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IN-VITRO PHARMACOLOGICAL ASSESSMENT AND PHYTOCHEMICAL ANALYSIS OF *SWERTIA CHIRATA* EXTRACT

Basant Kumar Chauhan*, Gyan Singh, Vivek Gupta
Faculty of Pharmacy, P.K. University, Thanra, Shivpuri (M.P.)

***Correspondence Info:**
Basant Kumar Chauhan
Faculty of Pharmacy, P.K. University, Thanra, Shivpuri (M.P.)
Email:
basantchauhan1@gmail.com

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ABSTRACT

Swertia chirata is a traditionally valued medicinal plant known for its wide range of pharmacological properties. The present study was carried out to evaluate the phytochemical constituents, antioxidant potential, antimicrobial activity, and anti-acne efficacy of the ethanolic extract of *Swertia chirata*. The percentage yield of the ethanolic extract was found to be 11.57% (w/w), indicating efficient extraction of bioactive compounds. Phytochemical screening revealed the presence of flavonoids, phenols, proteins, carbohydrates, saponins, and sterols, while alkaloids, glycosides, diterpenes, and tannins were absent. Total phenolic and flavonoid contents were found to be 0.72 mg/100 mg and 0.85 mg/100 mg, respectively. The antioxidant activity evaluated using the DPPH assay showed a concentration-dependent free radical scavenging effect with an IC_{50} value of 79.26 µg/ml for the extract, compared to 19.67 µg/ml for ascorbic acid. The antimicrobial evaluation demonstrated significant inhibitory activity against *Staphylococcus aureus* and *Klebsiella pneumoniae*, with maximum zones of inhibition of 12 ± 0.47 mm and 14 ± 0.94 mm, respectively, at 100 mg/ml. Furthermore, the extract exhibited promising anti-acne activity against *Propionibacterium acnes*, showing a maximum zone of inhibition of 16 ± 0.86 mm. The observed biological activities can be attributed to the presence of phenolic and flavonoid compounds. Overall, the findings suggest that *Swertia chirata* possesses significant antioxidant, antimicrobial, and anti-acne potential, supporting its traditional medicinal use and highlighting its prospects for development into natural therapeutic agents.

Keywords: *Swertia chirata*, phytochemical screening, flavonoids, phenolic content, antioxidant activity, DPPH assay, antimicrobial activity, anti-acne activity, *Propionibacterium acnes*, medicinal plants.

INTRODUCTION

Medicinal plants have been an integral part of traditional healthcare systems since ancient times and continue to serve as a rich source of therapeutic agents for modern drug development (Manisha *et al.*, 2025). The increasing interest in plant-based medicines is primarily due to their safety profile, cost-effectiveness, and wide range of biological activities (Latif and Jauhari, 2025). Among various medicinal plants, *Swertia chirata* (family: Gentianaceae), commonly known as Chirata, holds significant importance in Ayurveda and other traditional systems of medicine. It is widely distributed in the Himalayan regions and has been traditionally used for the treatment of fever, liver disorders,

gastrointestinal problems, diabetes, and various skin infections (Jauhari *et al.,* 2017).

Swertia chirata is reported to contain a variety of bioactive phytochemicals such as flavonoids, xanthones, iridoids, and secoiridoid glycosides, which are responsible for its diverse pharmacological activities. These constituents exhibit antioxidant, antimicrobial, anti-inflammatory, hepatoprotective, and antidiabetic properties. In particular, the presence of phenolic and flavonoid compounds contributes significantly to its free radical scavenging and antimicrobial potential (Kumar and Staden; 2016).

Oxidative stress and microbial infections are among the major factors responsible for the development of various chronic and infectious diseases. Natural antioxidants derived from medicinal plants play a crucial role in neutralizing free radicals and preventing cellular damage. Similarly, plant-based antimicrobial agents are gaining attention due to increasing resistance of pathogens to conventional antibiotics. Furthermore, skin-related disorders such as acne are commonly associated with bacterial infection, particularly *Propionibacterium acnes*, making the search for effective natural anti-acne agents highly relevant (Ivanov *et al.,* 2017).

In this context, the present study aims to perform phytochemical screening and evaluate the in-vitro pharmacological activities of ethanolic extract of *Swertia chirata*, including antioxidant, antimicrobial, and anti-acne effects. The study is intended to scientifically validate the traditional uses of the plant and explore its potential for development into novel herbal therapeutic formulations.

MATERIALS AND METHODS

Materials

The study utilized the whole plant of *Swertia chirata*, which was collected, authenticated, and processed for extraction. Ethanolic extract was prepared using ethanol as the primary solvent. Various analytical-grade chemicals and reagents were used for phytochemical screening, including Wagner's and Hager's reagents for alkaloids, Lead acetate and alkaline reagent for flavonoids, Ferric chloride and Folin–Ciocalteu reagent for phenols, Benedict's and Fehling's solutions for carbohydrates, Froth test reagents for saponins, and Salkowski reagent for sterols. For antioxidant evaluation, DPPH (2,2-diphenyl-1-picrylhydrazyl) was used along with ascorbic acid as the standard. Antimicrobial and anti-acne studies were carried out using microbial strains such as *Staphylococcus aureus*, *Klebsiella pneumoniae*, and *Propionibacterium acnes*. Standard laboratory equipment and glassware, along with spectrophotometric and incubation systems, were employed for the experimental work.

Methods

Extraction by soxhlet apparatus

Following procedure was adopted for the preparation of extract from the shade dried and powdered herbs. Aerial parts of *Swertia chirata* was shade dried at room temperature. The shade dried plant material was coarsely powdered. 40 gm of dried powdered aerial parts of *Swertia chirata* has been extracted with ethanol solvent using soxhlet extraction process for 24 hrs, filtered and dried using vacuum evaporator at 40°C (Mukherjee, 2007).

Determination of percentage yield

The percentage yield of each extract was calculated by using following formula:

Percentage yield = Weight of Extract/ Weight of powdered drug x 100

Phytochemical screening

Phytochemical tests are conducted to identify and determine the quantity of specific phytochemical compounds present in a plant extract or plant material. These tests employ various chemical, chromatographic, and spectroscopic techniques to isolate, separate, and characterize the phytochemicals. The choice of tests depends on the nature of the phytochemical of interest and the available resources. Phytochemical examinations were carried out for the extract as per the standard methods (Kokate, 1994).

Estimation of total phenol content

The total phenolic content of the extract was determined by the modified folin-ciocalteu method (Parkhe and Bharti, 2019).

Preparation of Standard: 10 mg Gallic acid was dissolved in 10 ml methanol, various aliquots of 5- 25µg/ml was prepared in methanol.

Preparation of Extract: 10mg of dried extracts of were dissolved in 10 ml methanol and filter. Two ml (1mg/ml) of this solution was used for the estimation of phenol.

Procedure: 2 ml of each extract or standard was mixed with 1 ml of folin-ciocalteu reagent (previously diluted with distilled water 1:10 v/v) and 1 ml (7.5g/L) of sodium carbonate. The mixture was vortexed for 15s and allowed to stand for 15 min for colour development. The absorbance was measured at 765 nm using a spectrophotometer.

Estimation of total flavonoids content

Determination of total flavonoids content was based on aluminium chloride method (Parkhe and Bharti, 2019).

Preparation of standard: 10 mg quercetin was dissolved in 10 ml methanol, and various aliquots of 5- 25µg/ml were prepared in methanol.

Preparation of extract: 10mg of dried extracts of were dissolved in 10 ml methanol and filter. Three ml (1mg/ml) of this solution was used for the estimation of flavonoid.

Procedure: 1 ml of 2% $AlCl_3$ methanolic solution was added to 3 ml of extract or standard and allowed to stand for 15 min at room temperature; absorbance was measured at 420 nm.

***In-vitro* antioxidant activity of *Swertia chirata* extract**

Total free radical scavenging capacity of extracts from *Swertia chirata* were estimated according to the previously reported method with slight modification (Parkhe and Jain, 2018). Solution of DPPH (6 mg in 100ml methanol) was prepared and stored in dark place. Different concentration of standard and test (10- 100 µg/ml) was prepared. 1.5 ml of DPPH and 1.5 ml of each standard and test was taken in seperate test tube; absorbance of this solution was taken immediately at 517nm. 1.5 ml of DPPH and 1.5 ml of the methanol was taken as control absorbance at 517nm.

The percentage inhibition of free radical DPPH was calculated from the following equation:

% inhibition = [(absorbance of control – absorbance of sample)/ absorbance of control] × 100%.

In vitro antimicrobial and anti-acne activity of *Swertia chirata* extract

The flask containing medium was cotton plugged and was placed in autoclave for sterilization at 15 lbs /inch^2 (121^{o}C) for 15 minutes. After sterilization, the media in flask was immediately poured (20 ml/ plate) into sterile petri dishes on plane surface. The poured plates were left at room temperature to solidify and incubate at 37^{o}C overnight to check the sterility of plates. The plates were dried at 50^{o}C for 30 minutes before use. The well diffusion method was used to determine the antimicrobial and anti-acne activity of the ethanolic extract prepared from of *Swertia chirata* using standard procedure (Bauer *et al.*, 1966).There were 3 concentration used which are 25, 50 and 100 mg/ml for extracted phytochemicals in studies. It's essential feature is the placing of wells with the antibiotics on the surfaces of agar immediately after inoculation with the organism tested. Undiluted over night broth cultures should never be used as an inoculums. The plates were incubated at 37^{o}C for 24 hr. and then examined for clear zones of inhibition around the wells impregnated with particular concentration of drug.

RESULTS AND DISCUSSION

The present study was designed to evaluate the phytochemical profile, antioxidant potential, antimicrobial activity, and anti-acne efficacy of the ethanolic extract of *Swertia chirata*. The findings demonstrate that the plant possesses notable bioactive constituents and significant biological activities, supporting its traditional medicinal use.

The percentage yield of the ethanolic extract was found to be 11.57% (Table 1), indicating a moderate extraction efficiency. This yield suggests that ethanol is an effective solvent for extracting polar and semi-polar phytoconstituents from *Swertia chirata*, which is consistent with previous reports where hydroalcoholic or ethanolic extracts provided higher recovery of secondary metabolites.

Phytochemical screening (Table 2) revealed the presence of flavonoids, phenols, proteins, carbohydrates, saponins, and sterols, while alkaloids, glycosides, diterpenes, and tannins were mostly absent. The strong presence of flavonoids and phenolic compounds is particularly important, as these metabolites are well known for their antioxidant, antimicrobial, and anti-inflammatory properties. The presence of saponins further contributes to membrane permeability and antimicrobial effects, enhancing the biological potential of the extract.

The total phenolic and flavonoid contents were found to be 0.72 mg/100 mg and 0.85 mg/100 mg respectively (Table 3). The relatively higher flavonoid content compared to phenols suggests that flavonoids may play a dominant role in the observed pharmacological activities, particularly antioxidant and antimicrobial effects. These compounds are known to scavenge free radicals and reduce oxidative stress, thereby contributing to cellular protection.

The antioxidant activity assessed by the DPPH assay (Table 4) showed a concentration-dependent increase in % inhibition for the ethanolic extract. At 100 µg/ml, the extract exhibited 52.74% inhibition compared to 81.25% for ascorbic acid. The IC_{50} value of the extract was found to be 79.26 µg/ml, which, although higher than ascorbic acid (19.67 µg/ml), indicates moderate antioxidant potential. This activity

can be attributed to the presence of flavonoids and phenolic compounds, which are capable of donating hydrogen atoms or electrons to neutralize free radicals.

The antimicrobial activity (Table 5) demonstrated that the ethanolic extract exhibited significant inhibitory effects against both *Staphylococcus aureus* and *Klebsiella pneumoniae*. The zone of inhibition increased with concentration, with the maximum activity observed at 100 mg/ml (12 ± 0.47 mm for *S. aureus* and 14 ± 0.94 mm for *K. pneumoniae*). The higher sensitivity of *K. pneumoniae* suggests that the extract may be more effective against Gram-negative bacteria in this study, possibly due to disruption of cell wall synthesis or membrane integrity by bioactive constituents.

Similarly, the anti-acne activity against *Propionibacterium acnes* showed promising results (Table 6), with a maximum zone of inhibition of 16 ± 0.86 mm at 100 mg/ml. This indicates that the extract possesses strong antibacterial activity against acne-causing bacteria, likely due to the synergistic effect of flavonoids, saponins, and phenolic compounds. The increasing zone of inhibition with concentration further confirms dose-dependent activity.

The results suggest that *Swertia chirata* ethanolic extract exhibits moderate antioxidant activity along with significant antimicrobial and anti-acne potential. These biological effects can be correlated with its rich phytochemical composition, particularly flavonoids and phenolic compounds. The study supports the traditional medicinal use of *Swertia chirata* and highlights its potential for development into natural therapeutic agents, especially for oxidative stress-related disorders and microbial infections. However, further studies involving isolation of active compounds and in vivo evaluation are necessary to confirm and standardize its pharmacological efficacy.

Table 1: % yield of extract of *Swertia chirata*

S. No.	Extract	Weight of extract	% Yield (w/w)
1.	Ethanolic	4.63	11.57

Table 2: Phytochemical screening of extract *of Swertia chirata*

S. No.	Constituents	Ethanolic extract
1.	**Alkaloids**	
	Wagner's test	-ve
	Hager's test	-ve
2.	**Glycosides**	
	Legal's test	-ve
3.	**Flavonoids**	
	Lead acetate	+ve
	Alkaline reagent test	+ve
4.	**Phenol**	
	Ferric chloride test	+ve
	Folin ciocalteu test	-ve
5.	**Proteins**	

	Xanthoproteic test	+ve
6.	**Carbohydrates** Benedict's test Fehling's test	 -ve +ve
7.	**Saponins** Froth test	 +ve
8.	**Diterpins** Copper acetate test	 -ve
9.	**Tannins** Gelatin test	 -ve
10.	**Sterols** Salkowski Test	 -ve

+ve=positive; -ve= negative

Table 3: Total phenol and total flavonoid content of *Swertia chirata*

S. No.	Total phenol content	Total flavonoid content
	mg/100mg	
1.	0.72	0.85

Table 4: % Inhibition of ascorbic acid and extract of *Swertia chirata* using DPPH method

S. No.	Concentration (µg/ml)	% Inhibition	
		Ascorbic acid	Ethanolic extract
1	10	41.05	17.69
2	20	50.89	28.04
3	40	65.57	34.95
4	60	71.04	41.22
5	80	75.96	49.85
6	100	81.25	52.74
IC_{50} value		**19.67**	**79.26**

Table 5: Antimicrobial activity of ethanolic extract of *Swertia chirata* against selected microbes

S. No.	Microbes	Zone of Inhibition (nm)		
		25mg/ml	50 mg/ml	100 mg/ml
1.	*Staphylococcus aureus*	8±0.94	10±0.74	12±0.47
2.	*Klebsiella pneumoniae*	9±0.5	11±0.57	14±0.94

Table 6: Antiacne activity of ethanolic extract of *S. chirata* against *Propionibacterium acnes*

S. No.	Microbes	Zone of Inhibition (nm)		
		25mg/ml	50 mg/ml	100 mg/ml
1.	*Propionibacterium acnes*	12±0.6	13±0.3	16±0.86

CONCLUSION

The ethanolic extract of *Swertia chirata* showed the presence of important phytochemicals such as flavonoids, phenols, and saponins, which are responsible for its biological activities. The extract exhibited moderate antioxidant activity, significant antimicrobial effects against tested bacteria, and promising anti-acne activity against *Propionibacterium acnes*. The study supports the traditional medicinal use of *Swertia chirata* and indicates its potential as a natural source for antioxidant and antimicrobial agents. Further detailed in-vivo and compound isolation studies are recommended.

DECLARATION OF INTEREST

The authors declare no conflicts of interests. The authors alone are responsible for the content and writing of this article.

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