RESEARCH PAPER

Ethnomedicinal Significance and Antioxidant Activity Evaluation of *Swertia hookeri* from Shi Yomi District of Arunachal Pradesh, India

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ABSTRACT: The present study investigates the ethnomedicinal importance, antioxidant potential, and phytochemical composition of Swertia hookeri from Shi Yomi district of Arunachal Pradesh, India. Ethnobotanical data were collected from 320 informants across 32 villages using semi-structured interviews and field surveys. Quantitative indices revealed high cultural significance with Relative Frequency of Citation (RFC = 0.709) and Use Value (UV = 1.681). Methanolic root extracts were evaluated for antioxidant activity using DPPH, ABTS, and FRAP assays, along with estimation of Total Phenolic Content (TPC) and Total Flavonoid Content (TFC). The species exhibited appreciable antioxidant activity across all assays, supported by the presence of phenolic and flavonoid compounds. The findings validate its traditional medicinal uses and highlight its potential as a natural source of antioxidant agents. This study represents the first ethnomedicinal and antioxidant evaluation of this species from the Shi Yomi district.

Keywords: Ethnomedicine**,** *Swertia hookeri*, Shi Yomi district, Antioxidant, Phenolics, Flavonoids
How to cite this article: Ado N, Singh AV. Ethnomedicinal Significance and Antioxidant Activity Evaluation of Swertia hookeri from Shi Yomi District of Arunachal Pradesh, India. Int J Drug Deliv Technol. 2026;16(32s): 892-902; DOI: 10.25258/ijddt.16.32s.99

1. INTRODUCTION

The genus *Swertia* L. (family Gentianaceae) comprises approximately 168 species[1], with a primary distribution across Asia, Africa, and North America, and only a few representatives in Europe. The genus has attracted considerable scientific interest due to the diverse pharmacological properties exhibited by its species, including cardioprotective effects, hypoglycemic activity, enhancement of blood circulation, and inhibition of testosterone reductase[2]. Among these, *Swertia hookeri* C.B. Clarke has been recognized as an important medicinal plant in the northeastern region of India[3–5] as well as in Bhutan[6].

Swertia hookeri is an erect herb growing up to 150 cm in height, characterized by hollow, unbranched, cylindrical to angular stems. The leaves are arranged in whorls of 3–8, glabrous, and range from spathulate to elliptic in shape. Basal leaves are comparatively larger with lacinulate margins, whereas stem leaves are smaller, sessile, and acute. The species bears tetramerous flowers arranged in a paniculate inflorescence composed of whorls, with lanceolate bracts and elongated pedicels. The calyx is short-tubed with hairs present at the inner base and consists of unequal, acuminate lobes. The corolla is reddish-purple to bronze-red, with ovate-oblong lobes, each bearing a distinctive gland that is orbicular to ovate with slightly dentate margins. The reproductive structures include linear filaments, small anthers, and an ovoid ovary, which develops into an ovoid capsule[7].

An antioxidant is defined as any substance that significantly delays or inhibits the oxidation of substrates such as lipids, proteins, carbohydrates, and DNA, even at relatively low concentrations compared to the substrate[8]. Since the discovery and isolation of ascorbic acid from plants, considerable attention has been directed toward plant-derived antioxidants due to their role in neutralizing excess free radicals and mitigating oxidative stress[9]. Among the commonly employed assays, the DPPH assay evaluates the free radical scavenging ability of antioxidants and is widely used due to its simplicity, rapidity, and cost-effectiveness[10]. The ABTS assay (TEAC assay) measures the ability of antioxidants to quench ABTS radicals relative to Trolox[11]. Similarly, the FRAP assay determines antioxidant capacity based on the reduction of ferric (Fe^{3+})-TPTZ complex to ferrous (Fe^{2+})-TPTZ, resulting in a colored complex that can be quantitatively measured[12].

The Folin–Ciocalteu method is a widely used colorimetric assay for estimating total phenolic content, based on electron transfer reactions between phenolic compounds and the Folin–Ciocalteu reagent, producing a blue chromophore; however, interference from other reducing substances such as sugars and ascorbic acid may occur[13]. Total flavonoid content is commonly determined using the aluminum chloride colorimetric method, which relies on the formation of stable complexes between aluminum ions and flavonoid functional groups[14,15]. Despite early phytochemical investigations on xanthone and flavonol constituents of *Swertia hookeri*[16], there remains a paucity of studies addressing its antioxidant potential, highlighting a significant gap in its pharmacological evaluation.

Arunachal Pradesh, located in the northeastern region of India, is recognized as one of the world's biodiversity hotspots and is often referred to as the "land of the rising sun." The state is inhabited by approximately 26 major indigenous tribes and over 110 subtribes, each possessing distinct languages, cultural traditions, and belief systems. This rich cultural diversity has contributed to the preservation of extensive indigenous knowledge, particularly in the use of medicinal plants for primary healthcare[17,18]. Shi Yomi district is among the most remote and least explored regions of the state. Therefore, the present study aims to document the traditional medicinal uses of *Swertia hookeri* in this district, along with the evaluation of its antioxidant activity and the estimation of total phenolic and flavonoid contents.

2. MATERIALS AND METHODS

2.1. Study site

Shi Yomi district covers an area of approximately 2,875 square kilometer[19] and lies between 94°00′–94°60′ E longitude and 28°15′–29°00′ N latitude[20]. The district headquarters is located at Tato, with other important administrative units including Menchukha, Pidi, and Monigong[20]. The McMahon Line demarcates the boundary between Indian and Chinese territories beyond the Menchukha and Monigong regions[21]. Climatically, the district ranges from subtropical conditions in the southern parts to temperate and alpine conditions in the northern regions[22], with human settlements largely confined to the subtropical and temperate zones. The district comprises a total of 107 villages[19], and snowfall is commonly observed during winter in the Menchukha and Monigong circles.

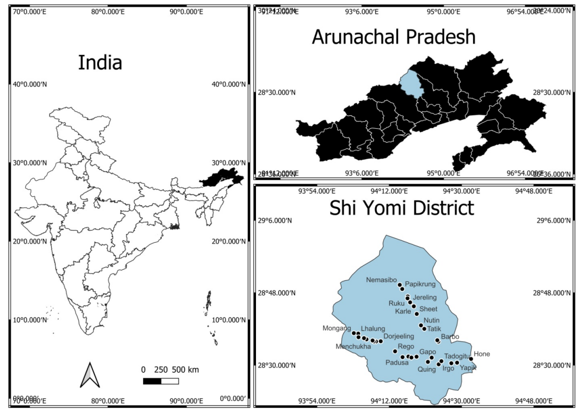

Figure 1: The study area map of Shi Yomi district. The black dotes representing the surveyed villages

The indigenous population mainly consists of the Adi tribe (Ramo, Bokar, Libo) and the Memba tribe. The region is rich in wild edible plant diversity and fish resources[22,23]. The major religions practiced include Christianity, Tibetan Buddhism, and the indigenous Donyi-Polo faith[23,19]. Agriculture remains the primary occupation, although tourism—particularly in Menchukha—has recently gained importance.

2.2. Ethnomedicinal data collection

Ethnobotanical surveys were conducted between 2019 and 2023 across different seasons in 32 villages, with 16 villages each representing subtropical and temperate zones. Based on elevation, areas ranging from 1800 to 3500 m AMSL were classified as temperate zones, while those between 900 and 1800 m AMSL were categorized as subtropical zones[24]. A total of ten informants were selected from each village using a combination of random and snowball sampling techniques. The first one or two informants from each village were selected randomly, while subsequent informants were identified based on recommendations from earlier participants. Ethnobotanical data were collected through free listing and semi-structured interviews. Detailed information, including vernacular names, plant parts used, habit, traditional uses, methods of preparation and modes of administration was recorded. Additional observations were noted in field notebooks. Interviews were followed by field visits for the collection of voucher specimens[25,26].

2.3. Identification and submission of voucher specimens

The identification of collected plant specimens was carried out with reference to the *Flora of Bhutan*[7] and with the assistance of taxonomists from Rajiv Gandhi University. For authentication and long-term preservation, voucher specimens were prepared as mounted herbarium sheets following standard procedures described previously[27,28]. The processed specimens were subsequently deposited at the Herbarium of Rajiv Gandhi University (HAU) and the Botanical Survey of India, Itanagar (ARUN), for future reference and verification.

2.4. Quantitative Indices

2.4.1. Relative frequency of citation (RFC)

The Relative Frequency of Citation (RFC) is used to assess the local importance of each plant species, independent of its use categories. It reflects how commonly a species is mentioned by informants. The RFC was calculated using the formula proposed previously[29]:

$$RFC = FC/N$$

Where 'FC' represents the number of informants who mentioned the use of a particular species and 'N' is the total number of informants participating in the study. The RFC value ranges from 0 to 1, where 0 indicates that no informant cited the species, and 1 represents the hypothetical situation in which all informants reported the use of that species.

2.4.2. Use value (UV)

Use Value (UV) is a quantitative measure that indicates the relative importance of plant species based on the number of uses reported by informants. It is widely employed in ethnobotanical studies to identify species perceived as highly valuable within a community. The UV was calculated following the previous report[30]:

$$UV = \sum U_i / N$$

Where 'U_i' is the number of uses reported by each informant for a particular species and 'N' is the total number of informants.

2.5. Antioxidant Activity Evaluation

2.5.1. Preparation of methanolic extract

Crude methanolic extracts were prepared following the method of described previously[31] with slight modifications. The plant parts reported for use were carefully separated from other portions, thoroughly washed, and shade-dried at room temperature. The dried samples were then ground into a coarse powder using an electric grinder.

Extraction was carried out using the cold maceration technique, wherein the powdered samples were immersed in methanol in sealed containers. The mixtures were subjected to periodic shaking and stirring for a duration of one week to ensure efficient extraction. Subsequently, the extracts were filtered using Whatman filter paper No. 1 to remove solid residues. The extraction process was repeated multiple times until the solvent became clear, indicating complete extraction.

The combined filtrates were concentrated under reduced pressure using a rotary evaporator maintained below 50°C to prevent thermal degradation of bioactive compounds. The concentrated extracts were further dried using a lyophilizer to obtain dry residues. Finally, the dried extracts were transferred into microcentrifuge tubes and stored under refrigerated conditions for subsequent analyses.

2.5.2. Determination of antioxidant activity by DPPH assay

The DPPH radical scavenging assay was performed following the method described previously[32] with slight modifications. A 0.1 mM DPPH solution was prepared by dissolving 3.94 mg of DPPH in 100 mL of methanol, and the solution was properly sealed and stored in the dark to prevent photodegradation. A 10 mM Trolox stock solution was prepared by dissolving 25 mg of Trolox in 10 mL of methanol, from which working standards ranging from 50 to 2500 μM were prepared. Three standard antioxidants, namely Ascorbic Acid, Quercetin, and Butylated hydroxytoluene (BHT), were used as controls and prepared at a concentration of 1 mg/mL in methanol. For the test sample, 10 mg of dried plant extract was dissolved in 1 mL of methanol to obtain a stock solution of 10 mg/mL, and appropriate dilutions were made to ensure that absorbance values fell within the range of the Trolox calibration curve. For the assay, 20 μL aliquots of each Trolox standard, plant extract, control, or blank (methanol) were mixed with 1.5 mL of DPPH solution in 2 mL microcentrifuge tubes and incubated in the dark at room temperature for 30 minutes. After incubation, absorbance was measured at 515 nm using a microplate spectrophotometer, and the decrease in absorbance indicated the radical scavenging activity. The antioxidant activity was expressed as μM Trolox equivalents (TE) per gram of dry extract by interpolating the absorbance values of the samples against the Trolox standard calibration curve.

2.5.3. Determination of antioxidant activity by ABTS assay

The ABTS radical cation decolorization assay was carried out following the method described previously[33]. A 7 mM ABTS stock solution was prepared by dissolving 7.68 mg of ABTS in 2 mL of distilled water, while a 2.45 mM potassium persulfate solution was prepared by dissolving 6.62 mg in 10 mL of distilled water. Equal volumes of these solutions were mixed and incubated in the dark at room temperature for 16–24 hours to generate the ABTS radical cation. The resulting solution was diluted with ethanol to obtain a working solution with an absorbance of 0.7 ± 0.02 at 734 nm. A 1 mM Trolox stock solution was prepared in methanol, and working standards ranging from 5 to 350 µM were obtained. Ascorbic Acid, Quercetin, and BHT were used as controls at a concentration of 50 µg/mL. The plant extract was prepared by dissolving 10 mg of dry extract in 1 mL of methanol (10 mg/mL stock), followed by appropriate dilution to obtain working solutions. For the assay, 20 µL of each standard, sample, control, or blank was mixed with 170 µL of ABTS working solution in a 96-well microplate and incubated at 30°C for 6 minutes in the dark. Absorbance was measured at 734 nm, and antioxidant activity was expressed as µM Trolox equivalents (TE) per gram of dry extract using the Trolox calibration curve.

2.5.4. Determination of antioxidant activity by FRAP assay

The Ferric Reducing Antioxidant Power (FRAP) assay was performed following the method described by described previously[34] with slight modifications. A 300 mM sodium acetate buffer was prepared by dissolving 0.31 g of sodium acetate trihydrate in 1.6 mL of glacial acetic acid, and the volume was adjusted to 100 mL with distilled water, with the pH adjusted to 3.6 using hydrochloric acid (HCl) or sodium hydroxide (NaOH). A 10 mM TPTZ solution was prepared by dissolving 0.031 g of 2,4,6-tripyridyl-s-triazine (TPTZ) in 10 mL of 40 mM HCl, which was obtained by diluting 0.18 mL of HCl to 50 mL with distilled water. A 20 mM ferric chloride solution was prepared by dissolving 0.27 g of ferric chloride in 50 mL of distilled water. The FRAP reagent was freshly prepared by mixing sodium acetate buffer, TPTZ solution, and ferric chloride solution in a ratio of 10:1:1. A 10 mM Trolox stock solution was prepared in methanol, from which working standards ranging from 50 to 2500 µM were obtained. Ascorbic Acid, Quercetin, and Butylated hydroxytoluene (BHT) were used as controls at a concentration of 1 mg/mL. For sample preparation, 10 mg of dried plant extract was dissolved in 1 mL of methanol to obtain a 10 mg/mL stock solution, and appropriate dilutions were made to ensure absorbance values fell within the range of the Trolox standards. For the assay, 100 µL of each standard, sample, control, or blank (methanol) was mixed with 1.5 mL of FRAP reagent and incubated at 37°C for 30 minutes in a water bath. Absorbance was measured at 593 nm, and antioxidant activity was expressed as µM Trolox equivalents (TE) per gram of dry extract by interpolating values from the Trolox calibration curve.

2.5.5. Estimation of Total Phenolic Content (TPC)

Total Phenolic Content (TPC) was determined using the Folin–Ciocalteu method as described previously[35]. A 10% Folin–Ciocalteu reagent was prepared by diluting 2 mL of the reagent with 18 mL of distilled water, and a 7.5% sodium bicarbonate ($NaHCO_3$) solution was prepared by dissolving 1.5 g in 20 mL of distilled water. A 1 mg/mL gallic acid stock solution was prepared in methanol, from which working standards ranging from 2.5 to 625 µg/mL were obtained. Ascorbic Acid, Quercetin, and BHT were used as controls at 1 mg/mL. The plant extract was prepared at 10 mg/mL stock concentration and diluted appropriately. For the assay, 160 µL of each standard, sample, control, or blank was mixed with 800 µL of Folin–Ciocalteu reagent and 800 µL of $NaHCO_3$ solution, followed by incubation at 45°C for 45 minutes. Absorbance was measured at 765 nm, and results were expressed as µg Gallic Acid Equivalents (GAE) per gram of dry extract using a standard calibration curve.

2.5.6. Estimation of Total Flavonoid Content (TFC)

Total Flavonoid Content (TFC) was estimated using the Aluminum Chloride colorimetric method described previously[36]. A 5% sodium nitrite ($NaNO_2$) solution, 10% Aluminum Chloride ($AlCl_3$) solution, and 4% sodium hydroxide (NaOH) solution were prepared using standard procedures. A 1 mg/mL rutin stock solution was prepared in methanol, and working standards ranging from 2.5 to 625 µg/mL were obtained. Controls (Ascorbic Acid, Quercetin, and BHT) were prepared at 1 mg/mL. The plant extract was prepared as 10 mg/mL stock solutions and diluted appropriately. For the assay, 320 µL of each standard, sample, control, or blank was mixed with 64 µL distilled water and 48 µL $NaNO_2$ solution and incubated for 5 minutes, followed by the addition of 48 µL $AlCl_3$ and incubation for 6 minutes. Subsequently, 640 µL NaOH and 480 µL distilled water were added, and the mixtures were incubated at room temperature for 15 minutes. Absorbance was measured at 510 nm, and results were expressed as µg Rutin Equivalents (RE) per gram of dry extract.

2.6. Statistical analysis

All calculations and graphical representations were performed using Microsoft Excel and IBM SPSS Statistics. Phytochemical analysis results were expressed as Mean ± Standard Error of the Mean (SEM) based on five replicates.

3. RESULTS

3.1. Demographic information of the informants

A total of 320 informants were interviewed to document ethnobotanical knowledge. The age-wise distribution revealed that the majority of respondents belonged to the 40–59 years age group (44.69%), followed by those aged ≥ 60 years (33.13%), while younger participants aged 20–39 years accounted for 20.63%. A very small proportion (1.56%) of informants were below 20 years of age, indicating that traditional knowledge is predominantly retained among middle-aged and older individuals.

In terms of gender distribution, male informants (52.50%) slightly outnumbered female informants (47.50%), suggesting a relatively balanced participation of both genders in the study. Regarding educational status, a considerable proportion of respondents were illiterate (36.88%), while the remaining informants had varying levels of formal education, including primary (Class 5: 17.19%), middle (Class 8: 17.81%), secondary (Class 10: 14.38%), and higher secondary education (Class 12: 10.31%). Only a small fraction had attained graduation (2.50%) and post-graduation (0.94%), indicating that traditional knowledge is more prevalent among less formally educated individuals.

3.2. Ethnomedicinal uses

Swertia hookeri C.B. Clarke, locally known as Dibin ringka among the Bokar and Ramo tribes and Siliguri among the Memba tribe, is a herbaceous plant collected under voucher numbers NAdo 0478 and NAdo 0477, with accession numbers HAU/AN-2677 and ARUN-42618. It typically grows in meadow habitats, and the ethnobotanical information was provided by informants belonging to the Bokar, Ramo, and Memba tribes residing in subtropical to temperate altitudinal zones. The species is currently categorized as Not Evaluated under the IUCN conservation status. The root is the primary part used for medicinal purposes, where an infusion is traditionally prepared to treat ailments such as stomach pain, cough, diarrhea, fever, body pain, high blood pressure, gastritis, and dysentery. Additionally, the root powder is applied topically for wound healing.

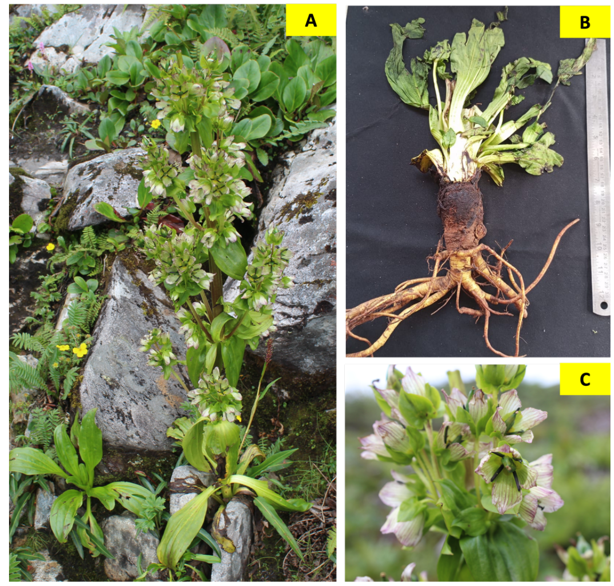

Plate 1: *Swertia hookeri*: A = Whole plant; B = Uprooted plant; C = Inflorescence

3.3. Relative frequency of citation (RFC) and Use value (UV)

The ethnomedicinal importance of Swertia hookeri was quantified through key quantitative indices, including Frequency of Citation (FC), Relative Frequency of Citation (RFC), Number of Use Reports (NU), the sum of individual use reports (∑Ui), and Use Value (UV). The species recorded a high FC value of 227 and a correspondingly strong RFC of 0.709, indicating a substantial level of recognition and citation among informants, reflecting its well-established presence in traditional knowledge systems.

A total of 9 distinct use categories (NU = 9) and 538 cumulative use reports (∑Ui = 538) were documented, demonstrating a diverse range of ethnomedicinal applications associated with the species. Notably, the calculated Use Value (UV = 1.681) highlights the considerable cultural and therapeutic significance of *S. hookeri* within the studied community. Overall, these findings underscore that *Swertia hookeri* is a highly valued ethnomedicinal plant with broad traditional applications and strong informant consensus, reflecting its importance in indigenous healthcare practices.

Quantitative indices	Value
Frequency of Citation (FC)	227
Relative Frequency of Citation (RFC)	0.709
Number of Use Reports (NU)	9

∑Ui (Sum of all uses reported by each informant)	538
Use Value (UV)	1.681

Table 1: Results obtained from the quantification of ethnomedicinal data of *Swertia hookeri*

3.4. Antioxidant Activity and Phytochemical Content

The antioxidant activity and phytochemical profile of *Swertia hookeri* were assessed using DPPH, ABTS, and FRAP assays, along with Total Phenolic Content (TPC) and Total Flavonoid Content (TFC), and compared with standard reference antioxidants, namely ascorbic acid, quercetin, and BHT. All values are expressed as mean ± SEM (n = 5).

The DPPH assay revealed that *S. hookeri* exhibited effective radical scavenging activity (1.21 ± 0.01 µM TE/g), indicating appreciable antioxidant potential, with activity comparable in trend to the standard antioxidants ascorbic acid (2.96 ± 0.00 µM TE/g) and quercetin (2.95 ± 0.00 µM TE/g), and showing higher radical scavenging efficiency than BHT (0.73 ± 0.01 µM TE/g) in maintaining radical neutralization capacity. In the ABTS assay, the extract demonstrated consistent free radical quenching ability (0.71 ± 0.01 µM TE/g), reflecting its stable antioxidant behavior across different radical systems. In the FRAP assay, *S. hookeri* showed notable reducing power (1.59 ± 0.00 µM TE/g), indicating strong electron-donating capability and redox activity, supporting its functional antioxidant properties.

In terms of phytochemical composition, *S. hookeri* contained measurable total phenolic content (0.19 ± 0.00 µg GAE/g), suggesting the presence of phenolic constituents contributing to its bioactivity. More importantly, the plant exhibited appreciable total flavonoid content (0.49 ± 0.00 µg RE/g), which was comparable to quercetin (0.47 ± 0.00 µg RE/g) and higher than BHT (0.09 ± 0.00 µg RE/g), highlighting flavonoids as a key contributor to its antioxidant potential.

Overall, the results indicate that *S. hookeri* possesses a consistent and biologically relevant antioxidant profile across multiple assay systems, supported particularly by its flavonoid content, suggesting its potential as a promising natural source of antioxidant compounds

Parameter	**Assay type**	***Swertia hookeri*** (Mean ± SEM)	**Ascorbic Acid** (Mean ± SEM)	**Quercetin** (Mean ± SEM)	**BHT** (Mean ± SEM)
Antioxidant activity	DPPH	1.21 ± 0.01	2.96 ± 0.00	2.95 ± 0.00	0.73 ± 0.01
Antioxidant activity	ABTS	0.71 ± 0.01	4.22 ± 0.02	6.15 ± 0.02	3.35 ± 0.02
Antioxidant activity	FRAP	1.59 ± 0.00	2.71 ± 0.00	2.51 ± 0.01	2.14 ± 0.01
Total Phenolic Content	Folin-Ciocalteu	0.19 ± 0.00	0.76 ± 0.00	0.67 ± 0.00	0.26 ± 0.00
Total Flavonoid Content	Aluminum Chloride	0.49 ± 0.00	0.00 ± 0.00	0.47 ± 0.00	0.09 ± 0.00

Table 2: Results of antioxidant activity and phytochemical content of *Swertia hookeri*
Note: Values for DPPH, ABTS, and FRAP assays are expressed as µM TE/g of dry extract (Mean ± SEM, n = 5); Total Phenolic Content (TPC) is expressed as µg GAE/g of dry extract (Mean ± SEM, n = 5); Total Flavonoid Content (TFC) is expressed as µg RE/g of dry extract (Mean ± SEM, n = 5)

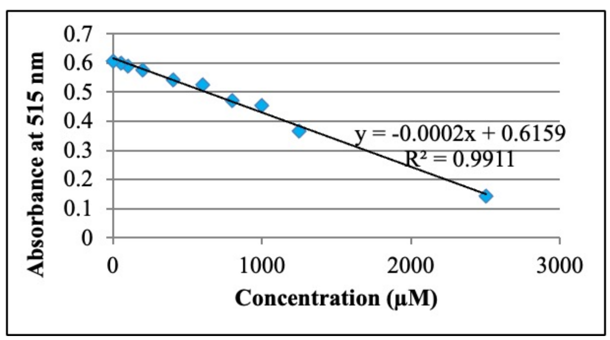

Figure 2: Trolox standard curve for DPPH assay

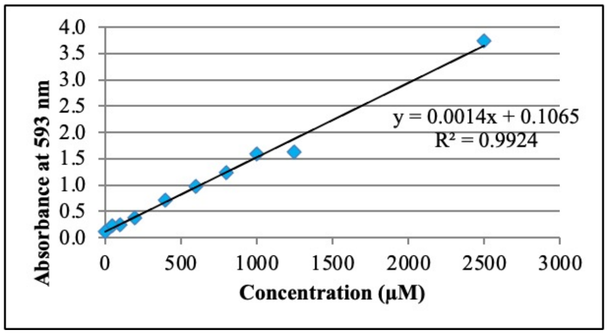

Figure 3: Trolox standard curve for FRAP assay

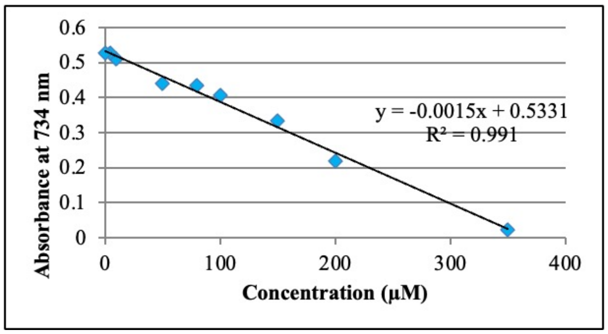

Figure 4: Trolox standard curve for ABTS assay

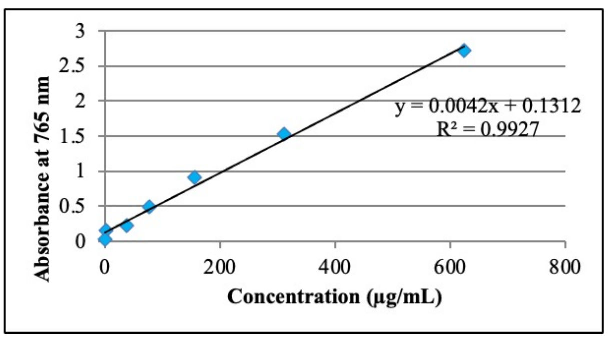

Figure 5: Gallic Acid Standard Curve for Folin-Ciocalteu Assay

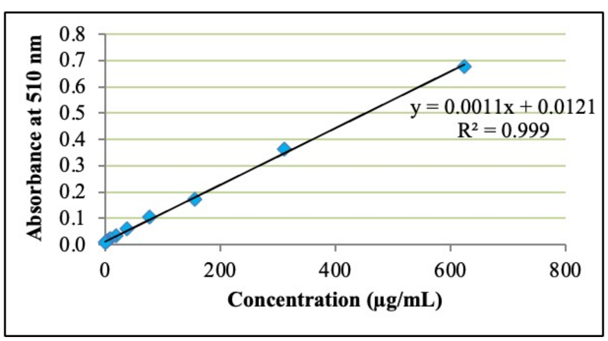

Figure 6: Rutin Standard Curve for Aluminium chloride Assay

4. DISCUSSION

The present study provides comprehensive insights into the ethnobotanical knowledge system and antioxidant potential of *Swertia hookeri*, highlighting both its cultural relevance and scientific validity. The demographic distribution of informants clearly indicates that ethnobotanical knowledge is predominantly concentrated among middle-aged and elderly individuals. The highest representation from the 40–59 years age group, followed by those aged ≥60 years, suggests that traditional knowledge is preserved through experience and long-term interaction with natural resources. The relatively balanced gender participation, with a slight dominance of male informants, indicates that both men and women contribute significantly to traditional knowledge systems. The educational profile further reinforces that ethnobotanical knowledge is more prevalent among less formally educated individuals. The high percentage of illiterate informants suggests that traditional knowledge exists independently of formal education and is instead rooted in cultural practices and experiential learning. This inverse relationship between formal education and traditional knowledge retention has been widely observed and underscores the need to document such knowledge before it declines further.

The ethnomedicinal uses of *Swertia hookeri* demonstrate its wide therapeutic applicability within the studied communities. The use of roots in treating gastrointestinal disorders (such as stomach pain, diarrhea, gastritis, and dysentery), respiratory issues (cough), body pain, and hypertension reflects its multipurpose medicinal value. The topical application for wound healing further indicates its antimicrobial and anti-inflammatory potential. Such diverse applications align with the traditional use of several species within the genus *Swertia*, many of which are known for their bitter principles and bioactive compounds. The preference for root usage, however, raises ecological concerns, as root harvesting can threaten plant survival and necessitates sustainable harvesting strategies. There have been previous reports on medicinal effects of *Swertia hookeri* on bone fracture and fever (Maity et al, 2003; Dahal et al., 2017), high pressure (Borah et al., 2019; Chen et al. 2021), body ache, nervine tonic, sedative, febrifuge (Dahal et al., 2017) and wounds (Chen et al. 2021). The root decoction has been reported to be used by Monpa tribe as anti-poison (Tsering et al., 2016). In another study on Monpa tribe, whole plant was found to cure laxative, purgative and malaria (Chakraborty et al., 2017).

The quantitative ethnobotanical indices strongly support the cultural importance of *Swertia hookeri*. The high Relative Frequency of Citation (RFC = 0.709) indicates that ethnomedicinal knowledge of this species is widely retained and effectively transmitted among local communities. However, RFC alone does not reflect the diversity of medicinal applications; rather, such versatility can be more accurately interpreted through the Use Value (UV) (Bibi et al., 2022). The high Use Value (UV = 1.681) indicates strong informant consensus and underscores its significance as a key medicinal resource within indigenous systems. Species exhibiting higher UV are considered promising candidates for further scientific validation. As suggested by Yaseen et al. (2015), such plants should be prioritized for detailed phytochemical and pharmacological investigations aimed at the development of novel herbal drugs. In this context, *Swertia hookeri* emerges as a potential bioresource for future drug discovery, warranting in-depth studies to isolate active compounds and validate its traditional therapeutic claims.

The antioxidant analysis provides scientific validation for the traditional uses of *Swertia hookeri*. The plant exhibited appreciable activity across multiple assay systems, including DPPH, ABTS, and FRAP, indicating its ability to scavenge free radicals and act as a reducing agent. Although its antioxidant capacity was lower than standard compounds such as ascorbic acid and quercetin, it demonstrated better performance than BHT in the DPPH assay, suggesting its potential as a natural antioxidant source. The consistency of results across different assays strengthens the reliability of its antioxidant profile. There are various assays developed till date for antioxidant activity evaluation of plant samples and it is suggested to use at least two of these assays (Číž *et al*., 2010).

The phytochemical analysis revealed the presence of phenolics and a comparatively higher flavonoid content. The antioxidant properties of numerous plants have previously been attributed to flavonoids and other phenolic compounds (Das *et al*., 1990; Hossain & Rahman, 2011). And the reason being that they possess an aromatic ring that enables the stability and relocation of their unpaired electrons, permitting the donation of hydrogen atoms and electrons from their hydroxyl groups (Leopoldini, 2004; Belcastro 2006). The highest obtained value of Ascorbic acid in terms of TPC indicates its highest Folin-Ciocalteu reducing potential. Ascorbic acid, being a vitamin, cannot form a complex with Aluminium chloride, resulting in the detection of no flavonoids.

Phytochemical investigations of *Swertia hookeri* have previously reported the presence of bioactive compounds such as flavonols and xanthones from the whole plant (Ghosal et al., 1980). In addition, studies have identified compounds with PPARγ partial agonist activity, suggesting promising antidiabetic potential (Pàmies, 2011). These findings support the therapeutic relevance of the species and provide a biochemical basis for its traditional uses. To the best of our knowledge, the present investigation represents the first ethnomedicinal documentation of *Swertia hookeri* from the Shi Yomi district, as well as the first report evaluating the antioxidant activity of its crude root extract

5. CONCLUSION

The present study highlights the ethnobotanical, phytochemical, and antioxidant significance of *Swertia hookeri* among indigenous communities of the Shi Yomi district. The findings demonstrate that traditional knowledge related to this species is predominantly retained among middle-aged and elderly individuals and is largely independent of formal education, emphasizing the importance of preserving such knowledge systems before they decline.

The documented ethnomedicinal uses reveal that *Swertia hookeri* is a multipurpose medicinal plant widely utilized for the treatment of gastrointestinal, respiratory, inflammatory, and hypertensive conditions, along with wound healing. Quantitative ethnobotanical indices, further confirm its cultural importance, widespread recognition, and strong informant consensus, establishing it as a key component of indigenous healthcare practices.

The antioxidant assays and phytochemical analysis provide scientific validation of its traditional uses, demonstrating consistent radical scavenging activity and reducing power. The presence of phenolic and notably higher flavonoid content suggests that these compounds significantly contribute to its antioxidant potential. Additionally, previously reported bioactive constituents such as flavonols, xanthones, and compounds with PPARγ partial agonist activity further support its pharmacological relevance.

Importantly, this study represents the first ethnomedicinal report of *Swertia hookeri* from the Shi Yomi district and the first evaluation of antioxidant activity of its crude root extract, thereby filling a critical research gap.

Overall, *Swertia hookeri* emerges as a promising natural source of bioactive compounds with significant therapeutic potential. However, the preference for root usage raises conservation concerns, necessitating sustainable harvesting practices and conservation strategies. Future research should focus on detailed phytochemical isolation, pharmacological validation, and clinical investigations to facilitate its potential development into effective herbal formulations while ensuring its long-term conservation and sustainable utilization.

Acknowledgements

The authors express their sincere gratitude to the indigenous communities of Shi Yomi district for generously sharing their valuable traditional knowledge, which formed the foundation of this study. The first author gratefully acknowledges the field assistance provided by Mr. Gumge Ado, Mr. Karli Poyom, Ms. Jumi Ado, Ms. Neeni Yorpen, and Mr. Kento Ango during the surveys. The first author also acknowledge the Ministry of Tribal Affairs, Government of India, New Delhi, for financial support through the National Fellowship and Scholarship for ST Students (NFST). Appreciation is further extended to Rajiv Gandhi University for providing logistical support throughout the research work. The authors are also thankful to the Herbarium of Rajiv Gandhi University (HAU) and the Botanical Survey of India, Itanagar (ARUN)), for their assistance in the authentication and deposition of plant specimens.

Conflict of interest

There are no conflicts of interest in publishing this research article.

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