REVIEW ARTICLE

JPAR 2023

Journal of Pharmaceutical Advanced Research

(An International Multidisciplinary Peer Review Open Access monthly Journal)

Available online at: www.jparonline.com

A review on *Swertia chirayita*: Phytochemistry and various pharmacological activities

Anjali Kadam*, Jugal Kishor Vyas, Anjali Wankhade, Vivek Paithankar

Department of Pharmacology, Vidyabharati College of Pharmacy, Amravati, Maharashtra, India – 444602.

Received: 18.02.2023 Revised: 06.03.2023 Accepted: 16.03.2023 Published: 31.03.2023

ABSTRACT: Popular medicinal plant *Swertia chirata* (*Gentianaceae*) is indigenous to the temperate Himalaya. *S. chirayita* is a plant that grows at altitudes between 1200 and 1300 meters, from Bhutan to Kashmir, and between 1200 and 1500 meters in the Khasi hills. It can also be grown in sub-temperate regions between 1500 and 2100 meters above sea level. Chirata has an upright, two to three-foot-long stem. Because they are more tolerable, have a better understanding of the human body, and have less side effects, herbal medicinal plants are essential for providing basic and primary health care for around 80 % of the world's population in both industrialized and developing nations. Plants used for herbal medicine are thought to be a rich source of phytochemicals. Swertiamarin, Amarogentin, Swechirin, Mangiferin, Sweroside, Gentianine, Amaroswerin, Oleanolic acid, Swertanone, and Ursolic acid are the primary chemical components. Alkaloids, flavonoids, steroids, glycosides, triterpenoids, saponins, xanthones, and ascorbic acid are revealed by phytochemical analysis in all samples. The best TLC was discovered in Nepali *S. chirata* (thin layer chromatography). Traditional medicinal plants have been used by humans for thousands of years. Traditional plants play a very important role in preventing and treating of human diseases. Medicinal usage of *S. chirayita* is reported in Indian pharmaceutical codex, the American and the British pharmacopoeias and in the different traditional systems of medicine (Unani, Ayurveda and Siddha). *S. chirata* is commonly known as a bitter tonic in traditional system of medicine for the treatment of fever, loss of appetite, digestive disorders, diabetes, skin and various other diseases.

Corresponding author:
Ms. Anjali U. Kadam
Scholar
Department of pharmacology
Vidyabharati College of Pharmacy, Amravati.
Tel: +91-87664 65751
E. Mail ID: kadamanjali828@gmail.com

Keywords: *Swertia chirayita*, phytochemical constituents, biological activity, traditional uses, poisoning.

INTRODUCTION:

Traditional medicinal herbs have been utilized for millennia all over the world and are crucial in the prevention and treatment of many ailments. Due to their effectiveness, safety, accessibility, and lack of side effects, medicinal herbs have gained popularity in both developed and developing nations [1]. *Swertia chirata* is one of many herbal plants that have been utilized in traditional medicine as hepatoprotective agents. It is a traditional herb that was brought to Europe in 1839. Because it grows as an annual or biennial herb in the woods of Nepal, it is occasionally also referred to as the

Nepali Neem. This annual plant, also known as a shrub, grows from Bhutan to Kashmir and is mostly found in the sub-temperate region of the Himalayas between an altitude of 1200 and 1500 meters [2]. Swertia, a member of the Gentianaceae family, was initially described by Roxburgh in 1814 under the name Gentiana chyrayta [3]. There are around 135 different species of annual and perennial herbs included in it. Many herbal treatments contain common Swertia species components. There are 40 different species of *S. chirata* known to exist in India [4]. The most significant therapeutic qualities of *Swertia chirata* include anti-inflammatory, hypoglycemic, hepatoprotective, antibacterial, wound-healing, antispasmodic, antioxidant, anti-diabetic, antipyretic, and antitussive activity [5]. About 80 % of the world's population, according to the WHO, relies on medicinal plants in both developing and developed nations for their essential and primary healthcare requirements [6]. According to the WHO, around 170 million individuals worldwide have hepatitis C alone, and 3 to 4 million more are infected each year. Acute hepatitis B virus infections total about five million each year, and there are over two billion people worldwide who have the hepatitis B virus [7]. The bitter-tasting *S. chirata* plant is widely used in traditional remedies despite its reputation. Both gram-positive and gram-negative bacteria are treated with it as an anti-microbial. Every portion of the plant is employed as an astringent, heart tonic, liver tonic, cough, scanty urination, melancholia, dropsy, sciatica, and skin ailments in Unani literature. *S. Chirayita* has several applications in conventional medicine despite its reputation for bitterness. It functions as an antimicrobial for both gram-negative and gram-positive bacteria.

Fig 1. The image of the Swertia plant.

Astringent, heart tonic, liver tonic, cough, scanty urination, melancholia, dropsy, sciatica, and skin problems are all treated with plant components according to Unani literature. The plant is also used as a bitter tonic for gastrointestinal diseases like dyspepsia and anorexia; it is said to have digestive and laxative properties as well as the ability to prevent malaria, making it particularly helpful during fever. The herb is also beneficial in treating bronchial asthma, burning of the body, intestinal worms, and bowel regulation [8].

Plant Profile:

Vernacular Names [10]:

English: Chirata (Indian Gentian), Hindi: Charayatah, Urdu: Chiarayata, Sanskrit: Anaryatikta, Bhunimba, Chiratika, Ardhatika, varantaka; Arabic: Qasabuzzarirah, Persian: Nenilawandi, Qasabuzzarirah, Panjabi: Charaita, Bengali: Chireta, Burma: Sekhagi, Marathi: Chirayita, Tamil: Nilavembu, Shirattakuchi; Telugu: Nilavembu, Kannada: Nilavebu, Malayalam: Nilaveppa, Gujarati: Chirayata, Nepal: Cherata, Deccan: Charayatah.

Taxonomical Classification [11]:

Kingdom: Plantae, Phylum: Tracheophyta, Class: Magnoliopsida, Order: Gentianales, Family: *Gentianaceae*, Genus: Swertia, Spicies: Chirata, Binomial name: *Swertia chirata*.

Botanical description:

Annual/biannual herb, *S. chirayita* grows between 0.6 and 1.5 m tall. It has an upright, two to three-foot-long stem, with a quadrangular upper portion and a central portion with a pronounced decurrent line at each angle. It has an orange, brown, or purple stem with thick, continuous yellow pith. The root is approximately 7 to 8 cm long, half an inch thick, simple, yellowish, somewhat oblique, or geniculate, tapering, and short [12]. Lanceolate, opposite-paired, without stalks, cordate at the base, sessile, five to seven-nerved, and 4 cm long are the characteristics of the leaves [13]. Small, numerous, tetramerous, large-leafed panicles, green-yellow, and tinged with purple and green or white hairs are the characteristics of the flowers [14]. The corolla lobes are four andtwisted and overlaid, connected at the base, and feature pairs of nectaries on each lobe that are covered in silky hairs. The calyx is gamophyllous and has four lobes. The fourth stamen is located near the base of the corolla, across from the lobe. Two stigmas; unilocular ovary with laminal placentation of the ovules. Egg-shaped capsules with two valves and a translucent,

whitish pericarp. There are many tiny, dark-brownish seeds. The presence of nectaries and the multicolored corolla of *S. chirayita* encourage cross-pollination [15].

Medicinal uses:

Different indigenous population groups employ *S. chirayita*, a traditional Ayurvedic herb, in a variety of methods for a variety of medical purposes. Locals frequently cure hepatitis, inflammation, and digestive disorders with the entire plant [16]. Treatment for chronic fever, malaria, anemia, bronchial asthma, hepatotoxic disorders, liver disorders, hepatitis, gastritis, constipation, dyspepsia, skin diseases, worms, epilepsy, ulcers, scanty urine, hypertension, melancholia, and some types of mental disorders are among the wide range of medicinal uses. Bile secretion, blood purification, and diabetes are also included [17]. Extracts of *S. chirayita* have recently demonstrated anti-hepatitis B virus (anti-HBV) properties [18]. This species' decoctions have historically been used for the anthelmintic, hepatoprotective, hypoglycemic, antimalarial, antifungal, antibacterial, cardio stimulant, antifatigue, anti-inflammatory, antiaging, and antidiarrheal purposes. They also serve as a heart protector and lower blood pressure and blood sugar levels [19]. *S. chirayita* extract is found in various amounts in herbal preparations including Ayush-64, Diabecon, Mensturyl syrup, and Melicon V ointment [20] because of its antipyretic, hypoglycemic, antifungal, and antibacterial characteristics. Additionally, this herb's therapeutic benefits have been documented in both traditional and ancient Ayurvedic medicinal systems. *S. chirayita* has been extensively chemically analyzed as a result of its widespread use in traditional medicines, revealing the active compounds that give the plant its therapeutic effects. Additionally, tinctures and infusions of *S. chirayita* are listed in the British and American Pharmacopeias [21]. Traditional medicines use the entire plant, but the root is thought to have the most bioactive components [22].

PHARMACOLOGICAL ACTIVITIES:

Antipyretic:

A medicinal plant native to the temperate Himalaya is called *Swertia chirayita*. The Indian Pharmaceutical Codex, the British and American Pharmacopoeias, as well as several ancient medical systems like Ayurveda, Unani, and Siddha, all mention its medicinal uses. The plant is used as a bitter tonic to alleviate fevers and to treat a number of skin conditions. The domestic (Indian) and foreign markets for *S. chirayita* are well-established and growing at a 10 % yearly rate. Many times, the plant that is sold in stores has been tampered with or replaced by chirata's near cousins. In this article, the botany, pharmacology, biochemistry, market demand, and trade of the plant are briefly reviewed. This is an effort to gather and record data on various aspects of *S. chirayita* and to draw attention to the need for further study and improvement [23].

Antioxidant:

The goal of the current study was to evaluate the antioxidant qualities of *Punica granatum* and *Swertia chirayita* aqueous leaf extracts. A comparison between BHA and the antioxidant activity of the aqueous leaf extracts was made (Butylated hydroxyl anisole). The findings showed that *Swertia chirayita* and *Punica granatum* have excellent antioxidant properties in their aqueous leaf extracts. As a result, *Swertia chirayita* and *Punica granatum's* aqueous leaf extracts can be employed as a source of antioxidants in the treatment of illnesses [24].

Antidiabetic:

Local people utilize the crude extract of *Swertia chirayita*, a significant Nepalese medicinal plant, for a variety of ailments, including type 2 diabetes. In this work, in vitro biochemical assays were used to assess the potential for anti-diabetic-linked anti-hyperglycemia in crude aqueous and 12 % ethanol solution extracts of *S. chirayita* from nine districts in Nepal. Although the phytochemical swerchirin found in *S. chirayita's* hexane fraction is primarily responsible for its anti-diabetic effects, we suggest that the plant's crude extract, which is utilized for local healing, also has the ability to reduce blood sugar levels [25].

Anti-inflammatory:

About 123 specialized metabolites from *S. chirayita* have been identified and described, including xanthones, seco-iridoids, terpenoids, alkaloids, and flavonoids. A wide range of pharmacological actions, including anti-inflammatory, were demonstrated by the extract and isolated components. To ascertain the phytochemicals of *S. chirayita*, several analytical techniques using HPTLC, UPLC, HPLC, LC-MS, and GC-MS have also been recorded [26].

Antimicrobial:

In various Asian nations and other parts of the world, a medicinal plant called *Swertia chirayita* is frequently

used as herbal medicine. The current study's objective was to assess the plant *Swertia chirata's* antibacterial capacity. For this, ethanol and methanol extracts of the plant's stem and leaves were utilized. Two Gram Positive bacteria (*Staphylococcus aureus* and Bacillus sp.) and three Gram Negative bacteria (*Escherichia coli*, Klebsiella pneumoniae, and *Pseudomonas aeruginosa*) were utilized as the test organisms. The agar well diffusion method was used to measure the antibacterial activity [27].

Hepatoprotective:

A contentious medicinal plant known as *Swertia chirayita* (Family: *Gentianaceae*) is utilized as Kiriyattu. It has a similar therapeutic effect and is used as a hepatoprotective and hepatostimulative agent. While *S. chirayita* grows in the Himalayan region, *A. paniculata* grows in southern India. The current study examines whether these plant extracts can protect Swiss albino mice from acute hepatotoxicity brought on by paracetamol (150 mg/kg). Thus, the results of the current investigation showed that *S. chirayita* extracts provided defence against paracetamol-induced hepatotoxicity [28].

PHYTOCHEMISTRY:

S. chirayita is used widely as a traditional medicine, and its commercialization in contemporary healthcare systems has sparked an increase in scientific investigation into its phytochemistry in an effort to pinpoint the active phytochemicals. As a result, a sizable amount of literature examining the chemical components of this plant has been produced [29]. The presence of a variety of pharmacologically bioactive substances from various classes, including xanthones and their derivatives, lignans, alkaloids, flavonoids, terpenoids, iridoids, secoiridoids, and other substances like chiratin, ophelicacid, palmitic acid, oleic acid, and stearic acid, is what is thought to be responsible for the wide range of biological activities of *S. chirayita* [30]. Chiratanin, found in various *S. chirayita* locations, was the first dimeric xanthone to be isolated. The biological activity of key phytoconstituents such amarogentin, swertiamarin, mangiferin, swerchirin, sweroside, amaroswerin, and gentiopicrin has been partially implicated in the pharmacological efficacy of *S. chirayita* (Fig 3).Amarogentin has been shown to have anti-diabetic [31], anti-cancer [32], and anti-leishmanial [33] properties, whilst swertiamarin has been investigated for its anti-hepatitis [34]. It has been demonstrated to have anti-diabetic activities [35]. Mangiferin has also been linked to anti-HIV [36] anti-cancer [37] anti-parkinson [38], and chemopreventive activities [39]. Swerchirin has been shown to have antimalarial, hypoglycemia, hepatoprotective, pro-hematopoietic [40], blood glucose reducing action [41], and modest chemo preventive pharmaco logical effects [42] properties [43]. Swerchirin significantly increased glucose-stimulated insulin release from isolated islets at various concentrations (1, 10, and 100 M) [44]. Sweroside has been suggested as a promising natural osteoporosis treatment because it has been shown to be antibacterial [45], hepatoprotective [46], preventative in the treatment of hyperpigmentation, and hepatoprotective properties [47]. Amaroswerin is well known for the digestive benefits that the bitter principles provide [48].

PHYTOCHEMICAL STRUCTURE [49]:

The phytochemical structure of *Swertia chirayita*is presented in Fig 2.

SAFETY EVALUATION:

One of the most important concerns facing the pharmaceutical industry is the safety of conventional medications. Some commonly used medicinal plants may be mutagenic or cytotoxic, especially when used over an extended period of time, according to studies [50]. There is growing data regarding the dangers of isolated chemicals and crude extracts from many plant species [51]. Nevertheless, despite *S.chirayita's* extensive history of usage in traditional medicine, there is still a dearth of scientific data pertaining to the assessment of its safety. It has been used as an ethnomedicinal plant for treating fever, headache, inflammation, and to stimulate the central nervous system throughout recorded history as a nontoxic and secure ethnomedicinal herb. Extracts of *S. chirayita* did not have overtly harmful effects on mice.In both its liposomal and niosomal forms, *S. chirayita* showed no signs of toxicity, according to clinical research. However, in order for *S. chirayita* to be utilized safely and effectively [52].

CONCLUSION:

S. chirayita has a number of intriguing opportunities for both conventional and modern treatment. *S. chirayita* may be used as an herbal treatment for a variety of conditions. This review provided an overview of *S.chirayita's* current ethnobotanical applications, phytochemistry, pharmacological activities, safety assessment, and conservation.To validate *S. chirayita's* safety in people, additional toxicological studies are still

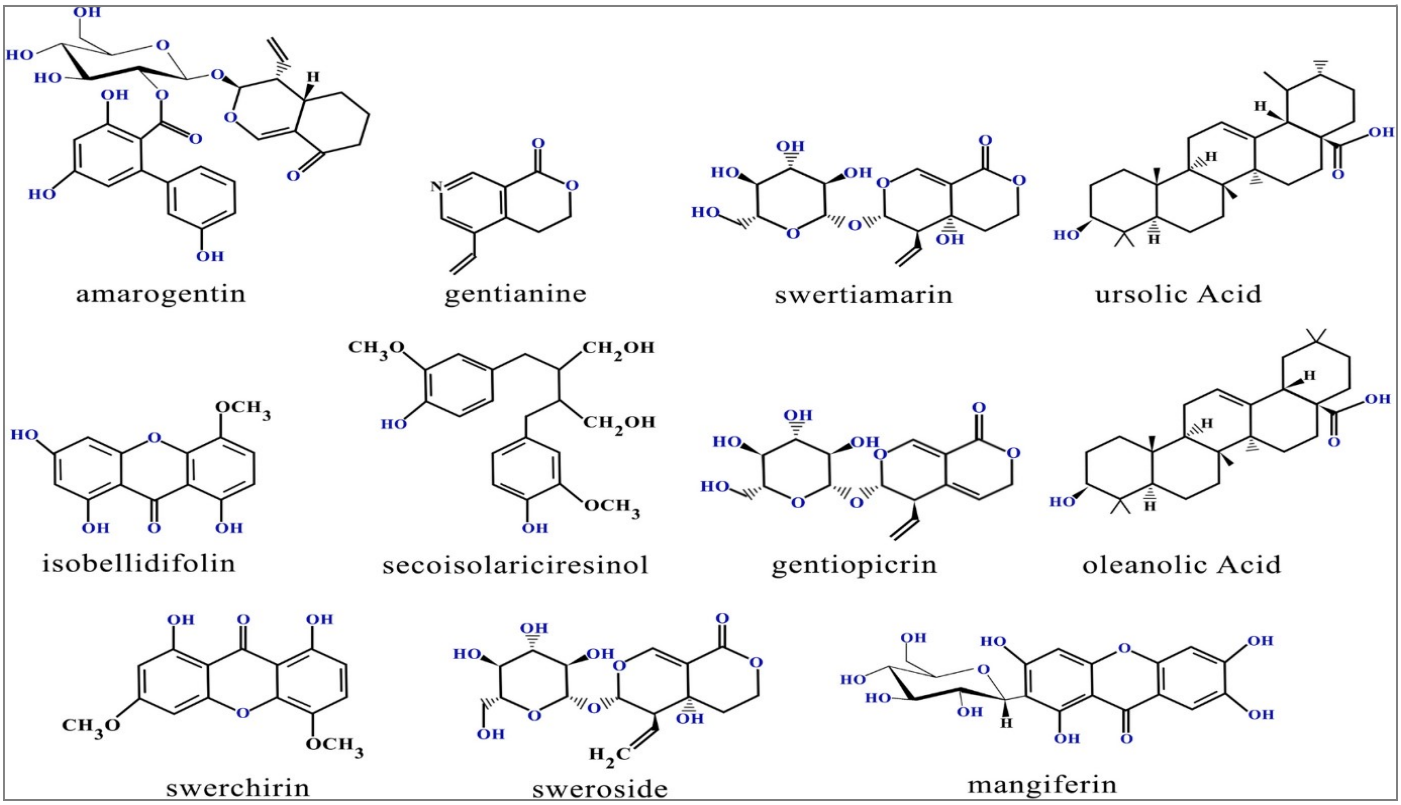

Fig 2.The phytochemical constituents of *Swertia chirayita.*

required. To yet, no major side effects or toxicity of *S. chirayita* have been documented. To more thoroughly verify the safety of these various plant-derived chemicals, further research is needed, particularly to assess their biological activity in vivo, toxicological effects, and mutagenesis potential. Clinical trials are likely required to demonstrate the effectiveness of employing *S. chirayita* in medicine. Because of its many applications, demand for it is always growing on both the domestic and global markets. The population has been drastically reduced as a result of overexploitation and habitat destruction. Any planned research must be regarded in a broader perspective that includes conservation techniques and a sustainable supply of raw materials in order for the commercialization of this medicinal plant to be successful. Hairy root technology can potentially be employed as a model system in the near future and will also give plant biotechnologists strong tools to enhance the beneficial phytochemicals of *S. chirayita*. Although effective micropropagation techniques have been developed, more research on the biology of seeds and strategies for enhancing bioactive secondary metabolites in cultivated *S. chirayita* would be helpful for their commercialization. Protocols for quality control are also required to avoid misidentification and potential adulteration of *S. chirayita*. Summary: Taxonomy, ethnobotany, phytochemistry, biological activity, and conservation of *S. chirayita* have all been widely investigated. New discoveries could, however, boost the therapeutic value of *S. chirayita* today and encourage its use in modern medicine in the future, while fresh biotechnological methods are needed for further conservation.

ACKNOWLEDGEMENT:

Author wishes to thank to Vidyabharati College of Pharmacy, Amravati, for providing the library facility to complete this review study.

REFERENCES:

1. Sewell RDE, Kopaei MR. The history and ups and downs of herbal medicine usage. J HerbmedPharmacol, 2014; 3:1-3.
2. Lodhi M, Memon Z, Shaheen S, Wasim A. Effect of methanol extract of *Swertia chirata* on various Cellular components of Blood in Rats. Health Sci, 2017; 6:59-64.
3. Kumar V,Staden JV.A review of *Swertia chirayita* (*Gentianaceae*) as a traditional medicinal plant.FrontPharmacol,2015; 6:308.
4. KirtikarKR,Basu BD. Indian Medicinal Plants. Allahabad, 1984; 3:1664-1666.

5. Laxmi A, Siddhartha S, Archana M. Antimicrobial screening of methanol and aqueous extracts of *Swertia chirata*. Int J Pharm Sci, 2011; 3:142-146.
6. Tabassum S,*et al*. An overview of medicinal importance of *Swertia chirayita*. Int J Appl Sci Technol, 2012; 2: 115-122.
7. World Health organization. Hepatitis B (Fact sheet No. 204). Geneva, Switzerland, 2000.
8. Sultana MJ, Ahmed FRS. Phytochemical investigations of the medicinal plant *Swertia chirata*. Ham Biochem Anal Biochem, 2013; 2:2161-1009.
9. Aleem A, Kabir H. Review on *Swertia Chirata* as traditional uses to Its Phytochemistry and Pharmacological Activity. J Drug Deliv Ther, 2018; 8:73-78.
10. Saraswati, Parihar S. *Swertia chirata*- A Wonderful herb. Indian JPharmBiol Res, 2021; 9: 10-15.
11. Kumar N,Chaubey S, Yadav C, Singh R. Review on *Swertia chirata*buch. -ham. ex-wall: a bitter herb w.s.rto its phytochemistry and biological activity. Int Ayurvedic Med J, 2017; 5: 243-251.
12. Bentley R, Trimen H. Medicinal Plants. London: J and A Churchill; 1880.
13. Scartezzini P, Speroni E. Review on some plants of Indian traditional medicine with antioxidant activity. J. Ethnopharmacol, 2000; 71: 23-42.
14. Joshi P, Dhawan V. *Swertia chirayita*an overview. Curr. Sci, 2005; 89: 635-640.
15. Chandra S, Kumar V, Bandopadhyay R, Sharma MM. SEM and elemental studies of *Swertia chirayita*: a critically endangered medicinal herb of temperate Himalayas. Curr Trends Biotechnol Pharm, 2012; 6: 381-388.
16. Bhatt A,Rawal R. S, Dhar U. Ecological features of a critically rare medicinal plant, *Swertia chirayita*, in Himalaya. Plant Species Biol, 2006; 21: 49-52.
17. Karan M, Vasisht K, Handa SS.Morphological and chromatographic comparison of certain Indian species of *Swertia*. J Med Aromat. Plant Sci, 1999; 19: 995-963.
18. Zhou NJ, Geng CA, Huang XY, Ma YB, Zhang XM, Wang JL, *et al*. Anti-hepatitis B virusactive constituentsfrom *Swertia chirayita*. Fitoterapia, 2015;100: 27-34.
19. Schimmer O, Mauthner H. Polymetoxylated xanthones from the herb of *Centaurium erythraea* with strong antimutagenic properties in *Salmonella typhimurium*. Planta Med, 62: 561-564.
20. Edwin R, Chungath JI. Studies in *Swertia chirata*. Indian Drugs, 1998; 25:143-146.
21. Joshi P, Dhawan V. *Swertia chirayita*an overview. Curr Sci, 2005; 89: 635-640.
22. Kirtikar KR, Basu BD. Indian Medicinal Plants. Allahabad: LM Basu Publishers; 1984; 3: 112-120.
23. Joshi P, DhawanV. *Swertia chirayita*–an overview. Cur Sci, 2005; 635-640.
24. Kumar M, Dandapat S, Sinha MP.Antioxidant Activity of Chiraita (*Swertia chirayita*) and Anar (*Punica granatum*).Eur J Pharm Med Res, 3(2): 267-269.
25. Phoboo S, Pinto MDS, Bhowmik PC, *et al*. Quantification of Major Phytochemicals of *Swertia Chirayita*. A Medicinal Plant from Nepal.Int J Ecol, 2010; 17: 59-68.
26. Swati K, Bhatt V, Sendri N, Bhatt P, Bhandari P. *Swertia chirayita*: A comprehensive review on traditional uses, phytochemistry, quality assessment and pharmacology. J Ethnopharmacol, 2023; 300:115714.
27. Ahirwal L, Siddhartha S, Archana M. Antimicrobial screening of methanol and aqueous extracts of *Swertia chirata*. Int J PharmSci, 2011; 3: 142-146.
28. Nagalekshmi R, Menon A, Chandrasekharan DK, Nair CK. Hepatoprotective activity of *Andrographis paniculata* and *Swertia chirayita*. Food Chem Toxicol, 2011;49: 67-73.
29. Chatterjee A, Pakrashi SC.The Treatise on Indian Medicinal plants. New Delhi: Publication Information Directoatte; 1995.
30. Pant N, Jain DC, Bhakuni RS. Phytochemicals from genus *Swertia* and their biological activities. Indian J Chem, 2000; 39: 565-586.
31. Phoboo S, Pinto MDS, Barbosa ACL, Sarkar D, Bhowmik PC, Jha PK, *et al*. Phenolic-linked biochemical rationale for the anti-diabetic properties of *Swertia chirayita* (Roxb. ex Flem.) Karst. Phytother *Res,* 2013; 27: 227-235.
32. Saha P, Mandal S, Das A, Das S. Amarogentin can reduce hyperproliferation by downregulation of Cox-II and upregulation of apoptosis in mouse skin carcinogenesis model. Cancer Let, 2006; 244: 252-259.
33. Medda S, Mukhopadhyay S, Basu MK. Evaluation of the *in-vivo* activity and toxicity of amarogentin, an antileishmanial agent, in both liposomal and niosomal forms. J AntimicrobChemother, 1999; 44: 791-794.

34. Wang CZ, Maier UH, Eisenreich W, Adam P, Obersteiner I. Unexpected biosynthetic precursors of amarogentin a retrobiosynthetic NMR study. Eur J Org Chem, 2001; 1459-1465.
35. Vaidya H., Goyal RK, Cheema SK. Anti-diabetic activity of swertiamarin is due to an active metabolite, gentianine, that upregulates PPAR-γ gene expression in 3T3-L1 cells. Phytother Res, 2013; 27: 624-627.
36. Guha S, Ghosal S, Chattopadhyay U. Antitumor, immunomodulatory and anti-HIV effect of mangiferin, a naturally occurring glucosylxanthone. Chemother, 1996; 42: 443-451.
37. Patel K, Kumar V, Amita R, Patel DK, Rahman M. Amaarogentin as topical Anticancer and Antiinfective Potential: Scope of lipid based vesicular in its effective Delivery. Recent Pat Antiinfect Drug Discov, 2019;14(1):7-15.
38. Kavitha M, Nataraj J, Essa MM, Memon MA, Manivasagam T. Mangiferin attenuates MPTP induced dopaminergic neurodegeneration and improves motor impairment, redox balance and Bcl-2/Bax expression in experimental Parkinson's disease mice. Chem Biol Interact, 2013; 206: 239-247.
39. Yoshimi N, Matsunaga K, Katayama M, Yamada Y, Kuno T, Qiao Z, *et al*. The inhibitory effects of mangiferin, a naturally occurring glucosylxanthone, in bowel carcinogenesis of male F344 rats. Cancer Lett, 2001; 163: 163-170.
40. Ya BQ, Nian LC, Li C, Gen XP. Protective effect of swerchirin on hematopoiesis in 60Co-irradiated mice. Phytomed, 1999; 6: 85-88.
41. Sekar BC, Mukherjee B, Chakravarti RB, Mukherjee SK. Effect of different fractions of *Swertia chirayita* on the blood sugar level of albino rats. J Ethnopharmacol, 1987; 21: 175-181.
42. Bajpai MB, Asthana RK, Sharma NK, Chatterjee SK, Mukherjee SK. Hypoglycemic effect of swerchirin from the hexane fraction of *Swertia chirayita*. Planta Med, 1991; 57: 102-104.
43. Hirakawa K, Yoshida M, Nagatsu A, Mizukami H, Rana V, Rawat MSM, *et al*. Chemopreventive action of xanthone derivatives on photosensitized DNA damage. Photochem. Photobiol, 2005; 81: 314-319.
44. Saxena AM., Bajpai MB, Mukherjee SK. Swerchirin induced blood sugar lowering of streptozotocin treated hyperglycemic rats. Indian J Exp Biol, 1991; 29: 674-675.
45. Siler B, Misic D, Nestorovic J, Banjanac T, Glamoclija J, Soković M, *et al*. Antibacterial and antifungal screening of *Centaurium pulchellum* crude extracts and main secoiridoid compounds. Nat Prod Commun, 2010; 5: 1525-1530.
46. Liu J, Liu Y. P, Klaassen CD. The effect of Chinese hepatoprotective medicines on experimental liver-injury in mice. J Ethnopharmacol, 1994; 42: 183-191.
47. Sun H, Li L, Zhang A, Zhang N, Lv H, Sun W, *et al*. Protective effects of sweroside on human MG-63 cells and rat osteoblasts. Fitoterapia, 2013; 84: 174-179.
48. Niiho Y, Yamazaki T, Nakajima Y, Yamamota T, Ando H, Hirai Y. Gastroprotective effects of bitter principles isolated from Gentian root and *Swertia* herb on experimentally-induced gastric lesions in rats. J Nat Med, 2006; 60: 82-88.
49. Dey P, Singh J, Suluvoy JK. Utilization of *Swertia chirayita* plant extracts for management of diabetes and associated Disorders: Present Status, Future Prospects and Limitations. Nat Prod Bioprospecting, 2020; 10(6): 431-443.
50. Verschaeve L, Van Staden J. Mutagenic and antimutagenic properties of extracts from South African traditional medicinal plants. J Ethnopharmacol, 2008; 119: 575-587.
51. Koorbanally C, Crouch NR, Mulholland DA. The phytochemistry and ethnobotany of the southern African genus *Eucomis* (Hyacinthaceae:Hyacinthoideae). Phytochem: Adv Res, 2006; 69-85.
52. Medda S, Mukhopadhyay S, Basu MK. Evaluation of the *in-vivo* activity and toxicity of amarogentin, an antileishmanial agent, in both liposomal and niosomal forms. J Antimicrob Chemother, 1999; 44: 791-794.

Conflict of Interest: None
Source of Funding: Nil
Paper Citation: Kadam A*, Vyas JK, Wankhade A, Paithankar V. A review on *Swertia chirayita*: Phytochemistry and various pharmacological activities. J Pharm Adv Res, 2023; 6(3): 1832-1838.