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Review Article

REVIEW ON SWERTIA CHIRATA AS TRADITIONAL USES TO ITS PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIVITY

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ABSTRACT

Swertia chirata (Gentianaceae), is a popular medicinal plant native to temperate Himalaya. The plant of *Swertia chirata* is found at an altitude of 1200-1300m, from Bhutan to Kashmir and in the Khasi hills at 1200-1500m. It also can be grown in sub-temperate territories between 1500-2100m altitudes. *Chirata* has an erect and about 2-3 ft long stem. Herbal medicinal plants are necessary for about 80% of the world population in developed and developing countries for their basic and primary health care required owing to better tolerability, superior empathy with human body and having lesser side effects. Herbal plants are considered as rich source of phytochemical ingredients. The main chemical ingredients are Swertiamarin, Amarogentin, Swechirin, Mangiferin, Sweroside, Gentianine, Amaraswerin, Oleanolic acid, Swertanoone, Ursolic acid. Phytochemical analysis divulges alkaloids, flavonoids, steroids, glycosides, triterpenoids, saponins, xanthenes and ascorbic acid in all samples. Nepali *S. chirata* was found to have finest TLC (thin layer chromatography). People have been using traditional medicinal plants for thousand years ago. Traditional plants play a very important role in preventing and treating of human diseases. Medicinal usage of *Swertia chirata* is reported in Indian pharmaceutical codex, the American and the British pharmacopoeias and in the different traditional systems of medicine (Unani, Ayurveda and Siddha). *Swertia 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.

Keywords: *Swertia chirata*, swerchirin, Anti-inflammatory, Oleanolic acid, Traditional medicine.

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INTRODUCTION

Since centuries, traditional medicinal plants have been used all over the world and they play an important role in preventing and treating of various diseases. Medicinal herbs have been popular in developing and developed countries due to its safety, efficacy, easily availability and lesser side effects^{1, 2}. A lot of herbal plants have been used in traditional medicine as hepatoprotective one of them is *Swertia chirata*. It is an ancient herb was introduced to Europe in 1839. Sometimes it is also known as the Nepali Neem because of annual/biennial herb in the forests of Nepal. This annual herb or shrub

develop in the sub-temperate region of Himalayas mostly between an altitude of 1200 to 1500 meters and grows up to the height of 1.5 meters from Bhutan to Kashmir^{3,4,5,6}. *Swertia*, a genus in family Gentianaceae was first describe by Roxburgh under the name of *Gentiana chyrayta* in 1814^{3,7}. It includes a vast group of annual and perennial herbs representing about 135 species. Common ingredients of *swertia* species are in a number of herbal remedies. In India, 40 species of *Swertia chirata* are recorded^{5,3,8}. *Swertia chirata* has been reported as most important medicinal properties such as anti-inflammatory, hypoglycaemic, hepatoprotective, antibacterial, wound healing⁹,

antispasmodic, antioxidant, anti-diabetic, antipyretic as well as antitussive activities^{10,11,12,13}. Moreover the different medicinal compounds were isolated from natural herbs effecting as anticancer, antitumor and anti AIDS etc.¹⁴. According to WHO 80% of world population depend on medicinal plants in developing and developed countries for their basic and primary health care needs^{11,15}. WHO estimate that around 170 million peoples are infected with hepatitis C solitary and 3-4 millions are newly added into the list every year. In addition, more than two billion infected by hepatitis B virus and over five million are getting infected with acute hepatitis B virus yearly^{11,16}. *Swertia chirata* is

known for the bitter taste and has tremendous uses in traditional medicines. It is used as anti-microbial against gram negative and gram positive bacteria. In Unani literature all parts of the plant are used as astringent, heart tonic, liver tonic, cough, scanty-urine, melancholia, dropsy, sciatica and skin diseases. The plant is also used as a bitter tonic in gastrointestinal disorders, like dyspepsia/anorexia, it is reported that it acts as digestive, laxative and to prevent malaria, particularly useful in fever. The plant is also effective against intestinal worms, burning of the body, bronchial asthma, regulating the bowel^{14,17,18}.



Figure 1¹⁴

VERNACULAR NAMES^{20,21,22,23}

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^{3,20,21,22}

Kingdom:	Plantae
Phylum:	Tracheophyta
Class:	Magnoliopsida
Order:	Gentianales
Family:	Gentianaceae
Genus:	Swertia
Species:	Chirata
Binomial name:	<i>Swertia chirata</i>

PERIOD OF OCCURRENCE

The plant is quickly spreads from seed which is shed during October and November. Herbs can be cultivated in suitable localities in the temperate Himalayas. Seeds are very small in size, should be sown in nursery and seedlings transplanted later in the field²⁴.

DISTRIBUTION

It is indigenous to the mountainous districts of northern India, Temperate Himalayas at altitudes between 1,200-3,000 m from Kashmir to Bhutan and in Khasi hills in Meghalaya at 1200- 1500m^{19,21}. It occurs as entire plants or as a broken piece of plant. The stem is smooth with thin readily separable bark, up to 1m in length, externally it is yellowish or purplish brown in colour. It is cylindrical in basal region, quadrangular with ascending branches, wood of stem is porous and yellow, enclosing in the intermodal regions. Large yellowish easily separable pith is found in this plant with simple root, conical with few slender rootlets. The leaves are opposite sessile, entire ovate lanceolate; 5- nerved with rounded base, acuminate apex and entire margin panicles; calyx and corolla each 4- lobed, stamens 4, perigynous; ovary unilocular with two parietal placentae; style slender with recurved stigmas, fruit an ovoid yellowish brown unilocular many seeded capsule, odor is indistinct and taste is very bitter²⁰.

ETHANOBOTANICAL DESCRIPTION

Macroscopic:

All parts of the *chirata* plant are useful for therapeutic purposes. It has a particular type of bright yellowish colour all over the herb in fresh sample. The surface of stem is smooth and without hairs or projections, and can be up to 1 m in length and 6 mm in diameter and yellowish-brown to purplish in colour. The upper part of stem is slightly quadrilateral and its lower part is cylindrical; large, continuous and readily detachable yellow pith. The leaves of the plant are cauline, opposite, broad at base, smoothed surface, of a narrow oval shape tapering to a point at each end, acuminate, generally with 5-7 easily recognizable lateral veins. The flowers are tetramerous and the shapes are oval, 2-3 mm

wide, with two glandular depressions near the base of each of corolla lobes. The ovary is oval shaped and pointed, having two carpels, characterized by only one loculus; fruit a capsule with several tiny reticulated seed around 0.25 mm in length and 0.16 mm to 0.45 mm in breadth with irregular oval shape^{21,24}.

Microscopic:

The inner tissue (parenchyma) of leaves contain many chloroplasts, and it shows very little differentiation of the mesophyll tissue. The epidermis is single layered and covered outwardly with a thick-lined cuticle which is more distinctly developed on the upper surface than on the lower one. By looking through naked eye it shows the upper epidermis cells have straight walls and are larger than the lower epidermis cells which show sinus outline. Stomata are of cruciferous type and found only on the lower surface. If we transect the stem it illustrates single layered epidermis, externally covered with a thick-lined cuticle present in the stem in its early age, and in older epidermis it remains intact but cells become flattened and tangentially elongated, four ribs also consists of an epidermis and parenchymatous cortical cells; endodermis distinct, showing anticlinal or periclinal walls. Very small needle-shaped crystals are also present in large quantity; cells are cortical, and in some cortical cells resin along with small drops of oil are present as dark brown mass. Roots if transected show 2-4 layers of cork; secondary cortex represented by 4-12 layers of parenchymatous cells which are thick-walled. Few of them showing radial wall formation, tangentially elongated with sinuous walls. The secondary phloem constituted of companion cells, thin-walled strands of sieve tubes and phloem parenchyma; secondary xylem composed of tracheids cells, vessels and xylem fibres^{21, 24}.



Figure 2

Distribution of *Swertia chirata*. The shaded area represents the natural habitat of *Swertia chirata* in the Himalayan Region.⁵⁵

SUSTITUTE²⁵

- *Swertia purpurascens* Wall.
- *S. chinensis* Franchet.
- *S. paniculata* Wall.
- *S. lawii* Burkill.
- *S. decussata* Nimmo.
- *S. affinis* C. B. Clarke.
- *S. perennis* Linn.
- *Exacum bicolor* Roxb.
- *Erythraea roxburghii* G. Don.
- *Exacum tetragonum* Roxb.
- *Enicostemma littorale* Blume.
- All are belongs to Gentianaceae family.

PART USED

The whole plant is used medicinally.²⁴

MIJAZ (TEMPERAMENT)^{21,22,23,24}

Hot² Dry⁰

AFA'AL (ACTIONS)

- Huma-e-Muzmina (Chronic fever)^{21,26,27,56}
- Musaffi-e-Dam (Blood purifier)^{20,21,56}
- Qatil-e-Deedan-e-Ama (Anthelmintic)^{24,27,56}
- Dafa-e-Humma (Antipyretic)^{21,24,26,27}
- Mulayyan (Laxative)^{22,24,27}
- Mufriz-e-Laban (Galagtogogue)²⁴
- Muqawwi-e-Jigar (Liver tonic)^{23,27,56}
- Muqawwi-e-Qalb (Heart tonic)²³
- Juzam (Leukoderma)²⁷
- Muqawwi-e-Basar (Eye Tonic)²³

ISTEMALAT (THERAPEUTIC USES)

- Iltihab (Inflammations)^{20,22,24,27,28,29,56}
- Qurooh (Ulcers)^{24,27,56}
- Amraz-e-Jild (Skin diseases)^{24,28,56}
- Zeequnnafas (Asthma)^{24,27,56}
- Sailan-ur-Reham (Leucorrhoea)^{24,27}
- Sual-e-had (Bronchitis)²⁴
- Bawaseer (Piles)²⁴
- Salsul Baul (Incontinence of Urine)²⁴
- Istisqa (Ascitis)²⁴
- Irq-un-Nisa (Sciatica)²⁴
- It cures Safrawiyat (Bilioussness)²⁴ and
- Qai- Hamal (Vomiting in Pregnancy)²⁴.

MUSLEH (CORROCTIVES)

Asl-us-soos (*Glycyrrhiza glabra*), Anisoon (*Pimpinella anisum*)^{24, 30}

BADAL(SUBSTITUTE)

Masoor^{31,32}, Murr³³

MIQDAR-E-KHURAK (DOSAGE)

5-7g^{24,30}

2-3g³²

IMPORTANT FORMULATIONS

- Arq-e-murakkab Musaff-e-Khun^{24,30}
- Majoon-e-Juzam²⁴
- Roghan-e-Kalan²⁴

PHYTOCHEMISTRY^{20, 22, 31}

It contains chiratin and ophelic acid. Both constituents are amorphous or crystalline substances. And some other important constituents such as Xanthones, Xanthone glycoside and a flavonoid mangiferine also found. Other constituents are calcium, magnesium, iron, potassium and sodium.

PHARMACOLOGICAL STUDIES

- Antibacterial Activity^{3,9,21,27,39,47,56,57}
- Antifungal Activity^{3,9,56,57}
- Antiviral Activity^{3,40,56,57}
- Antioxidant Activity^{3,12,21,22,27,34,37,38,45,56,57}
- Anti inflammatory Activity^{3,9,21,27,50,56,57}
- Hypoglycemic Activity^{3,9,18,27,35,36,51,56}
- Anti-diabetic Activity^{3,12,18,39,41,42,43,44,51,57}
- Anti-malarial Activity^{21,27,42,52,57}
- Hepatoprotective Activity^{7,9,15,18,27,35,39,42,51,52,53,55}
- Anti-leishmanial Activity^{12,39,41,43,51,57}
- Anti-carcinogenic Activity^{12,18,27,35,39,40,41,42,43,51,56,57}
- Anthelmintic Activity^{12,27,39,41,43,46,57}
- Anti-pyretic Activity^{49,52,57}
- Antidiarrhoeal Activity⁵⁴
- Anti HIV³
- CNS depressant Activity^{27,57}
- Mutagenicity Activity²⁷
- Anti leprosy Activity²⁷
- Anti cholinergic Activity²⁷
- Anti-hepatitis B Virus Activity^{3,56,57}
- Dyslipidemia⁵⁷
- Gastroprotective Activity^{12,39,41,42,43,51}
- Wound Healing Activity^{9,42}

Relation between important isolated chemical compounds of *Swertia chirata* and its biological activity

Chemical Constituent	Biological activity
Mangiferin ^{3,25,56,57}	Anti viral, Immunomodulatory, Anti-inflammatory, Antioxidant, Anti-diabetic, Antitumor, Anti-HIV, Chemo preventive, Hypoglycemic, Ant atherosclerotic, Antiparkinson.
Swertiamarin ^{3,25,56,57}	CNS depressant, Anticholinergic, Antibacterial, Anticancer, Anti-hepatitis, Anti-atherosclerotic, Cardio-protective, Anti-diabetic, Anti-arthritis.
Amaroswerin ^{3,25,56,57}	Gastroprotective.
Amarogentin ^{3,25,56,57}	Antileishmanial, Topoisomerase inhibitor, Anticancer, Anti-diabetic, Gastro protective, Anthelmintic.
Swerchirin ^{3,25,56,57}	Hepatoprotective, Hypoglycemic, Pro-hematopoietic, Chemo preventive, Blood

	glucose lowering activity.
Ursolic acid ^{3,25,57}	Antitumor, Antimicrobial.
Sweroside ^{3,25,56,57}	Hepatoprotective, Antibacterial, Hyper pigmentation, Osteoporosis, Anthelmintic.
Swertanone ^{25,56}	Anti-inflammatory.
Gentianine ^{3,25,56,57}	Antimalarial, Anti-hepatitis B virus, Antipsychotic.
Bellidifolin ^{25,56}	Hypoglycemic.
Oleanolic acid ^{3,25,56,57}	Antimicrobial, Antitumor, Anti-inflammatory, Antioxidant activity.
Syringaresinol ^{25,56}	Hepatoprotective.
Isobellidifolin ^{25,56}	Hypoglycemic.
1-Hydroxy-3,7,8-Trimethoxyxanthone ^{25,56}	Antiulcerogenic, Spasmogenic agent.
1-Hydroxy-3,5,8-Trimethoxyxanthone ^{25,56}	Antimalarial.
1,5,8-trihydroxy-3-Methoxyxanthone ^{25,56}	Blood sugar lowering.
Alkaloids ⁵⁷	Antipyretic.
Chiritol ^{25,56}	Anti-inflammatory.
Flavonoids ⁵⁷	Antipyretic.
β -Amyrin ^{25,56,57}	Anti-inflammatory, Antimicrobial, Antifungal.
Xanthoness ⁵⁷	Anti-inflammatory, CNS depressant.

CONCLUSION

Swertia chirayita is a medicinal plant belonging to the family Gentianaceae. In India, it is also known as *Chirayata*. The traditional plant is used as a tonic in

Unani system of medicine to cure various types of fever. Further research can be done to know the mode of action and efficacy of this plant in various type of fever. More activities have been proven scientifically and some are yet to evaluated.

REFERENCES

- Lodhi M., Memon Z., Shaheen S. and Wasim A. Effect of Methanol Extract of *Swertia chirata* on Various Cellular Components of Blood in Rats. *Health Sciences*, 2017; 6(8):59-64.
- Sewell Robert DE, and Mahmoud Rafieian Kopaei. "The history and ups and downs of herbal medicine usage." *Journal of Herbmed Pharmacology* 2014; 3(1):1-3.
- Kumar V. and Van Staden J., A review of *Swertia chirayita* (Gentianaceae) as a traditional medicinal plant. *Frontiers in pharmacology*, 2016; 6:308.
- Bentley R. and Trimen H (1880) "Medicinal Plant" J and A Churchill: London, pp.183.
- Clarke C. B. Verbenaceae, in *The Flora of British India*, Vol. IV, ed Hooker J. D., editor. (London: L. Reeve and Co), 1885; pp.560–604.
- Gaur R.D., 1999. *Flora of the District Garhwal North West Himalaya: With Ethnobotanical Notes*. Trans Media Publication, Srinagar Garhwal, India, pp. 811.
- Scartezzini P., and Speroni E. Review on some plants of Indian Traditional Medicine with Antioxidant Activity. *J.Ethnopharmacol.* 2000; 71:23–42. doi: 10.1016/S0378-8741(00)00213-0.
- Kirtikar, K. R. and Basu, B. D. (eds) "Indian Medicinal Plants", Allahabad, 1984; vol. III, pp. 1664–1666.
- Laxmi A., Siddhartha S. and Archana M., Antimicrobial screening of methanol and aqueous extracts of *Swertia chirata*. *Int J Pharm Pharm Sci*, 2011; 3(4):142-146.
- Tabassum S., Mahmood S., Hanif J., Hina M. and Uzair B. An overview of medicinal importance of *Swertia chirayita*. *International Journal of Applied*, 2012; 2(1).
- Mahmood S., Hussain S., Tabassum S., Malik F. and Riaz H., Comparative phytochemical, hepatoprotective and antioxidant activities of various samples of *Swertia Chirayita* collected from various cities of Pakistan. *Pak. J. Pharm. Sci*, 2014; 27(6):1975-1983.
- Saha P., Mandal S., Das A., Das P.C. and Das S., Evaluation of the anti-carcinogenic activity of *Swertia chirata* Buch. Ham, an Indian medicinal plant, on DMBA- induced mouse skin carcinogenesis model. *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives*, 2004; 18(5):373-378.
- Alam K.D., Ali, M.S., Parvin S., Mahjabeen S., Akbar M.A. and Ahamed R. In vitro antimicrobial activities of different fractions of *Swertia chirata* ethanolic extract. *Pakistan journal of biological sciences: PJBS*, 2009; 12(19):1334-1337.
- Sultana, M.J. and Ahmed, F.R.S., Phytochemical investigations of the medicinal plant *Swertia chirata* Ham. *Biochem Anal Biochem*, 2013; 2(145):2161-1009.
- Hussain S, Malik F, Khalid N, Qayyum MA and Riaz H, *Alternative and traditional medicines systems in Pakistan: History, Regulation, Trends, Usefulness, Challenges, Prospects and Limitations, A Compendium of Essays on Alternative Therapy*, Arup Bhattacharya (Ed.), ISBN: 978-953-307-863-2. 1st ed. In Tech., 2012; pp. 89-108.
- World Health organization (2000). *Hepatitis B (Fact sheet No. 204)*. Geneva, Switzerland.
- Ambasta S. P. (Ed). (1986). *The Useful Plants of India*. PID, CSIR, New Delhi.
- Khanal S. et al, *Swertia chirata* The Himalayan Herb. *International journal of applied science and biotechnology* 2014; 2(4):389-392
- Joshi P. and Dhawan, V., 2005. *Swertia chirayita*—an overview. *Current science*, pp.635-640.
- Kirtiker K. B. (1996). *Indian Medicinal Plants* (2 ed., Vol. 3). Dehradun: International Book Distributors, Rajpur road, Dehradun, India. pp.1664-66
- Anonymous, *The Unani Pharmacopoeia Of India*, CCRUM, Department of AYUSH Ministry of Health & Family Welfare, Government of India Rakmo Press New Delhi - 110 020, 2007.
- Chopra R. N. (1956). *Glossary of Indian Medicinal Plants*. New Delhi: Council of Scientific and Industrial Research. pp. 237
- Nadkarni A. K. (1989). *Indian Materia Medica*. Bombay: Bombay Popular Prakashan. pp. 1184-1185
- Anonymous (1992), *The Unani Pharmacopoeia Of India*, CCRUM, (Vol. 2) Department of AYUSH Ministry of Health & Family Welfare, Government of India Seema Offset Press New Delhi-110006. pp.117-125

25. Kumar N. et al, Review on *Swertia Chirata* Buch.-Ham. Ex Wall: A Bitter Herb W.S.R. to Its Phytochemistry and Biological Activity. International Ayurvedic medical journal, 2017; 5(9).
26. Baitar I. e. (2000). Al Jame- Al- Mufrada- Al Advia Wa Al-Aghzia(Urdu translation). CCRUM, New Delhi; Vol-II. New Delhi: CCRUM.
27. Negi J.S., Singh, P. and Rawat, B. Chemical constituents and biological importance of *Swertia*: a review. Curr Res Chem, 2011; 3(1):1-15.
28. Ibn-e-Sina (2007). *Alqanoon fil tibb*(Urdu Translation by HKM Ghulam Hussain Kantoori). Delhi: Aijaz Publishing House.
29. Hakeem H. M. (YNM). *Bustan ul Mufradat*. Lucknow: Idara Traraqqi Urdu Publications.
30. Anonymous. (2006). *The Unani Pharmacopoea of India* (Vol. V). Delhi: Department of AYUSH, Ministry of Health and Family Welfare, Government of India.
31. Anonymous. (YNM) "Standardisation of Single Drugs of Unani Medicine" (Vol.III). New Delhi: CCRUM Department of AYUSH Ministry Of Health And Family Welfare, Government of India.
32. Hakeem Mohammad Abdul Hakeem, Bustan Ul Mufredat, Idara Kitab-ul-Shifa Dariya Ghanj Delhi 2011; 110002, 2002; pp.142.
33. Kabiruddin H.,(YNM) *Makhzan Ul Mufredat*, Aijaz Publishing House Dariya Ganj New Delhi.
34. Nag G., Das S., Das S., Mandal S. and De B. Antioxidant, anti-acetylcholinesterase and anti-glycosidase properties of three species of *Swertia*, their Xanthones and Amarogentin: A Comparative Study. Pharmacognosy Journal, 2015; 7(2).
35. Saxena A.M., Bajpai M.B.,and Mukherjee S.K. Swerchirin induced blood sugar lowering of streptozotocin treated hyperglycemic rats. Indian J. Exp.Biol. 1991; 29:674–675.
36. Saxena A.M., Bajpai M.B., Murthy P.S., and Mukherjee S.K. Mechanism of blood sugar lowering by a Swerchirin containing hexane fraction (SWI) of *Swertia chirayita*. Indian J. Exp. Biol. 1993; 31:178–181.
37. Balaraju K., Saravanan S., Agastian P., and Ignacimuthu S. Arapid system for micropropagation of *Swertia chirata* Buch.-Ham. ex Wall.: an endangered medicinal herb via direct somatic embryogenesis. ActaPhysiol. Plant. 2011; 33:1123-1133. doi:10.1007/s11738-010-0640-5
38. Brahmachari G., S. Mondal A. Gangopadhyay D. Gorai, B. Mukhopadhyay S. Saha and A.K. Brahmachari. *Swertia* (Gentianaceae): Chemical and pharmacological aspects. Chem. Biodivers., 2004; 1:1627-1651.
39. Ray S., Majumder H.K., Chakravarty, A.K., Mukhopadhyay S., Gil R.R. and Cordell G.A. Amarogentin, a naturally occurring secoiridoid glycoside and a newly recognized inhibitor of topoisomerase I from *Leishmania donovani*. Journal of natural products, 1996; 59(1):27-29.
40. Wiart, C., Kumar, K., Yusof, M.Y., Hamimah, H., Fauzi, Z.M., Sulaiman, M. Antiviral properties of ent-labdene diterpenes of *Andrographis paniculata* nees, inhibitors of herpes simplex virus type 1. Phytother. Res. 2005; 19:1069–1070.
41. Medda S., Mukhopadhyay S., Basu M. K. (1999). Evaluation of the in-vivo activity and toxicity of amarogentin, an antileishmanial agent, in both liposomal and niosomal forms. J. Antimicrob. Chemother. 44, 791–794. 10.1093/jac/44.6.791
42. Rafatullah S, Tariq M, Mossa JS, Al-Yahya MA, Al-Said MS, Ageel AM. Protective effect of *Swertia chirata* against indomethacin and other ulcerogenic agent-induced gastric ulcers. Drugs under experimental and clinical research. 1993; 19(2):69-73.
43. 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 Lett. 2006; 244:252–259. 10.1016/j.canlet.2005.12.036
44. Arya R., Sharma S.K., Singh S. Antidiabetic effect of whole plant extract and fractions of *Swertia chirayita* Buch.-Ham. Plant a Med. 2011; 77:138.doi: 10.1055/s-0031-1273667
45. Chen Y., Huang B., He J., Han L., Zhan Y., Wang Y. In vitro and in vivo antioxidant effects of the ethanolic extract of *Swertia chirayita*. J. Ethnopharmacol. 2011; 136:309–315.
46. Iqbal Z., Lateef M., Khan M. N., Jabbar A., Akhtar M. S. Anthelmintic activity of *Swertia chirata* against gastrointestinal nematodes of sheep. Fitoterapia 2006; 77:463–465.10.1016/j.fitote.2006.05.010
47. Kweera B., Sharma N., Jadon V., Negi Y. and Parcha V., Phytochemical analysis and in vitro antibacterial activity of *Swertia chirayita* whole plant in different solvents. Journal of Pharmacy Research, 2011; 4(12):4448-4449.
48. AHIRWAL L., SINGH S., DUBEY M.K., BHARTI V. and MEHTA A. Investigation of Antioxidant Potential of Methanolic Extract of *Swertia chirata* Buch. Ham. European Journal of Medicinal Plants, 2014; 4(11):1345.
49. Bhargava S., Rao P., Bhargava P., Shukla S. Antipyretic potential of *Swertia chirata* BuchHam. Sci.Pharm. 2009; 77:617–623.doi: 10.3797/scipharm.0812-10
50. Kumar IV, Paul BN, Asthana R, Saxena A, Mehrotra S, et al. *Swertia chirayita* mediated modulation of interleukin-1beta, interleukin-6, interleukin-10, interferon-gamma, and tumor necrosis factor alpha in arthritic mice. Immunopharmacol Immunotoxicol 2003; 25:573–583.
51. Joshi P., Dhawan V. *Swertia chirayita*—an overview. Curr. Sci. 2005; 89:635–640.
52. Mishra K., Dash A.P., Swain Bijay.K., Dey N. Anti-malarial activities of *Andrographis paniculata* and *Hedyotis corymbosa* extracts and their combination with curcumin. Malaria J. 2009; 8:26–34.
53. Reen R.K., Karan M., Singh K., Karan V., Johri R.K. and Singh J. Screening of various *Swertia* species extracts in primary monolayer cultures of rat hepatocytes against carbon tetrachloride-and paracetamol-induced toxicity. Journal of ethnopharmacology, 2001; 75(2-3):239-247.
54. Gupta S., Choudhry M.A., Yadava J.N.S., Srivastava V., Tandon J.S. Antidiarrhoeal activity of diterpenes of *Andrographis paniculata* (Kal-Megh) against *Escherichia coli* enterotoxin in in vivo models. Pharm. Biol. 1990; 28:273–283.
55. Nagalekshmi R., Menon A., Chandrasekharan D. K., Nair C. K. Hepatoprotective activity of *Andrographis paniculata* and *Swertia chirayita*. Food Chem. Toxicol. 2011; 49:3367–3373. 10.1016/j.fct.2011.09.026
56. Kumar V & Van Staden J; A Review of *Swertia chirayita* (Gentianaceae) as a Traditional Medicinal Plant; PMC, 2015; 6, PMC4709473.
57. Sankar A.S.S., Sugathan N. V. and Mohan M. A REVIEW ON SYNERGISTIC AND HORMETIC ACTION OF SWERTIA CHIRATA FROM HOMOEOPATHIC PERSPECTIVE. International Journal of AYUSH Medicine & Research, 2017; : 2456-6209.
58. Abdul Latif and Sumbul Rehman, Shamim Ahmad and Asad U Khan. In vitro antibacterial screening of the extracts of *Swertia chirayita* Linn. against MRSA (Methicillin Resistant *Staphylococcus aureus*). Int J Curr Res Rev, 2011; 3(6):98-104.