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Evaluation of Phytoconstituents *Swertia chirayita* for its Antidiabetic properties

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ABSTRACT

Swertia chirayita **is a medicinal plant with a rich history in traditional Ayurvedic medicine. This article explores the various bioactive compounds present in *Swertia chirayita*, such as flavonoids and terpenoids. These compounds are thought to be responsible for the plant's noted antioxidant, anti-diabetic, antibacterial, and anticancer properties. A qualitative phytochemical screening in this study revealed significant secondary metabolites in *Swertia chirayita*, including flavonoids, phenols, saponins, glycosides, and tannins, which are considered important secondary metabolites of the plant. The initial screening process detected various substances in the extracts, including alkaloids, carbohydrates, glycosides, proteins, phenols, flavonoids, saponins, terpenoids, tannins, and steroids. These active metabolites are well-documented for their efficacy in addressing various human ailments, including menstrual disorders, chronic eczema, diarrhoea, dysentery, spasmodic conditions, and as diuretic-choleretic agents. *Swertia Chirayata* extracts from *Swertia chirayata* may help manage diabetes. It was corroborated by the fact that *Swertia chirayata* inhibited α-amylase activity at 59.36 ± 1.42 µg/ml and α-glucosidase activity at 28.12 ± 1.34 µg/ml. In summary, the antidiabetic qualities of *Swertia chirayata* make them potential candidates for a functional food or natural supplement. The antibacterial, antidiabetic, and antioxidant properties of *Swertia chirayita* may be attributed to the primary phytochemical components identified in this investigation. The preliminary findings indicate a need for further research, including in vitro studies. Consequently, *Swertia chirayita,* examined in this study, may have valuable applications in the pharmaceutical industry for various medical uses. Finally, the limitations of current research and the need for further studies are addressed.**

Keywords: ***Swertia Chirayata*****, Flavonoids, Medicinal Value, Anticancer Properties.**

INTRODUCTION

Swertia chirayita (Roxb. ex Flem.) Karst. It is a significant medicinal plant native to the Himalayan regions. It typically thrives on moist hill slopes within temperate forests at altitudes ranging from 1200 to 3000 meters, where it is extensively harvested from the wild for commercial and local medicinal purposes. In Eastern traditional medicine, such as Ayurveda, Unani, Siddha, traditional Chinese and Tibetan medicine, and local healing practices in India, *S. chirayita* is widely used.

This plant is traditionally employed in medicine to treat chronic fever, malaria, anemia, bronchial asthma, liver issues, hepatitis, gastritis, constipation, dyspepsia, skin ailments, parasitic worms, epilepsy, ulcers, low urine output, hypertension, depression, some mental disorders, bile secretion, blood purification, and diabetes (Karan et al. 1999, Banerjee et al. 2000, Airi et al. 2002, Rai 2003, Gao-Feng et al. 2004 and Saha et al. 2004). In Ayurveda, *S. chirayita* is noted for its bitter (tikta) flavour, with a cooling (shita) effect and characteristics that are easily digestible (laghu) and dry (ruksha) (Joshi and Dhawan 2005). It serves as a key component in numerous Ayurvedic health tonics, supplements, anti-diabetic and anti-cancer formulations, liver tonics, skin creams, soaps, and even hair oils (Khanal S et al. 2015). This species was first documented in the Edinburgh Pharmacopoeia in 1839 and is recognised in British and American Pharmacopoeias for use as an infusion or tincture. *Swertia chirayita*, part of the Gentianaceae family, contains various compounds responsible for its healing properties, including xanthones, flavonoids, terpenoids, iridoids, and secoiridoid glycosides (Pant et al. 2000).

The plant kingdom serves as a source of medicines exhibiting various potent bioactivities against several ailments. Compounds with potential therapeutic applications are extracted for use in pharmaceutical drug formulations (Dewick PM, 1996). The World Health Organisation indicates that 11% of 252 basic drugs are derived from flowering plants, and one-quarter of all prescribed pharmaceutical medications stem from plant origins (Paterson I & Anderson EA; 2005). Plants from the Himalayan region are noted for their high chemical diversity, which

presents a promising opportunity for discovering new and valuable natural products for therapeutic use (Cragg GM et al, 1997).

The genus Swertia encompasses such a powerful medicinal plant with significant therapeutic and pharmacological applications (Susanna P et al, 2010; Khanal S et al, 2014). Swertia is an indigenous Himalayan genus with considerable ethnopharmacological importance and notable market value, with *Swertia chirayita* being the most significant species. The other species within the Swertia genus are often considered substitutes and alternatives to *S. chirayita* (Joshi K., 2008). Nonetheless, nearly all Swertia species are recognised for their roles in traditional medicine. Swertia holds a prominent position in terms of medicinal significance and drug value in local Indian folklore. They contain bitter compounds like glycosides, seco-iridoids, and xanthones that contribute to their therapeutic effects and pharmacological actions (Brahmachari G et al, 2004; Negi JS et al, 2011). They are primarily used as medicines for fever and gastrointestinal diseases, typically prepared as infusions, decoctions, pastes, and juices.

MATERIALS AND METHODS

Plant samples

Swertia chirayita plants were collected from the Patna district of India. All plants were collected at the end of the flowering season in late August to October 2024, when the plants were in the seed dispersal phase.

Preparation of plant extracts

5gm of dried, finely powdered plant material was taken in a beaker, and 200ml of distilled water was added. The mixture was heated on a hot plate with continuous stirring at 30º-40ºC for 20 minutes. Then the water extract was filtered through filter paper, and the filtrate was used for the phytochemical analysis. The water extract was kept in the refrigerator when not in use.

Qualitative phytochemical screening

The extract was analysed for qualitative phytochemical screening as per the standard protocol mentioned below:

Test for Terpenoids: 0.5 ml crude extract added to 2 ml chloroform + 3 ml sulphuric acid, formation of reddish-brown colour indicates presence of Terpenoids.

Test for Phenol: To 10 mg of crude extract, add 1 mL of lead acetate. Formation of precipitate indicates the presence of phenolic compounds.

Test for Tannins: 200mg of plant extract is boiled with 10 ml of distilled water, then 0.1% of ferric chloride is added and mixed. A blue-green or black colour indicates the presence of tannins.

Test for Saponins: To 1 mL of extract added 5 mL of distilled water was added, shaken well, and the formation of foam indicates the presence of saponins.

Test for Flavonoids: A few drops of 10% lead acetate were added to 10 mg of plant extract, yellow colour precipitate indicates the presence of Flavonoids. A few drops of 10% NaOH are added to 5mg plant extract, watery yellow colour indicates the presence of Flavonoids.

Test for Steroids: 1 mL of extract mixed with 10 mL of chloroform and 10ml H_2SO_4. The upper layer turns red, and the H_2SO_4 layer shows a yellow colour, indicating the presence of steroids.

Test for Alkaloids: Preparation of Wagner reagent:-Potassium iodide (2gms) + iodine (1.24 gms)+ DD Water(5ml) Solution is diluted to 100 ml**.** A few drops of wagers reagent + 10 mg of plant extract**.** Reddish brown precipitate indicates the presence of Alkaloids.

Assessment of antidiabetic properties

α-amylase inhibition assay

By measuring the amount of reducing sugar (maltose equivalent) released under the assay conditions, the inhibition of α-amylase was determined. A reduction in the amount of maltose released was used to indicate the enzyme's inhibitory action. To determine the maltose equivalent, a modified dinitrosalicylic acid (DNS) technique was utilised. 8 1 mL of the chosen plant extracts' aqueous extracts were pre-incubated for 30 minutes with 1 U/mL of α-amylase, and then 1 mL of 1% w/v starch solution was added.

For ten minutes, the mixture was incubated at 37°C. After that, 1 mL of DNS reagent (12.0 g of sodium potassium tartrate tetrahydrate in 8 mL of 2 M NaOH and 96 mM 3, 5-dinitrosalicylic acid solution) was added to stop the reaction, and the mixture was heated for five minutes in a boiling water bath. At 20 degrees Celsius, equal amounts of buffer (20 mM sodium phosphate buffer with 6.7 mM sodium chloride, pH 6.9) were used to create two blanks: one without plant extracts and the other without the amylase enzyme.

At 540 nm, the absorbance was measured. Using a typical graph, the amount of reducing sugar released from starch was calculated as maltose equivalent. As a positive control, acarbose was employed. A final concentration of 5 mg/mL, 7 mg/mL, and 9 mg/mL was obtained by diluting the aqueous plant extracts from various plant components in buffer. The inhibition of α-amylase, which was expressed as a percentage of inhibition and computed using the following equations, was used to determine the anti-diabetic activity:

$$\% \text{ Inhibition} = \frac{\text{Absorbance of control - Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

α-Glucosidase inhibition assay

With a few minor modifications, the experiment was carried out using the previously published procedures34. Phosphate buffer (0.1 M) with a pH adjustment of 6.9 was used to manufacture αglucosidase (1 U/ml) and p-NPG (10 mM). Acarbose (positive control) and the tested samples were produced at varying quantities (4000-2 µg/ml). The combination was pre-incubated for 20 minutes at 37 °C after 50 µl of α-glucosidase was added to 250 µl of phosphate buffer (0.1 M, pH 6.9) and 100 µl of the tested sample/acarbose in a test tube. Then, as a substrate, 10 µl of pNPG (10 mM) was added, and the mixture was incubated for another half hour at 37 °C.

After adding 650 µl of sodium carbonate (1 M) to halt the reactions, the absorbance was measured at λmax 405 nm in a spectrophotometer. Three measurements were made. The following formula was used to determine the percentage of inhibition:

$$\% \text{ Inhibition} = \frac{\text{Absorbance of control - Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

RESULTS AND DISCUSSION

Qualitative analysis of *Swertia chirayita*

S.No.	Test	Aqueous extracts
1	Alkaloids	+
2	Terpenoids	+
3	Flavonoids	+
4	Tannin	+
5	Saponin	+
6	Phenol	+
7	Steroids	+

Presence (+) Absence (-)

Table 1:- Qualitative analysis results for analysis of *Swertia chirayata* powder sample

In the present study, a qualitative phytochemical screening of *Swertia chirayata* revealed the presence of several significant secondary metabolites. Among these, flavonoids, phenols, saponins, glycosides, and tannins are recognised as important phytochemical substances commonly found in *Swertia chirayata*. Our investigation identified various active constituents through this screening process. These metabolites are well-known for their potential to address a range of human health conditions, including chronic fever, malaria, anemia, bronchial asthma, liver issues, hepatitis, gastritis, constipation, dyspepsia, skin ailments, parasitic worms, epilepsy, ulcers, low urine output, hypertension, depression, some mental disorders, bile secretion, blood purification, diabetes, menstrual disorders, chronic eczema, and issues related to diuresis, choleresis, spasmodic activity, diarrhoea, and dysentery. Natural products are considered a rich reservoir of bioactive components due to their remarkable chemical diversity and extensive therapeutic potential (Huang M. et al., 2021). This category encompasses compounds derived from plants, fungi, and microorganisms, along with semi-synthetic variants. Their medicinal applications are wide-ranging, offering properties such as anticancer, antibacterial, and antioxidant effects (Harvey A. L., 2008).

Table 2: *α-amylase* and α-Glucosidase inhibitory activity of *Swertia chirayata*

Sample	***α*-Glucosidase inhibition assay (IC_{50} µg/ml)**	***α-amylase inhibition assay* (IC_{50} µg/ml)**
Swertia chirayata	28.12 ± 1.34	59.36 ± 1.42
Acarbose*	8.2 ± 0.2	8.2 ± 0.2

*Positive control, each experiment was done in triplicate, and results are expressed as mean ± S.D., n=3

The enzyme α-glucosidase is in charge of turning polysaccharides and disaccharides into α-glucose and, as a result, facilitating its absorption (Qaisar MN, et al., 2014). Acarbose and voglibose are two of the most effective α-glucosidase inhibitors for the treatment of type 2 diabetes mellitus (Choi C-I, et al., 2016). In type 2 diabetes mellitus, they control postprandial hyperglycaemia brought on by the α-amylase and α-glucosidase enzymes. The α-glucosidase inhibitory activity of the extract was found to be 28.12 ± 1.34 µg/ml, approximately three to four times the IC50 values of acarbose.
The number of free amino groups is reduced as a result of the α-amylase's reaction with phenolic and related compounds (Ayyanar et al., 2012). Nonetheless, the primary impacts are related to the polyphenols found in this investigation. Acarbose was less effective than α-amylase inhibition in *Swertia chirayata* extract. The extract of α-amylase showed α-amylase inhibitory activity of 59.36 ± 1.42 µg/ml, which is almost five to seven times the IC50 values of acarbose. In the past, diabetes and its consequences were treated with all components of the plant (Ayyanar M. et al., 2012).

Conclusion

A phytochemical analysis of *Swertia chirayata* demonstrated the existence of flavonoids and alkaloids, saponins, tannin, and terpene. Natural products are viewed as a valuable source of bioactive compounds because of their exceptional chemical variety and significant therapeutic potential. The medical usage of *Swertia chirayata* in treating a variety of gastrointestinal and respiratory problems, including chronic fever, malaria, anaemia, bronchial asthma, liver issues, hepatitis, gastritis, constipation, dyspepsia, skin ailments, parasitic worms, epilepsy, ulcers, low urine output, hypertension, depression, some mental disorders, bile secretion, blood purification, diabetes, constipation, colic, diarrhoea, and asthma.
There have been claims that *Swertia chirayata* has hepatoprotective, antioxidant, low blood sugar, anti-inflammatory, anticancer, antibacterial and antimalarial activity. Extracts from *Swertia chirayata* may help manage diabetes. It was corroborated by the fact that *Swertia chirayata* inhibited α-amylase activity at 59.36 ± 1.42 µg/ml and α-glucosidase activity at 28.12 ± 1.34 µg/ml. In summary, the antidiabetic qualities of *Swertia chirayata* make them potential candidates for a functional food or natural supplement. Based on these results, a thorough in vivo investigation and standardisation of the extracts with respect to the active components are advised.

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