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Research Article

Morpho-anatomical characterization, phytochemical screening, and antibacterial activity of *Swertia decurrens* C.B.Rob (Gentianaceae)

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Abstract

The pursuit of scientific exploration requires a thorough investigation into the morphology and anatomy of plants, extending beyond visible structures to analyze the intricacies found at the cellular and subcellular levels. To contribute to this endeavor, the study documented the morphological and anatomical characteristics of *Swertia decurrens*, an endemic plant from the Cordillera Central Range, Northern Philippines. The morphological and anatomical characteristics of *S. decurrens* showed similarities to *Swertia chirayita*. It was observed that both have longer and wider leaves and an erect, greenish, quadrangular stem. Their flower characteristic is found to be the same, hypogynous with complete bisexual and purplish, but seen to be dotted in *S. decurrens* while marginal in *S. chirayita*. Also, the flower of *S. decurrens* is smaller. The phytochemical screening found alkaloids, anthraquinones, essential oils, saponins, and steroids to be present in *S. decurrens,* but flavonoids, phenols, and tannins were negative. Lastly, the plant showed no antibacterial activity against Gram-positive *Staphylococcus aureus* and Gram-negative bacteria *Escherichia coli,* which could be attributed to the absence of phenols and flavonoids. This contrasts with the medically proven *S. chirayita* that have strong antimicrobial activity. This information is helpful documentation of the understudied endemics and unverified medicinal plants in the tropics and in the country.

Keywords: Cordillera Central Range, endemic, agar-well diffusion method, anomocytic, undivided mesophyll

Introduction

Family Gentianaceae is a vast family of perennial herbs known for their ornamental significance. It includes the genus *Swertia,* that are morphologically varied from other genera within the family, consisting of approximately 150 herbaceous species that manifest as annuals, biennials, and perennials (Chassot & Hagen 2008). One of its species – *Swertia chirayita* - is cited as one of the family`s most medically beneficial members. It has a crucial role to traditional medicine all around the world. It was used as a common household treatment in India to purify blood, treat numerous ailments such as liver disorders, malaria, and diabetes (Kumar & Van 2016; Prosenjit & Sukta 2010). Additionally, it has been recognized in Sushruta Samhita Medicine as antiseptic and curative of fevers, urinary disorders, skin diseases, cough, hiccup, and poisoning (Sharma *et al.* 2011).

Due to the common use of *S. chirayita* in traditional medicine, some studies have investigated its phytochemical and antimicrobial properties. Aleem & Kabir (2018) found *Swertia chirayita* to be frequently used as a bitter tonic in traditional medicine for the treatment of fever, appetite loss, diabetes, skin, and a variety of other illnesses. In another study, plant extract of *S. chirayita* revealed the presence of alkaloid, terpenoids, tannins, coumarins, flavonoids and sterols that plays a role in the anti-cancer activity of the plant (Adhikari *et al.,* 2015) while Latif & Rehman (2014) revealed the presence of alkaloids, carbohydrates, proteins, amino acids, phenols, sterols, glycosides, flavonoids, tannins, resins, sterols/ terpenes, and volatile oil in *S. chirayita*. On the other hand, Kabita *et al.* (2015) revealed the antibacterial sensitivity of both ethanol and methanol extracts of leaves and stems of the *S. chirayita* plant against five different bacterial strains. The ethanol extract of leaves showed substantial efficacy against *Bacillus sp*. and *Pseudomonas aeruginosa*, with a zone of inhibition ranging from 14 to 19 mm for *Bacillus sp*. and 10–18 mm for *Pseudomonas aeruginosa*.

With the importance of the *Swertia chirayita*, it will be interesting to document other species under the genus *Swertia.* There is a single species of *Swertia* in the Philippines, namely *Swertia decurrens.* It is endemic in the Cordillera Central Range in Northern Luzon, but no other information is available about it. Hence, this study aims to document its morpho-anatomical characters, phytochemical components, and antibacterial activity. The results of the study hope to help in the documentation of floral diversity that may hold significant importance across multiple disciplines, particularly in identifying endemic organisms that may face extinction without adequate attention. Additionally, the study could also help in verifying scientifically the many reported medicinal plants of the Philippines. According to Dapar (2020), there are more than 1,500

medicinal plants used by traditional healers in the Philippines, but only 120 plants have been scientifically validated for safety and efficacy.

Material and methods

Study Site._The plant was reported to be commonly distributed in mossy forest openings in Cordillera Central Range, Northern Philippines (Pelser et al., 2011-). However, when we surveyed different locations where the plant could be potentially found, we were only able to spot the plant in Bessang Pass Road, Ilocos Sur, and Pakpakitan, Buguias, Benguet (Figure 1). The plants were found along the road and the forest edge.

The Cordillera Central Range (CCR) is the one of 15 biogeographical zones in the Philippines (Guron and Napaldet, 2020; Ong et al. 2002). It is considered as the largest and youngest among the three mountain ranges in Northern Luzon, Philippines. According to Villa (1999), this mountain range has a maximum length of 320 km and a maximum width of 60 km, covering an area of about 23,000 km^2. The famous mountains in the CCR are Mt. Sto. Tomas and Mt. Pulag with elevations of 2258 and 2924 m asl, respectively. Other high-peaked mountains in this region with an altitude of over 2300 m asl are Mt. Amuyao, Mt. Pauai, Mt. Ugu, and Mt. Data. According to Lawrence (1951) and Dickerson (1928), the highest points of the Cordillera ranges are steep and geologically young because of their uniformly great heights.

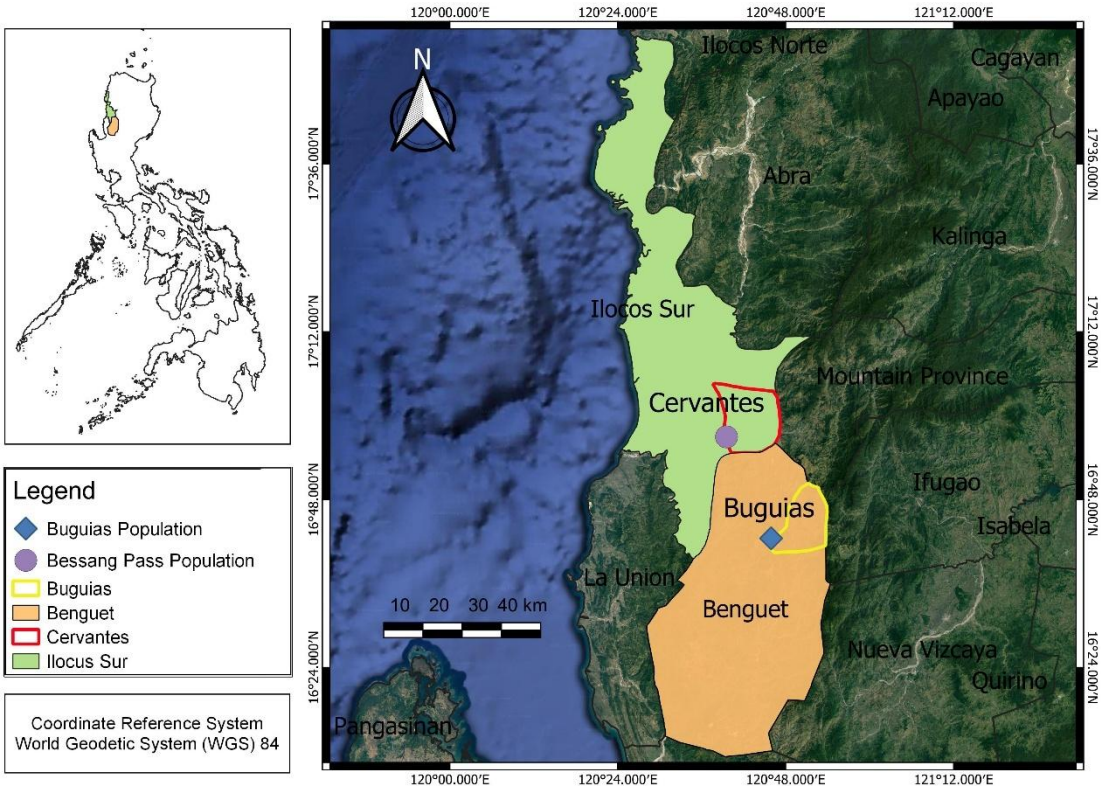

Figure 1. The collection site of *Swertia decurrens* in the study

Morpho-Anatomical Characterization of *Swertia decurrens*. In the field, the morphological characters and measurements, such as in leaves, roots, and stems of the plant, were gathered and documented using a camera, ruler, and field notes. Approximately 20 plant samples were gathered and brought to the laboratory for anatomical observation. Structures such as vascular bundles, the number of palisade cell layers, and the stomatal index were observed. Cross sections of the roots, stem, and leaf of *Swertia decurrens* were prepared and stained with safranin before observing under light microscope. The stomatal measurement was obtained by using ImageJ.

Extraction Methods of Phytochemical Constituents. The extraction of bioactive compounds from the plants and their quantitative and qualitative estimation is important for the exploration of new biomolecules to be used by the pharmaceutical and agrochemical industry directly or can be used as a lead molecule to synthesize more potent molecules (Deshmukh *et al*. 2017). The study adopted boiling as one of the extraction methods of plants. This method involves boiling the crushed plant sample in water at a ratio of 1:5 for intervals of 5, 10, and 15 minutes, respectively. After each boiling session, the extract is drained through a cloth and manually pressed to obtain the free-flowing extract. Subsequently, the obtained extract undergoes filtration using filter paper to eliminate fine particles (Aamer 2016).

With a few minor modifications, the Fatope *et al.* (2008) approach was used for the extraction of plant components. The leaves, stems, and roots of *Swertia decurrens*, with a total of 20 g were dried at room temperature; 400 mL of methanol was needed for methanolic extraction. Conicals were screw-capped and shaken for 24 hours at 100 rpm while at room temperature. The extracts were filtered with a muslin cloth after 24 hours, and then re-filtered with Whatman filter paper No. 1. A water bath heated to 35-40°C was used to concentrate the filtrates. The extracts were appropriately labeled and stored until further use at 4°C in the refrigerator.

In addition, ethanolic extraction from the study of Belete *et al.* (2021) was performed. The fresh leaves were air-dried, crushed into a coarse powder, and combined with 70% ethanol for 24 to 48 hours. Subsequently, the mixture underwent filtration using Whatman No. 1 filter paper. The solvent was dissolved using a rotary evaporator, and the resulting extract was further concentrated through heating and evaporation in an oven at 40°C. The concentrated extract was then stored in a securely sealed container at −20°C until it was ready for use.

Qualitative Phytochemical Screening. The qualitative phytochemical screening of the methanol extract was performed to identify the main groups of chemical constituents (alkaloids, essential oils, flavonoids, phenols, saponins, and tannins) present in the extracts using the color reactions

(Khanal *et al.,* 2015). Plant samples were brought by the researchers to Saint Mary's University, Nueva Vizcaya, to test for alkaloids, essential oils, flavonoids, phenols, saponins, and tannins.

Antibacterial Activity Test. The antibacterial activity of methanol, ethanol, and aqueous extract of *Swertia decurrens* was assessed against two bacterial species, namely the Gram-positive bacteria *Staphylococcus aureus* and Gram-negative bacteria *Escherichia coli* (Kweera *et al.* 2011). *Escherichia coli* and *Staphylococcus aureus* cultures were obtained from a hospital laboratory and stored at approximately 4° C until use. The effect of different concentrations of the different extracts of *Swertia decurrens* in this study against *E. coli* was assayed by the disk diffusion method. Twenty (20) ml of prepared sterile Mueller-Hinton Agar was placed in sterile petri plates and allowed to solidify. Afterwards, 20g of methanol extract concentration was placed in the disc by soaking the sterilized blank discs with each concentration of extracts for 20 minutes. After *E. coli* was diluted to 0.5 McFarland standard, then was swabbed onto the agar plates aseptically in the form of spreading 100 µL evenly with the help of a sterile L-shaped rod and was labeled accordingly. Discs were placed aseptically on the solid agar medium by pressing gently. These bacterial plates were incubated at 37° C for 24 hours. The mean inhibition zone diameter was measured by a vernier caliper.

Negative and positive controls were used for comparison. Distilled water served as a negative control, while penicillin was the positive control. *E. coli* was resistant to penicillin, as it only affects gram-positive bacteria. Two hundred fifty (250) mg of penicillin was used for the antibacterial activity. With that, twelve (12) petri dishes, indicating three (3) replicates each, were used to conduct the test with *E. coli* at different levels of concentration, such as 100%, 75%, 50%, and 25% respectively.

Further, the MIC (minimum inhibitory concentration) of the different extracts was also performed to determine the minimum concentration of the extracts that inhibited the growth of *S. aureus* and *E. coli.* The Minimum Inhibitory Concentration (MIC) was observed using an agar-well diffusion method (Balouiri et al., 2016). The test bacteria were spread in plates evenly, making sure to distribute the bacteria in the whole petri plate. Three (3) replicates each concentration from each dilution 2.9 µg/ml, 1.45 µg/ml, 0.725 µg/ml, 0.363 µg/ml, and 0.181 µg/ml were utilized. After, a sterilized cork borer measuring 4mm was used in making wells, and sterilized cotton swabs were used in cleaning the wells. Using a pipette, 50µL was dispensed in each well from each dilution. Lastly, petri plates were incubated at 37° C for 24 hours.

Results

Morphological Traits

Swertia decurrens is an annual herb up to 92 cm tall and known to grow 1,200 m to 3,000 m above sea level. It exhibited an erect growth habit, displaying a quadrangular stem with a diameter of about 0.6 cm with a prominent decurrent line along the angles. Its stem is greenish in color but turns purplish in individuals exposed directly to sunlight. Leaves are lanceolate, in opposite pairs, acuminate, cuneate at the base, sessile, and about 13 cm long and 5 cm wide. The root is simple, yellowish, sinker, and short, about 110 mm long and 4 mm thick. Inflorescence was observed to be cymes in corymbose panicles. Table 1 summarizes the major characteristics of the plant.

Table 1. Major morphological features of *Swertia decurrens*

Characters	Description
Habit	Erect, branched, annual herb
Stem	Single-stemmed, branched, quadrangular, greenish
Leaves	Lanceolate, opposite, acuminate, sessile, green.
Inflorescence	Cymes in corymbose panicles, terminal clusters of 3-5 flowers.
Flower	Bracteate, pedicellate, complete and bisexual, actinomorphic, hypogynous, purplish dotted color.
Calyx	Sepals four, gamosepalous, lanceolate, smaller than corolla, acute sepal tip, green.
Corolla	Petals four, gamopetalous, ovate, lurid green-yellow, darker dotted petals tinged with purple above half of each corolla lobe, one green nectar gland at each base of the corolla lobe.
Androecium	Stamens four, epipetalous, alternipetalous, polyandrous, bithecous, inferior.
Gynoecium	Bicarpellary, syncarpous, unilocular, parietal placentation, stigma bifid, superior.

Flowers are observed to be abundant, greenish yellow, and darkly dotted, tinged with purple. It has four sepals that are gamosepalous, lanceolate, smaller than the corolla, equal-sized, greenish in color, with an acute tip. The number of petals is also four, gamopetalous, oblong with acute apex, dominantly spotted with purple dots on a white background. The petals are also found to have one green nectar gland at each base of the corolla lobe. Stamens is four, epipetalous, and arranged in an alternipetalous form with four filaments that are uniform in size. Gynoecium has a syncarpous ovary, bicapellary, unilocular, and with a parietal placentation. Stigma is bifid and superior. Flowers are found to be hypogynous and possess actinomorphic symmetry. Flowering is from August to December. Fruit is a capsule, greenish when young then yellow when ripe. Figures 2 and 3 show the general features of the plant.

Figure 2. (A) Leaves (B) General view of *S. decurrens* inflorescence (C) Internode (stem) (D) Roots of the plant. (E) Close-up view of flowers

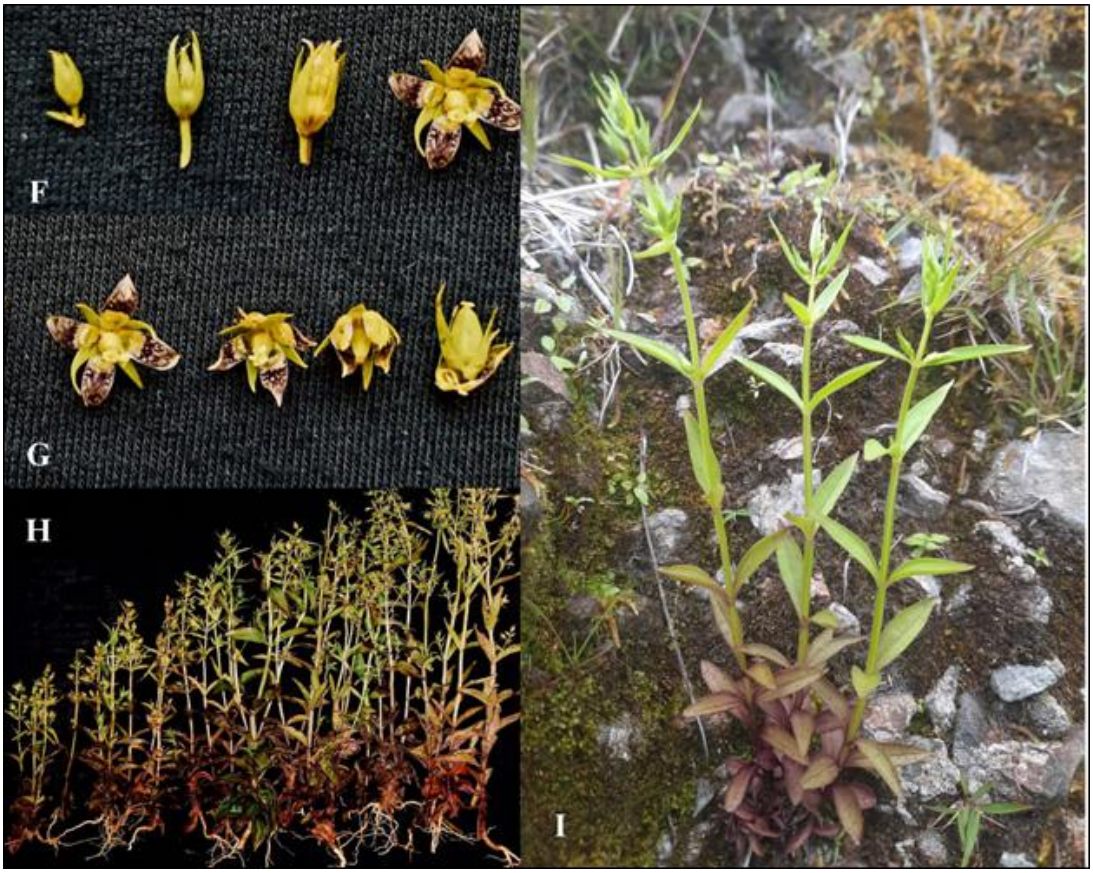

Figure 3. (F-G) Development of flower (H) General view of *S. decurrens* height differences (I) General view of *S. decurrens* in its habitat

Quantitative Morphological Traits. A total of 24 morphological traits were measured in the plant (Table 2). Plant height varied from 20 cm to 92 cm in height, while leaf size varied from 1.8 cm to 13 cm in length and from 0.3 cm to 5 cm in width. Internode length ranged between 0.6 cm to 5.6 cm. Flower diameter ranges from 9.4 mm to 17.8 mm. The length of its anther ranged from 0.1 mm to 0.6 mm, with stamen length of 1.4 mm to 3.6 mm, while its filament ranged from 1 mm to 3 mm in length. Its stigma is at 0.2 mm to 0.8 mm in width, having a style length of 0.6 to 1.8 mm. The ovary length ranges from 1 mm to 2.3 mm in length, with a diameter of 0.3 mm to 1.7 mm.

Moreover, the stomatal length ranges from 17.29 to 43.44 μm, while its stomatal width ranges from 15.38 to 41.41 μm. The stomatal density ranges from 137.5 to 387.5 stomata per mm². Fruits are about 5-7 mm long and 2-4 mm in diameter. The roots range from 35-110 mm long with a diameter of about 1.2-4 mm.

Table 2. Means, standard deviation, and ranges of quantitative characters assessed on *Swertia decurrens*

Characters	Mean	Standard Deviation	Range
Plant height (cm)	51.09	± 21.54	20.00-92.00
Stem diameter (cm)	0.35	± 0.13	0.20-0.60
Vegetative leaf length (cm)	6.36	± 3.10	2.20-12.90

Reproductive leaf length (cm)	4.3	± 1.86	1.87-7.43
Vegetative leaf width (cm)	2.32	± 1.29	0.60-4.67
Reproductive leaf width (cm)	1.45	± 0.88	0.37-3.53
Internode length (cm)	3.35	± 1.68	0.60-5.60
Flower diameter (mm)	12.05	± 2.01	9.40-17.80
Sepal length (mm)	4.59	± 0.83	3.20-6.10
Sepal width (mm)	1.02	± 0.27	0.70-1.50
Petal length (mm)	5.19	± 0.49	4.30-6.00
Petal width (mm)	2.2	± 0.19	1.80-2.50
Stamen length (mm)	2.22	± 0.57	1.40-3.60
Anther length (mm)	0.33	± 0.13	0.10-0.60
Filament length (mm)	1.89	± 0.50	1.00-3.00
Stigma width (mm	0.45	± 0.18	0.20-0.80
Style length (mm)	1.18	± 0.29	0.60-1.80
Ovary length (mm)	1.78	± 0.34	1.00-2.30
Ovary diameter (mm)	1.04	± 0.30	0.30-1.70
Stomatal length (um)	27.49	± 5.72	17.29-43.44
Stomatal width (um)	22.49	± 6.34	15.38-41.41
Stomatal density (um)	246.88	± 101.46	137.5-387.5
Fruit length (mm)	5.9	± 0.72	5.00-7.00
Fruit diameter (mm)	2.25	± 0.55	2.00-4.00
Root length(mm)	54.55	± 17.40	35.00-110.0
Root diameter (mm)	2.12	± 0.86	1.20-4.00

Anatomical Features of *Swertia decurrens*

The leaf. A cross-section of the leaf shows both upper and lower epidermises enclosing the mesophyll (Figure 4). The stomata were found only in the lower epidermis and are of the anomocytic type. The subsidiary and epidermal cells of the lower epidermis are irregularly shaped with curved cell walls. On the other hand, the epidermal cells of the upper epidermis are more polygonal, but the cell walls are slightly curved. The palisade layer and spongy layer of the mesophyll cannot be distinguished (Figure 4C). The midrib layer was also observed with the vascular bundle surrounded by parenchymatous layers with more layers below. The phloem is located above the xylem, which is conspicuously thick-walled (Fig. 4D-E).

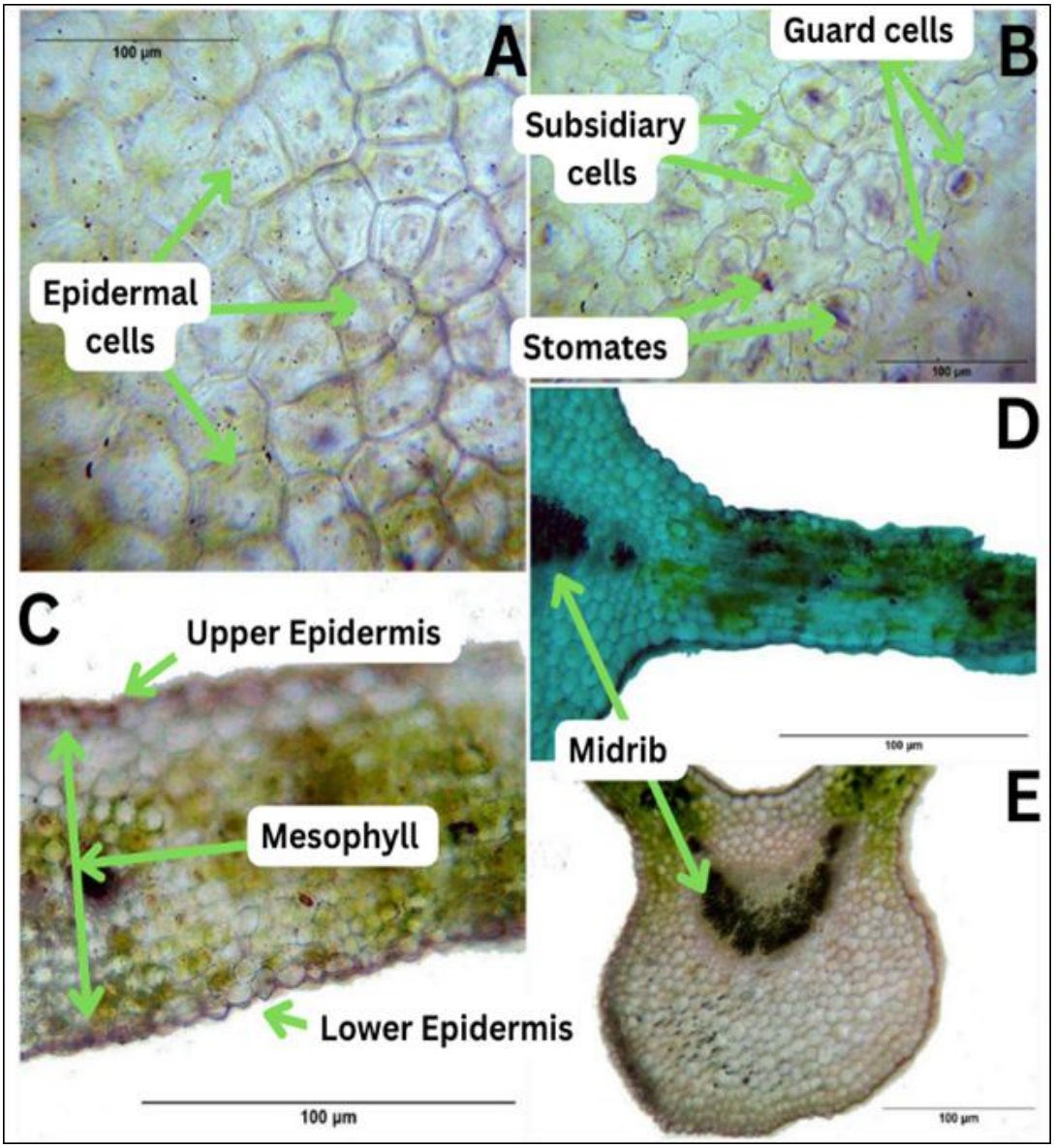

Figure 4. Leaf: (A) Upper epidermis (B) Lower epidermis (C) Middle palisade layer (D) Palisade layer near midrib (E) Midrib

The Stem. Cross section of *Swertia decurrens* was observed to be amphiphloic siphonostele arrangement (Figure 5). Here, the epidermis is seen to be uniseriate immediately followed by a wide cortex. The epidermis consists of small circular cells while the cortex exhibits big collenchyma cells arranged polyhedrally. After the cortex, the phloem appears less wide than the cortex and has continuous cylinder-shaped cells arranged evenly. Next is the thin vascular cambium followed by a wide band of secondary xylem (Figure 6A) marked by thick-walled cells of 15-20 layers. The primary xylem is less dominant followed by a wide pith. Xylem vessels appeared circular that runs along the secondary xylem. On the other hand, the majority of the pith is parenchymatous in which pith cells have unequal sizes and are arranged compactly.

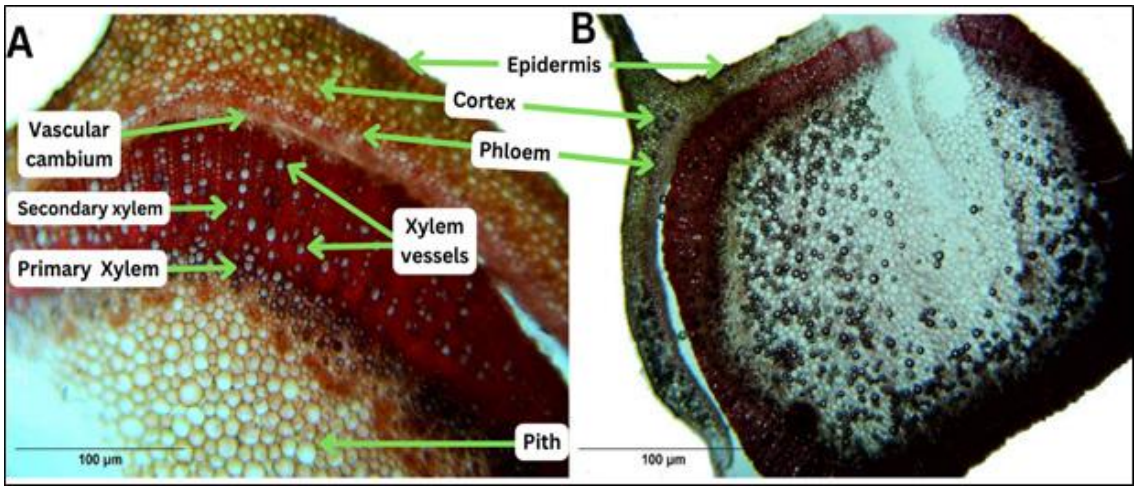

Figure 5. Stem: (A) Overview of the stem (B) Side portion of the stem

The Roots. Cross cross-section of the woody roots was shown in Figure 6, where both the side portion and the middle portion of the roots were seen. The periderm is shown to be multi-layered, followed by remnants of cortex intermixed with phloem tissues. The cortex is composed of circular parenchyma cells and is distributed evenly in the entire root section. After this is the vascular cambium, followed by a wide secondary xylem occupying the central portion of the root, while the primary xylem is pushed to the centermost.

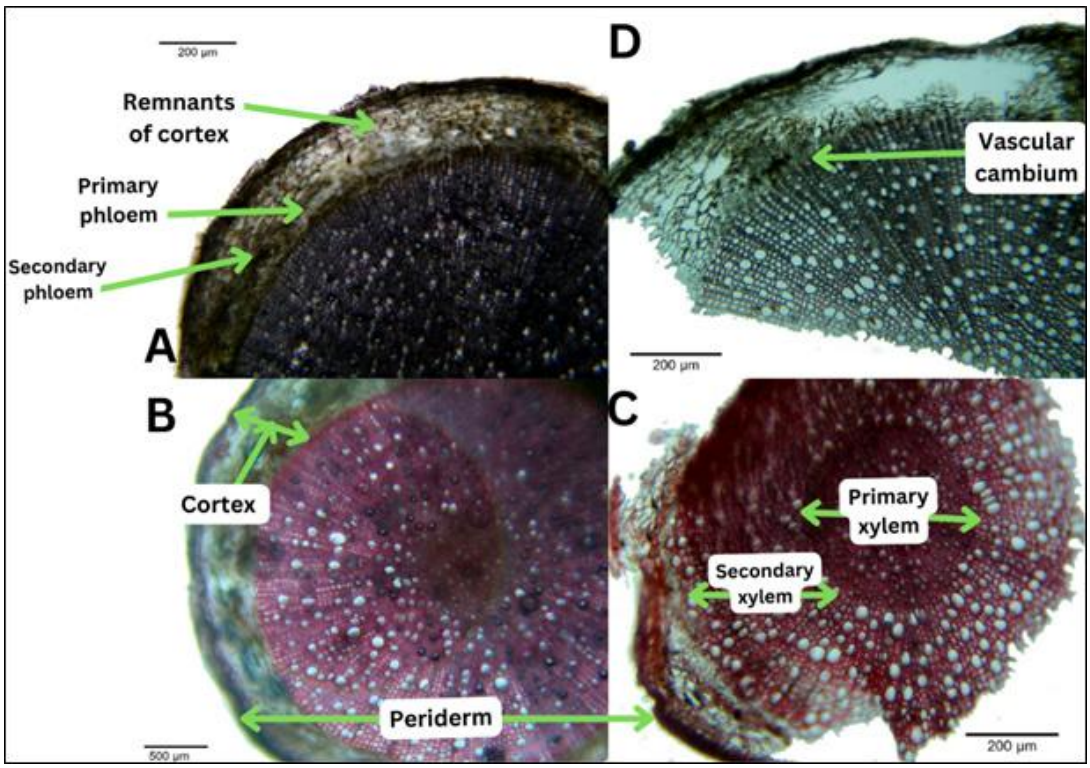

Figure 6. Roots: (A&D) Side portion of the root (B) Overview of the root (C) Middle portion of the root

Phytochemical Analysis of *Swertia decurrens*

The qualitative result of phytochemical screening of crude methanolic extraction of *Swertia decurrens* revealed the presence of medically active metabolites such as alkaloids, anthraquinones, essential oils, saponins, and steroids (Table 3). However, some metabolites, such as flavonoids, phenols, tannins, and terpenoids, were negative on the plant.

Table 3. Phytochemical Component of *Swertia decurrens*

PLANT CONSTITUENT	RESULT
Alkaloids	+
Anthraquinone	+
Essential Oils	+
Flavonoids	-
Phenols	-
Saponins	+
Steroids	+
Tannins	-

Legend: (+) Present; (-) Absent

Antibacterial Activity of *Swertia decurrens*

Antibacterial activity of *Swertia decurrens* was observed against Gram-positive *S. aureus* and Gram-negative *E. coli* bacteria strains. Methanolic, ethanolic, and aqueous extracts of *Swertia decurrens* were utilized and revealed the absence of any antibacterial activity of the plant in terms of zone of inhibition (Table 4) and minimum inhibitory concentration (Table 5). These negative results could be attributed to the lack of phenols and flavonoids in the plant, which are known to have anti-bacterial properties. Only the positive control showed significant inhibition activity.

Table 4. Zone of Inhibition of *Swertia decurrens* plant extracts against *S. aureus* and *E. coli*

	Zone of Inhibition (mm)					
Concentration	**Methanol**		**Ethanol**		**Aqueous**	
	E.coli	*S. aureus*	*E. coli*	*S. aureus*	*E. coli*	*S. aureus*
100%	-	-	-	-	-	-
75%	-	-	-	-	-	-
50%	-	-	-	-	-	-
25%	-	-	-	-	-	-
Negative	-	-	-	-	-	-
Positive	20mm	12mm	3mm	5mm	25.2mm	23.9mm

Table 5. Minimum Inhibitory Concentration of *Swertia decurrens* plant extracts against *S. aureus* and *E. coli*

Minimum Inhibitory Concentration						
Dillution	**Methanol**		**Ethanol**		**Aqueous**	
	E.coli	*S. aureus*	*E. coli*	*S. aureus*	*E. coli*	*S. aureus*
2.9 g	-	-	-	-	-	-
1.45 g	-	-	-	-	-	-
0.725 g	-	-	-	-	-	-
0.363 g	-	-	-	-	-	-
0. 18	-	-	-	-	-	-
Negative	-	-	-	-	-	-
Positive	25.4mm	25mm	24.7mm	24.9mm	25.6mm	25mm

Discussion

Morpho-Anatomical Characters of *Swertia decurrens*

The morphological features of *Swertia decurrens* are closest to the features of *Swertia chirayita* as described by Mehta *et al.* (2016). They are both annual herbs and they exhibit erect growth habit. However, their stem may differ a little; *S. decurrens* displays a full quadrangular stem while *S. chirayita* displays a lower half circular becoming quadrangular above. Both species have lanceolate type of leaves with opposite phyllotaxy. They have sessile leaves. In terms of inflorescence, they both possess panicles while having terminal clusters of 3-5 flowers. Further, their flowers are also similar to bracteates, pedicellate, hypogynous, complete and bisexual. *Swertia decurrens* has a purplish dotted color on a white background, while *S. chirayita* is also purplish at the margins and not dotted. Sepals are also found to be the same; four in number, gamosepalous, lanceolate form with acute tip, green and smaller than the corolla. Corollas are the same but differ a little; both have four petals, gamopetalous, ovate form and greenish yellow in color. *S. decurrens* has one green nectar gland at each base of the corolla lobe, while *S. chirayita* has two nectar glands.

In terms of plant height, *S. cordata* is the closest at 21-70 cm (Mehta *et al.* 2016) to *S. decurrens* at 20-90 cm. In terms of vegetative leaf width, *S. decurrens* with 0.6-4.7 cm is observed to be wider compared to other *Swertia* species. Its reproductive leaf length and width are observed to be the same of *S. chirayita* but longer and wider compared to other *Swertia* species. The flower diameter of *S. decurrens* at 9.4-17.8 mm is close to *S. chirayita* at 9.2-11.5 mm. *S. decurrens,* together with *S. chirayita, S. alata,* and *S. angustifolia* all have four petals. With 4.3-6 mm, *S. decurrens* has the shortest petal length compared to other *Swertia* species at 6-10 mm. In terms of

width, *S. decurrens* was narrower with 1.8-2.5 mm compared to other *Swertia* at 2-3 mm. Also, *S. decurrens* has the shortest sepal length (3.2-6.1 mm) compared to others, at 5-14 mm in length. It`s also narrower, with 0.7-1.5 mm in width, compared to other *Swertia* at 1-3 mm. In terms of stamens, *S. decurrens, S. chirayita, S. alata,* and *S. angustifolia* all have four, with *S. decurrens* being the shortest (1.4-3.6 mm) compared to other *Swertia* at 3-6 mm. Also, *S. decurrens* has the shortest filament length at 1-3 mm (versus 2-5 mm with others) and anther length at 0.1-0.6 mm. But in terms of ovary length, *S. decurrens* is similar to *S. alata, S. angustifolia,* and *S. purpurascens,* ranging from 1-2.5 mm.

The anatomy of *Swertia decurrens* was found to be similar to other *Swertia* species. For example, the stem of *Swertia chirayita* was described to have xylem vessels that are angular, wide, thick-walled, and are either in clusters or in short radial multiples (Selvam 2011). The root has secondary xylem located at the center of the root section. Also, there is a presence of xylem elements distributed in the ground tissue of the roots. Lastly, the cortical zone was parenchymatous and wide, consisting of different cortical cells that are thin and wide. These are similar to *S. decurrens*.

Phytochemical Components of *Swertia decurrens*

Swertia decurrens showed the presence of alkaloids. According to Roy (2017), alkaloids are extremely important and have been discovered to have crucial biological qualities that can solve certain illnesses, and they act as antioxidants, antitumoral, muscle relaxants, antihypertensives, antiarrhythmic, myotics, anticancer, pain relievers, and anti-asthmatic. Approximately five (5) types of alkaloids were reportedly active in the genus *Swertia* that were isolated from different species of *Swertia. Swertia decurrens* also tested positive for essential oils as one of its active metabolites. Essential oils can be utilized in improving not just emotional and physical problems but also in the view of developing defenses against various types of harm, including pathogens, fungi, and bacteria, without imposing a larger percentage of side effects, unlike synthetic drugs. This is consistent with the study conducted by Chandra *et al.* (2017) on *Swertia ciliata,* which also contains essential oil, which was tested to have a significant role in its antifungal activity against *Candida albicans*.

In addition, saponins are also present in *Swertia decurrens.* Saponins are common phytochemicals with roles in physiological and biological membranes, gastrointestinal absorption, blood and liver cholesterol, enzymes, general body metabolism, reproductive, antioxidant, and free-radical scavenging function, smooth muscle activity, and effects on ruminant digestion are only a few of the effects of saponin (Soetan et al., 2018). *Swertia chirayita* also recorded the presence of saponin, which is known to have inhibitory effects on inflammation (Sodipo *et al*., 2000).

Lastly, *S. decurrens* revealed the occurrence of steroids as one of the active metabolites of the plant, which is known to have antibacterial properties (Raquel 2007). Patel (2015) said that plant steroids are a unique class of chemical compounds that are found throughout the animal and plant kingdom. Similarly, Mahmood *et al.* (2014) revealed the presence of steroids as primary metabolites found in *S. chirayita* collected from various cities of Pakistan.

Compared to our plant, more phytochemical components were determined in *S. chirayita.* Ansari *et al.* (2014) determined the presence of alkaloids, carbohydrates, glycosides, flavonoids, tannins, terpenes, and phenolic compounds in the methanolic extract of *Swertia chirayita*. Notably, saponins were not detected in the extract. Archana *et al.* (2011) also affirm this result, showing the existence of tannins, alkaloids, glycosides, and flavonoids in the methanol extract. However, it was revealed that in the aqueous extract, only tannins and glycosides were identified.

Antimicrobial Property of *Swertia decurrens*

Our results revealed the zero inhibition of the different treatments of *S. decurrens* against the test bacteria. These showed that *S. decurrens* has no significant microbial activity against *S. aureus* and *E. coli.* These results contrasted well with the results of Roy *et al.* (2015), which showed the methanol extracts of *Swertia chirayita* and *Swertia cordata* to have significant antibacterial activity. Thus, they conclude that *Swertia chirayita* and *Swertia cordata* can be utilized as medicinal plants.In another study, the methanol extract of *Swertia chirayita* revealed the highest antibacterial property among the acetone, chloroform, and petroleum ether, giving off an MIC value of 30mg/l on *S. mutans*, 10mg/l on *S. aureus,* 10mg/l on *B.subtilis,* and 20mg/l on *S. epidermis* (Kweera et al. 2011). Moreover, Nayak *et al.* (2015) asserted that the ethanol and methanol extracts of *Swertia chirayita* exhibited positive results against *S. aureus, Bacillus spp., E. coli, K. pneumonia, and P. aeruginosa.* The positive result of *S. chirayita* starts at increasing concentration at 100-5000 µg/ml. Their findings also suggested that the ethanol extract of *S. chirayita* demonstrated greater efficacy than the methanol extract against these microorganisms.

On the other hand, Aleem & Kabir (2018) demonstrated that the aqueous extract of *Swertia chirayita* did not exhibit any activity against *E. coli*, leading them to conclude that the plant's aqueous extract cannot inhibit the growth of this bacterium. Similarly, Khalid et al. (2011) conducted a study indicating that the aqueous extract of *S. chirayita* displayed no activity against *S. aureus* and other bacterial samples. They recommended further research focusing on the antibacterial activity of *S. chirayita.*

Conclusion

The study was conducted to characterize the morphological and anatomical characteristics of *Swertia decurrens*, an endemic plant from the Cordillera Central Range. *Swertia decurrens* is an annual herb up to 92 cm tall, erect with a quadrangular stem and a prominent decurrent line along the angles. Leaves are lanceolate, in opposite pairs, acuminate, cuneate at the base, sessile, and about 13 cm long and 5 cm wide. Inflorescence cymes in corymbose panicles; flowers greenish yellow, and darkly dotted, tinged with purple, with four sepals, green, lanceolate, with acute tip arranged alternately with four petals, oblong with acute apex, dominantly spotted with purple dots on a white background. Anatomical features of the plant showed common dicot root and stem anatomy but the leaf mesophyll is not divided into palisade and spongy layers. Additionally, phytochemical screening found alkaloids, anthraquinones, essential oils, saponins, and steroids to be present in *S. decurrens,* but flavonoids, phenols, and tannins are negative. Lastly, antibacterial activity showed zero inhibition against Gram-positive *Staphylococcus aureus* and Gram-negative bacteria *Escherichia coli,* which could be attributed to the absence of phenols and flavonoids that are known to have antibacterial activity. This information is are helpful addition to the ongoing effort to document the endemic and understudied plants in the area.

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