UV = 1.71), *Withania somnifera* (CI = 1.00, UV = 1.00), *Bacopa monnieri* (CI = 0.76, UV = 1.22), *Allium sativum* (CI = 0.90, UV = 1.24), and *Centella asiatica* (CI = 0.95, UV = 0.95). Pharmacological analysis revealed mainly anti-inflammatory (21.5%), neuroprotective/cognitive (19.2%), and antioxidant (16.9%) activities.

*Conclusion:* The study highlights the continued use of traditional medicinal plants for memory enhancement among tribal communities of southern Odisha. Species with high cultural importance and use values may be promising candidates for future phytochemical, pharmacological, and clinical studies to develop evidence-based cognitive therapeutics.

*Keywords:* Ethnobotany; Memory enhancement; Nootropic plants; Cultural Importance Index; Traditional knowledge; Odisha.

## Background

A thorough overview of the many traditional medical practices used by various cultures and indigenous populations can be obtained from an ethnobotanical survey. These surveys provide insight into conventional medical knowledge, practices, and beliefs through the gathering and analysis of data about medicinal plants and their uses (Malík & Tlustoš, 2023). Plants are used as the primary source of medicine in many cultures. The many medicinal plants utilized by diverse tribes, along with their preparation techniques and applications, are documented by ethnobotanical studies. This covers herbal treatments for common disorders such as gastrointestinal, respiratory, and skin concerns and pain relief. More than only herbal medicines are frequently included in traditional medicine (Lin *et al.,*2021). It might incorporate various techniques, including acupuncture, massage, energy healing, and spiritual ceremonies. These many forms of healing can be documented by ethnobotanical studies, which can also shed light on their cultural and spiritual value. Traditional medicine has a solid cultural foundation passed down through the years. The conventional knowledge systems around medicinal plants, including the identification, harvesting, and processing methods, are documented by ethnobotanical studies (Jain *et al.* 2025). This information is frequently ingrained in ceremonial practices, oral traditions, and cultural beliefs. Surveys conducted by ethnobotanists help protect medicinal plants' habitats and their species. Researchers can discover endangered species owing to overharvesting or habitat degradation by cataloguing the traditional uses of plants. To guarantee that medicinal plants are available for future generations, this information can direct conservation efforts and sustainable practices (Lawal et al.,2020). Integrating conventional medicine with contemporary healthcare systems is made more accessible by ethnobotanical surveys. Researchers can work with scientists and healthcare practitioners to evaluate traditional knowledge and create remedies using evidence by identifying plants with possible therapeutic characteristics. This integration can advance holistic healthcare strategies by bridging the gap between conventional and modern medicine (Yogeesha & Krishnakumar, 2023). In general, ethnobotanical studies highlight the complex connections between plants, culture, and therapeutic techniques and offer a comprehensive understanding of ancient medical systems. They encourage sustainable resource management, help keep traditional knowledge alive, and provide chances for cooperation between conventional healers and modern healthcare professionals.

Rayagada district of Odisha, India, has a long history of using medicinal plants to treat various illnesses. Generation after generation has carried down their knowledge of these plants, a crucial component of their cultural heritage. The ancient medical practices of Ayurveda, Siddha, and folk medicine are primarily used by the indigenous populations in the Rayagada district. These systems strongly emphasise using therapeutic plants that can be found nearby (Swain *et al.* 2022). The territory of Rayagada is endowed with a wide variety of vegetation, which offers a plentiful supply of medicinal plants. The district has various medicinal plant species due to its location, variable climate, and woods. The inhabitants of the Rayagada district are very knowledgeable about medicinal plants and their curative qualities (Nayak *et al.* 2024). Oral transmission of this knowledge frequently occurs through tribal shamans, elders in the local community, and conventional healers. In Rayagada district, traditional techniques such as decoctions, infusions, poultices, and pastes are frequently used to manufacture medications (Pattanaik,2006). Depending on the condition and the plant portion employed, these medicines are given orally, topically, or through inhalation. It is crucial to remember that the traditional use of medicinal plants in the Rayagada district has mostly been based on cultural customs and empirical knowledge. Additional scientific investigation and validation are required to comprehend the effectiveness, safety, and potential interactions of these botanicals with contemporary medicine (Das & Gautam 2022).

Nootropics, commonly referred to as "smart drugs," are chemicals that are thought to increase cognitive processes like memory, focus, creativity, and mental clarity. Despite the availability of pharmacological and synthetic alternatives, ethnobotanical studies have also revealed several plants that have long been utilised as nootropics (Babawale *et al.,*2016). Brahmi, also known as *Bacopa monnieri*, is a popular plant in Ayurvedic medicine. It is well known for its capacity to improve cognition. Ethnobotanical studies have confirmed its historical usage in enhancing memory, concentration, and general cognitive function (Adams *et al.,*2007). The use of the Chinese native *Ginkgo biloba* in traditional Chinese medicine dates back many years. It is regarded as a strong antioxidant and is thought to improve mental abilities, including focus and memory. Ethnobotanical investigations have confirmed its historical use as a nootropic drug. East Asians frequently use *Panax ginseng*, also referred to as Asian ginseng or Korean ginseng (Dabaghian *et al.* 2022). It has been used for centuries to boost memory, attentiveness, and cognitive performance. Its historical use as a nootropic drug has been discovered through ethnobotanical studies. The perennial herb *Rhodiola rosea*, sometimes called Arctic root or golden root, has long been utilized in Scandinavian and Siberian folk medicine. It is used to treat stress and fatigue since it is thought to have adaptogenic characteristics. Ethnobotanical studies have emphasized its potential cognitive-enhancing properties, such as better mental performance and decreased mental tiredness (Masondo *et al.*,2019). A tiny herbaceous plant native to Southeast Asia, gotu kola is known by its scientific name, *Centella Asiatica*. It has long been employed in conventional medical practices, including

Ayurveda and traditional Chinese medicine. Its potential nootropic characteristics, such as its capacity to boost memory and cognitive function, have been uncovered through ethnobotanical study (Usman *et al.* 2025).

Despite the availability of ethnobotanical information, there is a lack of focused studies addressing plants with specific therapeutic roles, particularly those related to cognitive enhancement and neurological health in this region. Most existing studies emphasize general medicinal uses, while limited attention has been given to the identification and quantitative evaluation of plants with nootropic or memory-enhancing potential among tribal communities of Rayagada. Therefore, the present study aims to document and analyse the medicinal plants used by indigenous communities of Rayagada district for memory enhancement and cognitive health. The study further intends to provide a systematic ethnobotanical evaluation of these plants, thereby contributing to the scientific understanding and potential future validation of traditional knowledge.

## Materials and Methods

**Study area**

The study was conducted in the Rayagada district, located in the southern part of the state of Odisha. Geographically, the district lies between 18°30′ N and 19°35′ N latitude and 83°30′ E and 84°30′ E longitude (Das, 2021). It is bounded by Koraput district to the south, the Kalahandi district to the west, Kandhamal district to the north, and Gajapati district to the east. The district forms part of the Eastern Ghats and is characterized by undulating topography consisting of hills, plateaus, and river valleys, with elevations ranging from 150 to 900 m above mean sea level. Major rivers such as the Nagavali River, along with Bansadhara, Kalyani, and Retinga, play a crucial role in sustaining agriculture and local livelihoods (Majhi *et al.* 2023). The region experiences a tropical climate with hot summers (25-40°C), mild winters (15-25°C), and monsoon rainfall from June to September. The area is dominated by dense forest cover and is inhabited by indigenous tribal communities such as the Dongria Kondh, Kutia Kondh, and Soura tribe, who possess extensive traditional knowledge of plant resources.

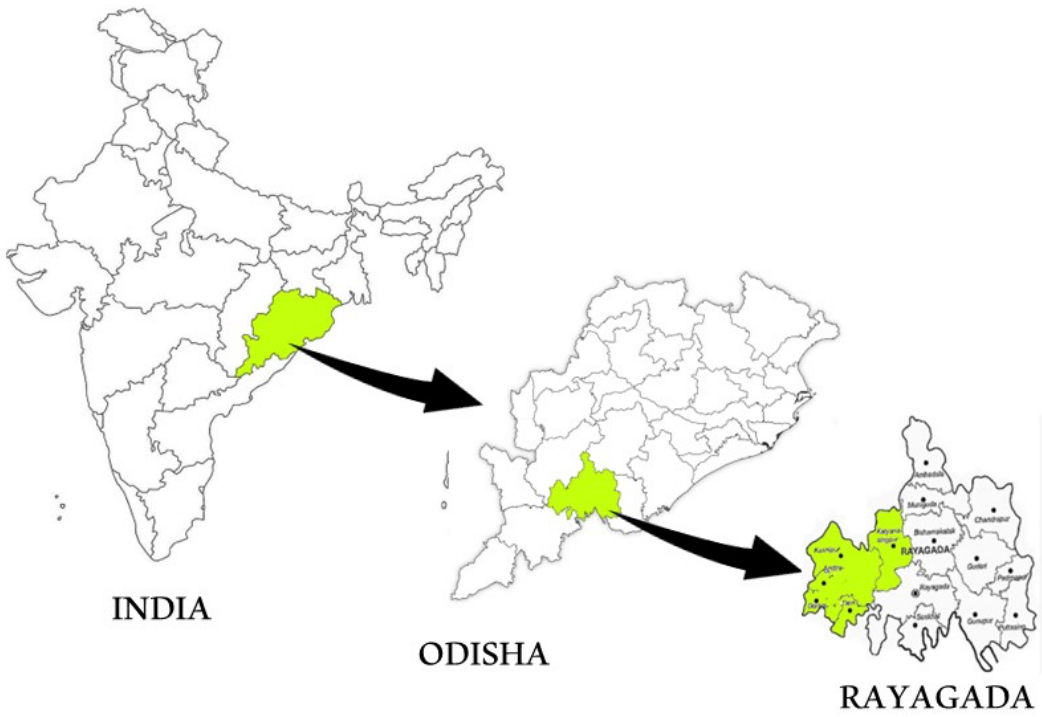


Figure 1. Study area of the research

**Selection of Study Sites and Informants**

Fifteen tribal villages, namely Kurusomohi, Duargudi, Durgapadu, Kurli, Ambabali, Otaghati, Panchakudi, Hingubari, Musudi, K. Singhpur, Kaliyaripeta, Sanadenganali, Bhatiguma, and Niyamgiri, were selected for the ethnobotanical survey based on their rich biodiversity and the prevalence of traditional healing practices. Informants were identified through purposive and snowball sampling approaches, focusing primarily on traditional healers, elderly individuals, and knowledgeable community members. A total of 105 informants representing different age groups and both genders participated in the study.

Figure 1. Ethnobotanical Survey at Kurli Village

**Data Collection and Ethnobotanical Survey**

Field investigations were carried out during 2023-2024. Each village was visited twice, with each visit lasting two days and approximately five hours of fieldwork per day, resulting in a total sampling effort of 30 days (150 hours). Before field visits, field books were prepared, and GPS devices were calibrated for accurate recording. During the survey, ethnobotanical information was collected through semi-structured interviews, open-ended discussions, and direct field observations. Data recorded included local plant names, parts used, methods of preparation, therapeutic applications, and modes of administration.

Plant specimens were collected in the presence of local informants and tagged with unique field numbers. GPS coordinates and habitat details were recorded for each specimen. The collected samples were pressed, dried, and processed following standard herbarium techniques. Voucher specimens were mounted on herbarium sheets with detailed labels including collection number, date, locality, vernacular names, and ethnomedicinal uses. Digital documentation was also performed to support specimen records.

**Plant Identification and Authentication**

Taxonomic identification of collected specimens was carried out using standard floristic literature and comparison with authenticated herbarium specimens. Where necessary, expert consultation was undertaken to resolve ambiguities. Identified specimens were deposited in recognized herbaria, including the Botanical Survey of India, and institutional repositories for future reference (Weckerle *et al.* 2019).

**Ethical Considerations**

Ethical guidelines for ethnobotanical research were strictly followed throughout the study. Prior to data collection, Prior Informed Consent (PIC) was obtained from all participants after clearly explaining the objectives, scope, and intended use of the research. Participation was entirely voluntary, and informants had the right to withdraw at any stage.

The study also complies with the principles of the Nagoya Protocol on Access and Benefit Sharing (ABS). Traditional knowledge was documented with due respect to community rights, ensuring that no information was exploited without acknowledgment. Confidentiality and anonymity of the informants were maintained, and the use of ethnobotanical knowledge was restricted to academic and research purposes only.

**Quantitative Ethnobotanical Analysis**

The collected ethnobotanical data were analysed using quantitative indices such as Relative Frequency of Citation (RFC) and Cultural Importance Index (CI). RFC was calculated based on the number of informants citing a particular species (U) divided by the total number of informants (N), reflecting the relative significance of each species within the study area.

RFC is used to measure how commonly a plant species is mentioned by informants. Each time an informant reports using a particular species, it is counted as a use report (UR). The total number of informants who mention a species is called the frequency of citation (FC). RFC is calculated by dividing the number of informants who cited the species (FC) by the total number of informants in the study (N). The value of RFC ranges from 0 to 1, where 0 means no one mentioned the plant and 1 means all informants mentioned it (Acharya *et al.* 2023). The formula used to calculate RFC is as follows:

$$\mathrm{RFCs} = \frac{\mathrm{FCs}}{\mathrm{N}} = \frac{\sum_{\mathrm{i=i1}}^{\mathrm{iN}} \mathrm{URi}}{\mathrm{N}}$$

CI shows how important a plant is in a community based on how many people use it and how many different uses it has. It is calculated by adding all the use reports for a species and dividing by the total number of informants (N) (Leonti 2022). The formula utilised to compute CI is:

$$\mathrm{CIi} = \sum_{\mathrm{u=u1}}^{\mathrm{uNC}} \sum_{\mathrm{i=i1}}^{\mathrm{iN}} \mathrm{URui}\ /\mathrm{N}.$$

**Use Value (UV)**

UV indicates the relative importance of a plant species based on the number of use reports.

$$UV = \frac{\sum U_i}{N}$$

Where:

$U_i$= Number of use reports cited by each informant for a given species

$N$= Total number of informants

**Family Use Value (FUV)**

FUV represents the average use value of all species within a particular plant family.

$$FUV = \frac{\sum UV_s}{n_s}$$

Where:

$UV_s$= Use value of each species within a family

$n_s$= Total number of species in that family

**Fidelity Level (FL)**

FL shows the percentage of informants who use a plant species for a specific purpose compared to all uses of that species.

$$FL(\%) = \frac{N_p}{N} \times 100$$

Where:

$N_p$= Number of informants who reported a specific use of a species

$N$= Total number of informants who mentioned the plant for any use

## Results

**Demographic Profile and other essential information about learning and memory enhancers in the study area**

The research engaged 105 participants from diverse communities, encompassing tribal groups such as Saura, Kandha, Santala, Dangaria, Paroja, Mirdha, Sabar, Halva, Kutia, Manda, Gadaba, Bonda, Gond, and Jatapu. Among the all-community informants, 65% were men and 35% were women, aged 18 to 80. Male participants exhibited a higher degree of informativeness than their female counterparts. Informants aged 45 years were particularly prominent in explaining the traditional uses of plants for enhancing learning and memory. Despite most informants being illiterate, there was widespread trust in traditional Ayurvedic herbal therapies. The study primarily focused on the Niyamgiri Hills region, known for its tribal richness in southwest Odisha, Rayagada. Most information was gathered from the Hingubari region, followed by Kurusomohi and Panchakudi. These details, including survey specifics and informant data, are meticulously presented in Table 1. The study identified 33 plant species from 25 families commonly used to enhance memory and treat cognitive disorders by various ethnic groups and tribes across different locations. The bar diagram illustrates the family-wise distribution of medicinal plant species documented during the ethnobotanical survey, highlighting the number of species represented in each plant family (Figure 3). The collected data include botanical names, vernacular names, family names, voucher specimen numbers, habits, parts used, routes of administration, modes of preparation, doses, types of people who use them, and their locations (Table 2).

Table 1. Demographics/Sociocultural parameters of Participants in the ethnobotanical study (N=105)

| Demographic/ Sociocultural Variables | Parameters | Sample Number | Percentage |
|---|---|---|---|
| **Locality** | Kurusomohi | 10 | 9.5 |
| | Duargudi | 9 | 8.5 |
| | Durgapadu | 6 | 5.7 |
| | Kurli | 5 | 4.7 |
| | Ambabali | 5 | 4.7 |
| | Otaghati | 5 | 4.7 |
| | Panchakudi | 10 | 9.5 |
| | Hingubari | 11 | 10.5 |
| | Musudi | 7 | 6.6 |
| | K.Singhpur | 8 | 7.6 |
| | Kaliyaripeta | 6 | 5.7 |
| | Sanadenganali | 7 | 6.6 |
| | Bhatiguma | 7 | 6.6 |
| | Niyamgiri | 9 | 8.5 |
| **Gender** | Male | 68 | 64.76 |
| | Female | 37 | 35.23 |
| **Age Group** | <30 | 13 | 12.38 |
| | 31-40 | 15 | 14.28 |
| | 41-50 | 31 | 29.52 |
| | 51-60 | 15 | 14.28 |
| | 61-70 | 19 | 18.09 |
| | >71 | 12 | 11.42 |
| **Name of the community of informants** | Saura | 9 | 8.5 |
| | Kandha | 7 | 6.6 |
| | Santala | 10 | 9.5 |
| | Dangaria | 1 | 0.95 |
| | Paroja | 10 | 9.5 |
| | Mirdha | 13 | 12.38 |
| | Sabar | 3 | 2.85 |
| | Halva | 6 | 5.7 |
| | Kutia | 10 | 9.5 |
| | Manda | 1 | 0.95 |
| | Gadaba | 9 | 8.5 |
| | Bonda | 14 | 13.33 |
| | Gond | 12 | 11.42 |
| | Jatapu | 8 | 7.6 |
| **Study level** | No study | 54 | 51.42 |
| | Primary School | 28 | 26.66 |
| | High School | 16 | 15.23 |
| | Intermediate | 5 | 4.7 |
| | University | 2 | 1.9 |

Table 2. Botanical Details of Traditionally Used Plants to enhance the memory in the study area.

| Botanical name | Vernacular name | Family | Voucher specimen No. | Habit | Part used | Route of administration | Mode of preparation | Dose | Reported pharmacological activity |
|---|---|---|---|---|---|---|---|---|---|
| *Withania somnifera* (L.) Dunal | Aswagandha | Solanaceae | CUTM/BOT/23/21 | Herb | Leaves | Oral | Decoction | 1-2 tbsp with lukewarm water for 2months | immune modulatory, anti-stress, anti-oxidant, analgesic, adaptogenic, immunostimulant properties |
| *Centella asiatica* (L.) Urb. | Thalkudi | Apiaceae | CUTM/BOT/23/11 | Herb | Leaves | Oral | Juice, Decoction | 1tbsp once a day for 2-3 weeks for 4 months | Antidepressant activity, Antioxidant activity, Neuroprotective Activity, Wound healing activity, Anti-cancer activity, Anti-inflammatory activity |
| *Ginkgo biloba* L. | Balkuanri | Ginkgoaceae | CUTM/BOT/23/13 | Tree | Leaves | Oral | Tincture, Powder, Decoction | 1 tsp daily for 6months | improves spatial memory, anti-anxiety, anti-allergic activity |
| *Glycyrrhiza glabra* L. | Jatimadhu | Fabaceae | CUTM/BOT/23/14 | Herb or under shrub | Root | Oral | Powder | 1-2 tsp twice daily with luke warm water or milk befor food for 15 days | anticancer, hepatoprotective, antibacterial, anti-inflammatory |
| *Tinospora cordifolia* (Willd.) Hook. f. & Thomson | Guduchi | Menispermaceae | CUTM/BOT/23/15 | Shrub | Whole plant | Oral | Juice, Powder, Decoction, Satwa | 1 tsp once daily for 1 month | antioxidant, antimicrobial, antiviral, antiparasitic, antidiabetic, anticancer, anti-inflammatory, analgesic, antipyretic, hepatoprotective |
| *Alstonia scholaris* (L.) R.Br. | Saatparna | Apocynaceae | CUTM/BOT/23/18 | Tree | Bark | Oral | Powder, Decoction | Powder 1tsp or decoction 2-3tbsp once a day for a month | Antioxidant, antimalarial, spasmolytic activity |
| *Asparagus racemosus* Willd. | Satamuli | Asparagaceae | CUTM/BOT/23/16 | Herb | Root | Oral | Decoction | 30 drops thrice | Antidepressant, antistress, adaptogenic activity, memory enhancing property |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | daily for 15 days | |
| *Allium sativum* L. | Rasuna | Amaryllidaceae | CUTM/BOT/23/20 | Herb | Bulb | Oral | Oil, Powder | 1tbsp powder or 1 coin size amount of oil daily for 1 month | Memory enhancing, antibacterial, fungicidal antihypertensive, antimicrobial, and anticancer property |
| *Bacopa monnieri* (L.) Wettst. | Bahmni | Plantaginaceae | CUTM/BOT/23/12 | Herb | Whole plant | Oral | Powder, Maceration, Decoction | 1-2 tsp twice a day for 2 months | antistress, immunomodulatory, cognition fascilatatory, anti-inflammatory and anti-aging effect |
| *Boerhavia diffusa* L. | Gadhapuni | Nyctaginaceae | CUTM/BOT/23/22 | Herb | Leaves | Oral | Powder | 1tsp twice a day for 2 months | Antidepressant, antioxidant, immunomodulatory, antistress activity |
| *Celastrus paniculatus* Willd. | Pengu | Celastraceae | CUTM/BOT/23/23 | Shrub | Seed | Topical | Oil | 1-5drops with cold water or milk once a day | intellect-promoting, digestive, laxative, emetic, expectorant, appetizer, aphrodisiac, cardiotonic, anti-inflammatory |
| *Curculigo orchioides* Gaertn. | Talamuli | Hypoxidaceae | CUTM/BOT/23/24 | Herb | Rhizome | Oral | Powder | 2tbsp with milk after dinner | anti-diabetes, antibacterial, anti-inflammatory, osteoporosis, antioxidant, Neuroprotective effect |
| *Curcuma longa* L. | Haladi | Zingiberaceae | CUTM/BOT/23/17 | Herb | Rhizome | Oral | Powder | 1 tbsp with milk 2 times a day | antitoxic, anticancer, antibacterial, anti-inflammatory, antioxidant effects |
| *Ipomoea aquatica* Forssk. | Kalam saag | Convolvulaceae | CUTM/BOT/23/01 | Herb | Leaves | Oral | Decoction | ½ tbsp thrice a day for 30 days | Anti-diabetic activity, Anti-inflammatory activity, Nootropic activity, anti-epileptic activity, Anxiolytic activity |
| *Abelmoschus esculentus* (L.) Moench | Bhendi | Malvaceae | CUTM/BOT/23/08 | Herb | Fruits | Oral | Powder | 1tbsp with lukewarm water twice a day | antioxidant, anti-inflammatory and immunomodulatory, antibacterial, anticancer, antidiabetic, nootropic effect |

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|---|---|---|---|---|---|---|---|---|---|
| *Pueraria tuberosa* (Willd.) DC. | Masiha Kanda | Fabaceae | CUTM/BOT/23/32 | Herb | Rhizome | Oral | Half Boiled | 2-3 little finger size pieces with honey or jagerry | Antitubercular, antifungal, antihepatotoxic, anti-inflammatory, wound healing activity |
| *Rubia cordifolia* L. | Manjistha | Rubiaceae | CUTM/BOT/23/04 | Climbing herb | Leaves | Oral | Decoction | 2tbsp daily once for 2moths on alternative days | Anti-inflammatory, analgesics, lantihyperglycemic, antistress, nootropic activity |
| *Panax ginseng* C.A.Mey. | Khandabahali | Araliaceae | CUTM/BOT/23/05 | Herb | Root | Oral | Powder, Decoction | 1/4$^{th}$ tbsp once daily for 3 months | Antioxidant activity, Antiinflammatory activity, Anticancer activity, Neuroprotective activity |
| *Sida cordifolia* L. | Bajromuli | Malvaceae | CUTM/BOT/23/19 | Shrub | Bark | Oral | Water infusion | 1 cup daily once a day | Anti-inflammatory, antistress, antioxidant, memory enhancing activity |
| *Vitis vinifera* L. | Angur | Vitaceae | CUTM/BOT/23/27 | Climber | Fruit | Oral | Juice, dry fruit | Daily 1 glass for 10-15 days | Antistress, antioxidant, nootropic activity |
| *Tridax procumbens* L. | *Bishalya karani* | Asteraceae | CUTM/BOT/23/28 | Shrub | Leaves | Oral | Juice | 1tbsp once a day for 2-3months | anti-inflammatory, Immunomodulatory, Anti-diabetic, antiviral, antibiotic efficacies, antiparasitic, Antiobesity, Anticancer, wound healing, antioxidant activity |
| *Ocimum tenuiflorum* L. | Tulsi | Lamiaceae | CUTM/BOT/23/29 | Shrub | Leaves | Oral | Decoction, raw leaves | 1/2tbsp daily for 15 days | Antistress, anticonvulsant, antioxidant, antiulcer, antidiabetic, immunomodulatory, anti-inflammatory effect |
| *Convolvulus prostratus* Forssk. | Aprajita | Convolvulaceae | CUTM/BOT/23/30 | Herb | Flower | Oral | Decoction | Decoction daily 1 cup before food in the morning | anti-oxidant, analgesic, immunomodulatory, memory enhancing properties |

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|---|---|---|---|---|---|---|---|---|---|
| *Benincasa hispida* (Thunb.) Cogn. | Paenkakharu | Cucurbitaceae | CUTM/BOT/23/10 | Herb | Fruit | Oral | Soup, Juice | 1 glass once a day for 1month | antiulcer, anti-inflammatory drug, antihistaminic, antidepressant drug, bronchodilator, antihistaminic, analgesic |
| *Acorus calamus* L. | bacha | Acoraceae | CUTM/BOT/23/06 | Herb | Rhizome | Oral | Decoction, Powder | 1/2 tbsp powder once a day for 15 days | anticonvulsant, antispasmodic, cardiovascular, hypolipidemic, immunosuppressive, anti-inflammatory, cryoprotective, antioxidant, antidiarrheal, antimicrobial, anticancer |
| *Nardostachys jatamansi* (D.Don) DC. | kuchlata | Caprifoliaceae | CUTM/BOT/23/07 | Herb | Rhizomes | Oral | Decoction | 1tbsp once a day for 15-30 days | hepatoprotective activity, central nervous system activity, anticonvulsant activity, neuroprotective activity, antioxidant activity |
| *Phyllanthus emblica* L. | Aanla | Phyllanthaceae | CUTM/BOT/23/25 | Tree | Fruit | Oral | Juice, Powder | 1tbsp juice at morning and 1tbsp powder at night after dinner with luke warm water daily for 3 months | antioxidant, anti-aging, anti-cholesterol, anti-diabetic, immunomodulatory, antipyretic, analgesic, anti-inflammatory, |
| *Zingiber officinale* Roscoe | Ada | Zingiberaceae | CUTM/BOT/23/02 | Herb | Rhizome | Oral | Juice, Powder, Decoction | 1tbsp juice or ¼ tbsp powder or 1 cup decoction once after food | immuno-modulatory, anti-tumorigenic, anti-inflammatory, anti-apoptotic, anti-hyperglycemic, anti-lipidemic and anti-emetic |
| *Foeniculum vulgare* Mill. | Panmahuri | Apiaceae | CUTM/BOT/23/03 | Herb | Fruit | Oral | Decoction | 1 cup at morning after food | immuno-modulatory, anti-tumorigenic, anti-inflammatory, anti-apoptotic, |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | anti-hyperglycemic, anti-lipidemic and anti-emetic |
| *Albizia lebbeck* (L.) Benth. | Sirla | Fabaceae | CUTM/BOT/23/31 | Tree | Bark | Oral | Powder | 1tsp for 15 days once a day | Anti-histaminic activity, Analgesic and Anti-inflammatory activity, Anti-bacterial activity, Anti-convulsive activity, Anthelmintic activity |
| *Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult. | Tagra | Apocynaceae | CUTM/BOT/23/26 | Shrub | Root | Oral | Powder Decoction | Powder 1-2tsp once a day after lunch | antimicrobial, antioxidant, anti-inflammatory, anticholinesterase, antineurodegenerative, anticancer, antidiabetic |
| *Eclipta prostrata* (L.) L. | Gurgul | Burseraceae | CUTM/BOT/23/33 | Shrub | Resin | Oral | Powder | 1-2tsp once a day for 1 month | Anti-Inflammatory and Antiarthritic Activity, Antioxidant Activity, Antihyperglycemic Activity, Antimicrobial Activity |

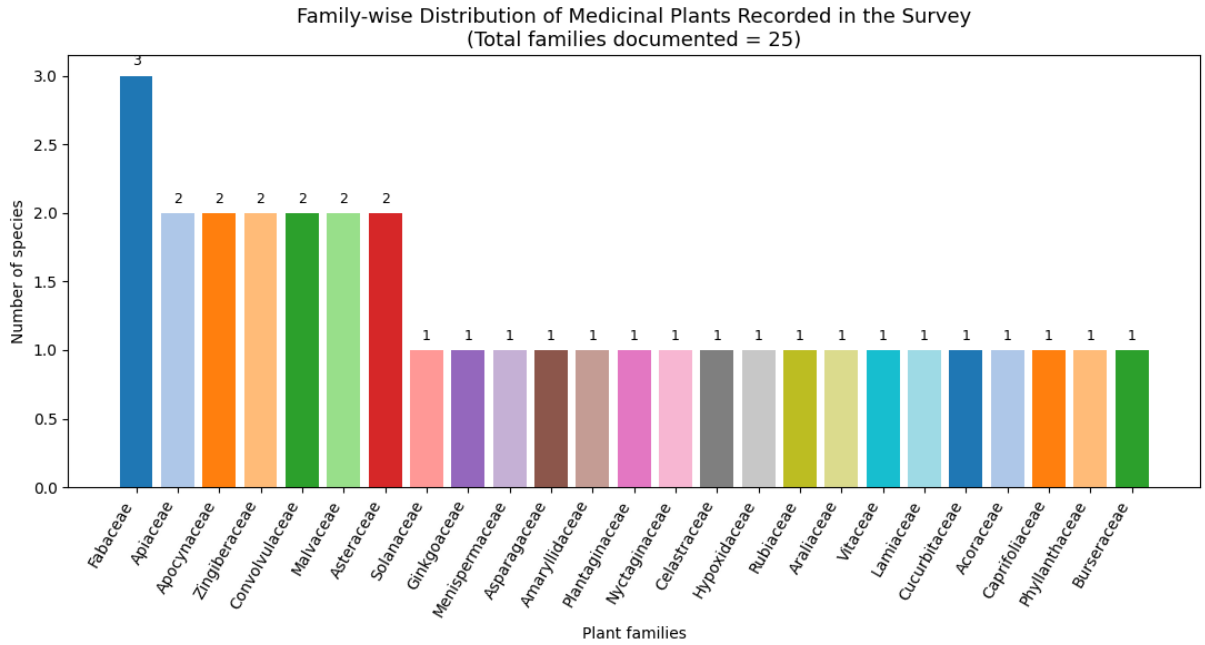


Figure 3. Family-wise distribution of medicinal plants recorded in the ethnobotanical survey (Microsoft Excel, Microsoft Corporation, USA).

Key findings show that common herbs and their preparations include *Withania somnifera* (Aswagandha) leaves as a decoction, *Centella asiatica* (Thalkudi) leaves as juice and decoction, *Ginkgo biloba* (Balkuanri) leaves in tincture, powder, and decoction forms, *Glycyrrhiza glabra* (Yastimadhu) roots as powder, and *Tinospora cordifolia* (Guduchi) whole plant as juice, powder, decoction, and satwa. Most of the plants belong to the herb category. Usage patterns reveal that plant parts like leaves, roots, rhizomes, and fruits are predominantly used, with the oral route being the most common method of administration. Modes of preparation include decoctions, powders, juices, tinctures, and oils. Dosages vary from small amounts to larger quantities, with treatment durations ranging from 15 days to several months. The bar diagram depicts the frequency of different modes of preparation used for medicinal plants as reported in the ethnobotanical survey (Figure 4)

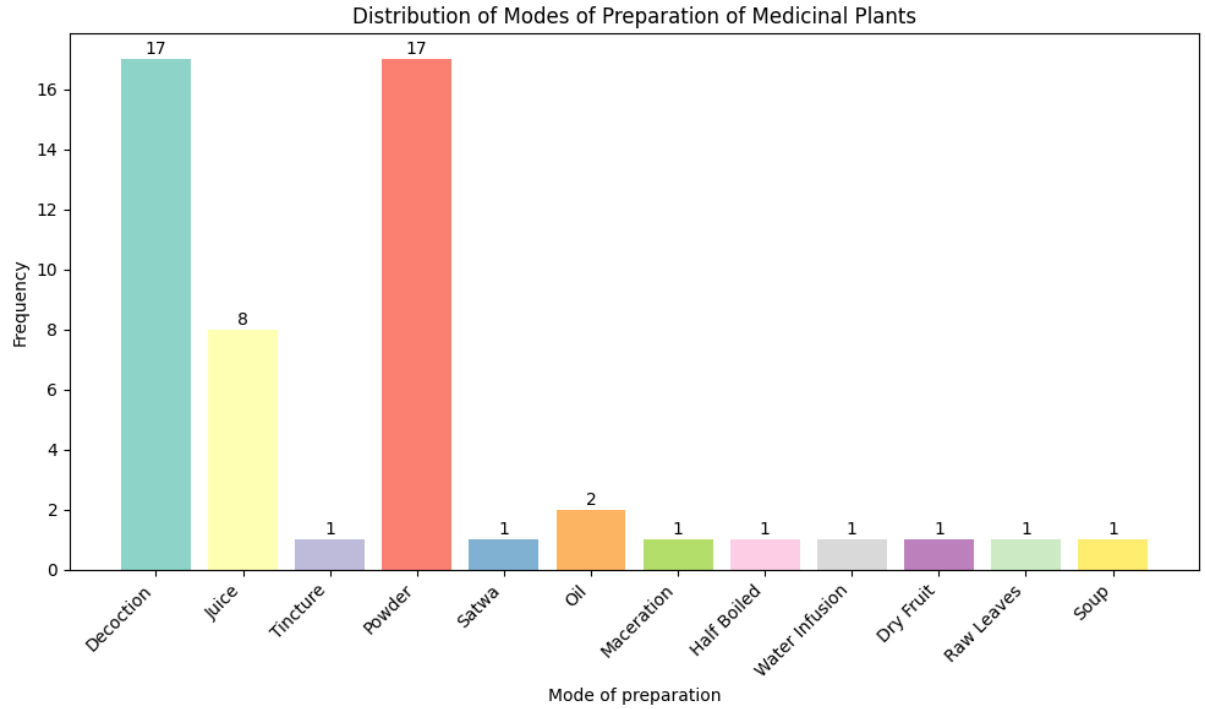


Figure 4. Distribution of modes of preparation of medicinal plants documented during the ethnobotanical survey. (Microsoft Excel, Microsoft Corporation, USA)

The herbs are utilized by various tribal groups such as Saura, Gadaba, Bonda, Gond, and Paroja, in geographical locations including Kurusomohi, Duargudi, Durgapadu, and Kaliyaripeta. Specific examples include *Withania somnifera* taken as a decoction by tribes in Kurusomohi and surrounding areas, *Centella asiatica* consumed as juice or decoction by tribes in Kurli and Ambabali, *Ginkgo biloba* used in tincture, powder, or decoction form by tribes in K. Singhpur, *Glycyrrhiza glabra* used as a powder by the Gadaba and Bonda tribes in Dhanapadar and Bhatiguma, and *Tinospora cordifolia* administered as juice, powder, decoction, or satwa by several tribal groups in Hingubai and Musudi. The detailed documentation of doses and preparation methods provides a valuable resource for further research and potential therapeutic applications. The study revealed that among the 33 plant species, *Curculigo orchioides* had the highest number of participants (IP) with 100, closely followed by Acorus Calamus and Benincasa hispida, both with 99 participants. *Curculigo orchioides* (Talamuli) had the highest response (IR) with 98, while *Curculigo orchioides* had the highest use report (UR) with 180, and *Allium Sativum* had a notable UR of 130. The highest relative frequency of citation (RFC) was observed in *Curculigo orchioides*, which scored 0.95 for IP/N and 1.71 for UR/N, indicating a strong recognition of its effectiveness among users (Table 3). The bar diagram presents medicinal plant species exhibiting high cultural importance based on Cultural Importance Index (CI) values (Figure 5).

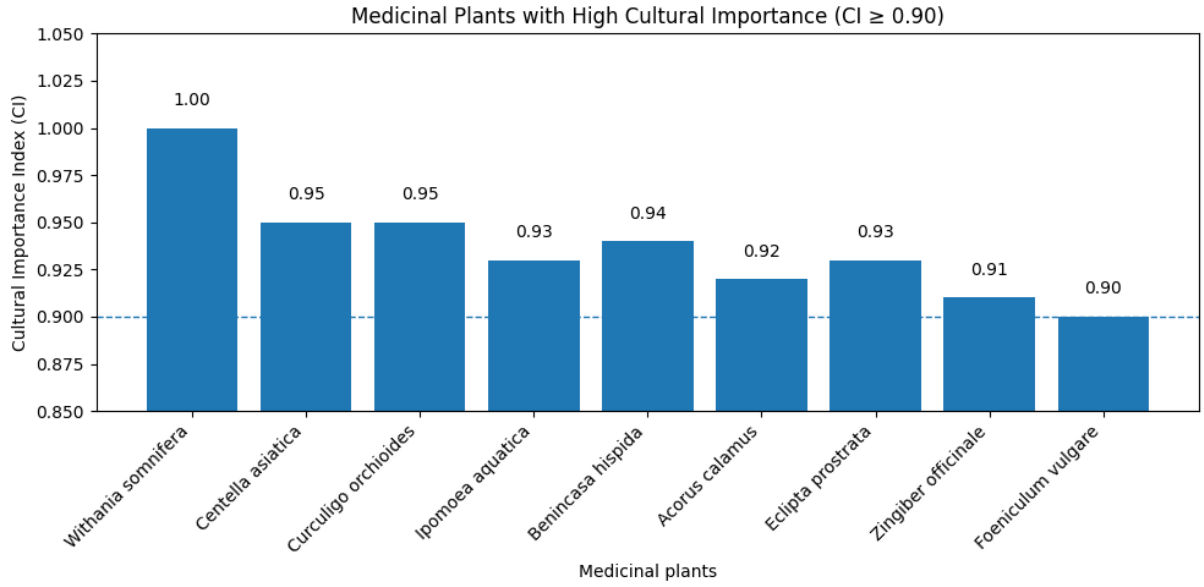


Figure 5. Medicinal plants with high cultural importance (CI ≥ 0.90) documented during the ethnobotanical survey. (Microsoft Excel, Microsoft Corporation, USA)

Table 3. Quantitative parameters and the results obtained from the participants of the ethnobotanical survey (N=105)

| **Botanical name N=105** | **IP (participant)** | **IR (response)** | **UR (Use report)** | **RFC** | **CI** | **UV** |
|---|---|---|---|---|---|---|
| *Withania somnifera* (L.) Dunal | 95 | 90 | 105 | 0.90 | 1.00 | 1.00 |
| *Centella asiatica* (L.) Urb. | 98 | 76 | 100 | 0.93 | 0.95 | 0.95 |
| *Ginkgo biloba* L. | 70 | 38 | 80 | 0.67 | 0.76 | 0.76 |
| *Glycyrrhiza glabra* L. | 76 | 35 | 60 | 0.72 | 0.57 | 0.57 |
| *Tinospora cordifolia* (Willd.) Hook. f. & Thomson | 68 | 50 | 70 | 0.65 | 0.67 | 0.67 |
| *Alstonia scholaris* (L.) R.Br. | 80 | 60 | 85 | 0.76 | 0.81 | 0.81 |
| *Asparagus racemosus* Willd. | 90 | 75 | 88 | 0.86 | 0.84 | 0.84 |
| *Allium sativum* L. | 95 | 88 | 130 | 0.90 | 1.24 | 1.24 |
| *Bacopa monnieri* (L.) Wettst. | 80 | 76 | 128 | 0.76 | 1.22 | 1.22 |
| *Boerhavia diffusa* L. | 80 | 65 | 60 | 0.76 | 0.57 | 0.57 |
| *Celastrus paniculatus* Willd. | 80 | 30 | 25 | 0.76 | 0.24 | 0.24 |
| *Curculigo orchioides* Gaertn. | 100 | 98 | 180 | 0.95 | 1.71 | 1.71 |
| *Curcuma longa* L. | 80 | 78 | 100 | 0.76 | 0.95 | 0.95 |
| *Ipomoea aquatica* Forssk. | 98 | 85 | 90 | 0.93 | 0.86 | 0.86 |
| *Abelmoschus esculentus* (L.) Moench | 92 | 92 | 90 | 0.88 | 0.86 | 0.86 |
| *Pueraria tuberosa* (Willd.) DC. | 60 | 45 | 70 | 0.57 | 0.67 | 0.67 |
| *Rubia cordifolia* L. | 85 | 73 | 44 | 0.81 | 0.42 | 0.42 |
| *Panax ginseng* C.A.Mey. | 79 | 65 | 34 | 0.75 | 0.32 | 0.32 |
| *Sida cordifolia* L. | 78 | 60 | 36 | 0.74 | 0.34 | 0.34 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Vitis vinifera* L. | 75 | 70 | 95 | 0.71 | 0.90 | 0.90 |
| *Tridax procumbens* L. | 65 | 50 | 98 | 0.62 | 0.93 | 0.93 |
| *Ocimum tenuiflorum* L. | 82 | 78 | 102 | 0.78 | 0.97 | 0.97 |
| *Convolvulus prostratus* Forssk. | 90 | 90 | 48 | 0.86 | 0.46 | 0.46 |
| *Benincasa hispida* (Thunb.) Cogn. | 99 | 93 | 78 | 0.94 | 0.74 | 0.74 |
| *Acorus calamus* L. | 97 | 95 | 56 | 0.92 | 0.53 | 0.53 |
| *Nardostachys jatamansi* (D.Don) DC. | 85 | 70 | 35 | 0.81 | 0.33 | 0.33 |
| *Phyllanthus emblica* L. | 90 | 88 | 104 | 0.86 | 0.99 | 0.99 |
| *Zingiber officinale* Roscoe | 96 | 85 | 100 | 0.91 | 0.95 | 0.95 |
| *Foeniculum vulgare* Mill. | 95 | 88 | 78 | 0.90 | 0.74 | 0.74 |
| *Albizia lebbeck* (L.) Benth. | 66 | 66 | 35 | 0.63 | 0.33 | 0.33 |
| *Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult. | 80 | 74 | 46 | 0.76 | 0.44 | 0.44 |
| *Eclipta prostrata* (L.) L. | 98 | 96 | 34 | 0.93 | 0.32 | 0.32 |

Family-wise analysis of use value revealed marked variation in ethnobotanical importance among the documented taxa (Table 4). Hypoxidaceae exhibited the highest average FUV per species (1.71), followed by Amaryllidaceae (1.24) and Plantaginaceae (1.22), indicating strong cultural preference despite single-species representation. Zingiberaceae (ΣUV = 1.90) and Asteraceae (ΣUV = 1.84) showed high total IV due to multiple frequently utilised species. A comprehensive review of the literature revealed that various medicinal plants exhibit cognitive and neuroprotective properties mediated by specific phytoconstituents acting on distinct molecular pathways and targets (Table 5). Fidelity level analysis revealed strong informant consensus for memory-related pharmacological activities, with several use categories showing very high values. Memory-enhancing and neuroprotective activities exhibited the highest fidelity levels (up to 171%), followed by nootropic, cognition-facilitatory, and antioxidant-mediated neuroprotective effects (≥90%). In contrast, activities related to CNS modulation, anxiolytic, and antistress effects demonstrated comparatively lower fidelity levels, indicating moderate consensus among informants.

Table 4.Family-wise distribution of medicinal plants showing total UV and average Use Value per species based on ethnobotanical survey data.

| **Family** | **No. of species** | **Total UV** | **FUV** |
|---|---|---|---|
| Solanaceae | 1 | 1.00 | 1.00 |
| Apiaceae | 2 | 1.69 | 0.85 |
| Ginkgoaceae | 1 | 0.76 | 0.76 |
| Fabaceae | 3 | 1.57 | 0.52 |
| Menispermaceae | 1 | 0.67 | 0.67 |
| Apocynaceae | 2 | 1.25 | 0.63 |
| Asparagaceae | 1 | 0.84 | 0.84 |
| Amaryllidaceae | 1 | 1.24 | 1.24 |
| Plantaginaceae | 1 | 1.22 | 1.22 |
| Nyctaginaceae | 1 | 0.57 | 0.57 |
| Celastraceae | 1 | 0.24 | 0.24 |
| Hypoxidaceae | 1 | 1.71 | 1.71 |
| Zingiberaceae | 2 | 1.90 | 0.95 |
| Convolvulaceae | 2 | 1.32 | 0.66 |
| Malvaceae | 2 | 1.20 | 0.60 |
| Rubiaceae | 1 | 0.42 | 0.42 |
| Araliaceae | 1 | 0.32 | 0.32 |
| Vitaceae | 1 | 0.90 | 0.90 |
| Asteraceae | 2 | 1.84 | 0.92 |
| Lamiaceae | 1 | 0.97 | 0.97 |
| Cucurbitaceae | 1 | 0.74 | 0.74 |
| Acoraceae | 1 | 0.53 | 0.53 |
| Caprifoliaceae | 1 | 0.33 | 0.33 |
| Phyllanthaceae | 1 | 0.99 | 0.99 |
| Burseraceae | 1 | 0.32 | 0.32 |

Table 5. Ethnobotanically reported plant species with cognition-associated phytoconstituents, memory-related pharmacological activities, and fidelity level (%) in Rayagada district.

| **Botanical name** | **Major phytoconstituents (cognition-linked)** | **Memory-related pharmacological activity** | **Fidelity Level (%)** |
|---|---|---|---|
| *Withania somnifera* (L.) Dunal | Withanolides, sitoindosides | Memory enhancing, neuroprotective, adaptogenic | 100 |
| *Centella asiatica* (L.) Urb. | Asiaticoside, madecassoside | Cognition enhancement, neuroprotective | 95 |
| *Ginkgo biloba* L. | Ginkgolides, bilobalide | Memory improvement, anti-anxiety | 76 |
| *Glycyrrhiza glabra* L. | Glycyrrhizin, liquiritigenin | Neuroprotective, antistress | 57 |
| *Tinospora cordifolia* (Willd.) Hook. f. & Thomson | Diterpenes, alkaloids | Neuroprotective, antistress | 67 |
| *Alstonia scholaris* (L.) R.Br. | Alkaloids, triterpenes | CNS modulation, antioxidant | 81 |
| *Asparagus racemosus* Willd. | Shatavarin saponins | Memory enhancing, adaptogenic | 84 |
| *Allium sativum* L. | Allicin, ajoene | Memory enhancing, neuroprotective | 124 |
| *Bacopa monnieri* (L.) Wettst. | Bacosides | Nootropic, cognition-facilitatory | 122 |
| *Boerhavia diffusa* L. | Punarnavine, flavonoids | Antistress, neuroprotective | 57 |
| *Celastrus paniculatus* Willd. | Celastrine, terpenoids | Memory enhancing, intellect-promoting | 24 |
| *Curculigo orchioides* Gaertn. | Curculigoside | Neuroprotective, antioxidant | 171 |
| *Curcuma longa* L. | Curcumin | Neuroprotective, antioxidant | 95 |
| *Ipomoea aquatica* Forssk. | Flavonoids | Nootropic, anxiolytic | 86 |
| *Abelmoschus esculentus* (L.) Moench | Polysaccharides | Nootropic, neuroprotective | 86 |
| *Pueraria tuberosa* (Willd.) DC. | Puerarin | Neuroprotective, antistress | 67 |
| *Rubia cordifolia* L. | Anthraquinones | Nootropic, antistress | 42 |
| *Panax ginseng* C.A.Mey. | Ginsenosides | Cognitive enhancement, neuroprotective | 32 |
| *Sida cordifolia* L. | Alkaloids, flavonoids | Memory enhancing, antistress | 34 |
| *Vitis vinifera* L. | Resveratrol | Nootropic, antioxidant | 90 |
| *Tridax procumbens* L. | Flavonoids | Neuroprotective, antioxidant | 93 |
| *Ocimum tenuiflorum* L. | Eugenol, ursolic acid | Antistress, neuroprotective | 97 |
| *Convolvulus prostratus* Forssk. | Alkaloids | Memory enhancing, neuroprotective | 46 |
| *Benincasa hispida* (Thunb.) Cogn. | Polysaccharides | Antidepressant, neuroprotective | 74 |
| *Acorus calamus* L. | α-, β-asarone | Memory enhancing, anticonvulsant | 53 |
| *Nardostachys jatamansi* (D.Don) DC. | Jatamansone | Neuroprotective, CNS modulator | 33 |
| *Phyllanthus emblica* L. | Ascorbic acid, tannins | Neuroprotective, antioxidant | 99 |
| *Zingiber officinale* Roscoe | Gingerols | Neuroprotective, antistress | 95 |
| *Foeniculum vulgare* Mill. | Anethole | Neuroprotective, anxiolytic | 74 |
| *Albizia lebbeck* (L.) Benth. | Saponins | CNS activity, anxiolytic | 33 |
| *Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult. | Indole alkaloids | Anticholinesterase, neuroprotective | 44 |
| *Eclipta prostrata* (L.) L. | Wedelolactone | Neuroprotective, antioxidant | 32 |

## Discussion

**Demographic Profile of Informants and Knowledge Distribution**

The findings of the present ethnobotanical survey conducted in the Rayagada district reveal clear patterns in the distribution of traditional medicinal knowledge across demographic groups. The higher level of knowledge observed among male informants suggests a gender-based differentiation in knowledge transmission, which may be attributed to sociocultural roles that traditionally position men as primary custodians of ethnomedicinal practices in many tribal societies. However, this does not necessarily indicate the absence of knowledge among women but rather reflects differences in accessibility, participation in formal interviews, and cultural visibility of knowledge holders.

Age emerged as a significant determinant of ethnobotanical knowledge, with individuals aged 45 years and above demonstrating greater familiarity with medicinal plant use. This trend supports the concept of erosion of traditional knowledge among younger generations, likely due to modernisation, reduced dependence on forest resources, and increased inclination toward allopathic medicine. Similar observations have been reported in other ethnobotanical studies, where elders act as repositories of indigenous knowledge (Contractor *et al.* 2018).

Spatial variation in knowledge distribution, particularly the higher concentration of information from Hingubari, followed by Kurusomohi and Panchakudi, may reflect localised biodiversity richness and the presence of experienced traditional healers. These findings indicate that ethnobotanical knowledge is not uniformly distributed but is influenced by ecological availability and social structure. The continued reliance on traditional medicine despite low literacy levels highlights a strong cultural foundation and trust in indigenous healthcare systems (Abha and Sadangi, 2012). Furthermore, the role of local healers, community elders, and Ayurvedic practitioners as key knowledge transmitters underscores the importance of social networks in maintaining ethnomedicinal traditions.

**Interpretation of Reported Cognitive-Enhancing Plants**

The documentation of plant species associated with memory enhancement reflects a convergence between traditional knowledge and emerging pharmacological evidence. While traditional claims form the basis of plant selection, the degree of scientific validation varies significantly across species.

Plants such as *Bacopa monnieri* and Centella asiatica demonstrate relatively stronger scientific support, particularly in terms of neuroprotective and cognition-enhancing effects. The presence of bioactive compounds like bacosides and triterpenoids suggests plausible mechanisms involving synaptic modulation, antioxidant defence, and neuronal growth (Ganapathy *et al.* 2023; Sbrini *et al.* 2020). Similarly, *Withania somnifera*, known for its adaptogenic properties, may indirectly influence cognitive function through stress reduction pathways (Meher et al. 2025). These findings indicate that some traditionally used plants have pharmacological relevance supported by experimental evidence.

In contrast, plants such as *Benincasa hispida* and *Ipomoea aquatica* appear to contribute more indirectly to cognitive health through nutritional support rather than specific neuropharmacological actions (Ng *et al.* 2020; Zweig *et al.* 2021). This distinction is important, as it highlights that not all plants classified as “memory-enhancing” act via direct neurocognitive mechanisms; some may improve general physiological conditions that support brain function.

The inclusion of globally recognised species such as *Ginkgo biloba* further suggests an overlap between indigenous practices and widely studied phototherapeutics. Although evidence supports its role in improving cerebral blood flow and cognitive performance, variability in clinical outcomes indicates the need for cautious interpretation (Soliani *et al.* 2023). Similarly, compounds like curcumin from *Curcuma longa* and bioactive constituents of *Allium sativum* highlight the importance of antioxidant and anti-inflammatory pathways in neuroprotection (Martínez-González *et al.* 2025).

**Pharmacological Interpretation of *Curculigo orchioides***

Among the documented species, *Curculigo orchioides* holds particular ethnopharmacological significance. Its frequent citation by informants suggests a strong cultural belief in its cognitive-enhancing properties. From a scientific perspective, this prominence may be partially justified by its reported adaptogenic, antioxidant, and anti-inflammatory activities (Khare *et al.* 2022).

The adaptogenic nature of *Curculigo orchioides* implies its potential role in modulating stress-related pathways, which are closely linked to cognitive performance. Additionally, its antioxidant properties may counteract oxidative stress, a known

contributor to neurodegeneration. The reported anti-inflammatory effects further support its possible involvement in reducing neuroinflammation, thereby creating a favourable environment for cognitive function (Pratap *et al.* 2022).

However, despite these promising mechanisms, the lack of robust clinical and mechanistic studies limits definitive conclusions. The current findings therefore, highlight a gap between ethnobotanical importance and scientific validation, emphasising the need for targeted pharmacological and clinical investigations (Chaitanya *et al.* 2023).

**Integration of Traditional Knowledge and Scientific Evidence**

The results of this study underscore the dynamic interplay between traditional knowledge systems and modern scientific research. While several plants identified in the survey show pharmacological potential, the variability in scientific evidence suggests that traditional claims should be interpreted as hypotheses rather than confirmed facts. The convergence observed in certain species supports the reliability of indigenous knowledge systems, whereas discrepancies highlight areas requiring further validation (Basumatary *et al.* 2025).

The reliance on traditional medicine in the study area reflects not only cultural continuity but also practical healthcare accessibility. However, the observed decline in knowledge among younger individuals signals a potential loss of ethnobotanical heritage. This necessitates urgent documentation and validation efforts to preserve and integrate this knowledge into broader healthcare frameworks (Saki & Pourrahim,2025) .

**Implications and Future Perspectives**

The present study provides a foundation for future pharmacological exploration of ethnomedicinal plants used for cognitive enhancement. Priority should be given to highly cited species such as *Curculigo orchioides*, focusing on mechanistic studies, bioactive compound isolation, and clinical validation. Interdisciplinary collaboration between ethnobotanists, pharmacologists, and neuroscientists will be essential to bridge the gap between traditional use and scientific evidence (Kumar *et al.* 2023).

Furthermore, ethical and culturally sensitive approaches must be maintained while utilising indigenous knowledge, ensuring compliance with global frameworks and respect for community contributions (Liu *et al.* 2020). The integration of validated traditional remedies into modern healthcare systems may offer cost-effective and culturally acceptable solutions for cognitive health management (Kakurde *et al.* 2024).

## Conclusions

*Curculigo orchioides* was identified as one of the most frequently cited species in the Rayagada district, indicating its importance in the traditional medicinal practices of local tribal communities. Its frequent mention by informants suggests a strong cultural association with memory-related uses and highlights its role in the ethnomedicinal knowledge system of the region. The present study documents this traditional usage and provides a basis for understanding its ethnopharmacological relevance. While existing literature indicates possible neuroprotective and antioxidant properties, the current findings are primarily observational and based on indigenous knowledge systems. Therefore, the results should be interpreted as indicative rather than confirmatory. Further experimental and clinical investigations are necessary to establish its efficacy, safety, and mechanisms of action. The documentation of *Curculigo orchioides* contributes to the preservation of traditional knowledge and underscores the need for its careful, sustainable use. The study highlights the importance of integrating ethnobotanical insights with scientific research, while maintaining cultural sensitivity and ecological balance.

## Declarations

**List of abbreviations:** RFC-Relative frequency citation; CI-Cultural Importance Index; FC- frequency of citation

**Ethics approval and consent to participate**: Verbal consent was obtained from all the informants before the survey who willingly participated and provided the information.

**Consent for publication:** The participants of this study gave their prior informed consent or the publication of the article. People shown in images gave their permission to have the image published.

**Availability of data and material:** All the supporting data are available in the article

**Competing interests:** The author declared no competing interest

**Funding:** No funding was received for the work.

**Author's Contribution:** P.B. carried out the survey and collected the data. B.A. and D.R. designed the study, analyzed the data, and prepared the manuscript. P.S. and S.K.R. assisted in manuscript preparation and proofreading. All authors read and approved the final version of the manuscript.

## Acknowledgements

All authors appreciated the contribution of all participants.

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**Appendix-1: Questionnaire**

**Semi-Structured Questionnaire Used for the Study**

**Section 1: Demographic Details of the Participant**

1. Name:
2. Age:
3. Gender:
4. Educational Qualification:
5. Occupation/Employment Status:
6. Marital Status:

**Section 2: Knowledge about Brain and Memory Disorders**

1. Are you aware of any brain-related disorders?
2. What is your understanding of memory?
3. Do you consider memory loss as a type of brain disorder?
4. What are the common causes of memory loss according to you?

**Section 3: Use of Herbal Remedies for Memory Enhancement**

1. Have you ever used herbal medicines to improve memory?
2. Which plants or herbs do you commonly use for memory enhancement?
3. Which part(s) of the plant is/are used? (e.g., leaf, root, bark, fruit)
4. How are these herbal remedies prepared? (e.g., decoction, powder, juice)
5. What is the mode of administration? (oral/topical/others)
6. What is the dosage and duration of use?
7. From whom did you learn about these remedies? (e.g., elders, healers)
8. Are these remedies used alone or in combination with other treatments?
9. Have you experienced any side effects?

**Section 4: Perception and Effectiveness**

1. How effective do you find these herbal remedies?
2. How long does it take to observe improvement?
3. Do you prefer herbal remedies over modern medicine? Why?
4. Do you recommend these remedies to others?

**Section 5: Additional Information**

1. Are these plants easily available in your area?
2. Are there any cultural beliefs or traditions associated with their use?
3. Any additional comments or suggestions regarding traditional medicine?